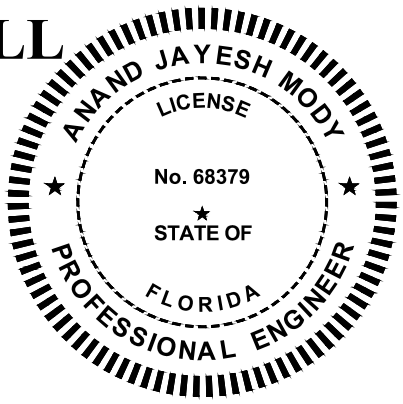
NWRF
BELT FILTER PRESS IMPROVEMENTS

BID SET
TECHNICAL SPECIFICATIONS
APRIL 2020

PREPARED FOR
BOARD OF COUNTY COMMISSIONERS
COUNTY OF MANATEE, FLORIDA
MANATEE COUNTY PROJECT NO: 6010881

PREPARED BY
BROWN AND CALDWELL
PROJECT NO: 153586



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NWRF
BELT FILTER PRESS IMPROVEMENTS

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DIVISION 17 – INSTRUMENTATION

This specification includes by reference the Manatee County Public Works Standards, Part I Utilities Standards Manual approved 2019.

END OF SECTION

SECTION 01005

GENERAL REQUIREMENTS

PART 1 – GENERAL

1.01 SCOPE AND INTENT

A. Description

The work to be done consists of the furnishing of all labor, materials and equipment, and the performance of all work included in this Contract.

B. Work Included

The Contractor shall furnish all labor, superintendence, materials, plant, power, light, heat, fuel, water, tools, appliances, equipment, supplies, shop drawings, working drawings and other means of construction necessary required to perform and complete the work. He shall obtain and pay for all required permits necessary for the work, other than those permits such as the DEP permit, which may have already been obtained. He shall perform and complete the work in the manner best calculated to promote rapid construction consistent with safety of life and property and to the satisfaction of the County, and in strict accordance with the Contract Documents. The Contractor shall clean up the work and maintain it during and after construction, until accepted, and shall do all work and pay all incidental costs. He shall repair or restore all structures and property that may be damaged or disturbed during performance of the work.

The cost of incidental work described in these General Requirements, for which there are no specific Contract Items, shall be considered as part of the general cost of doing the work and shall be included in the prices for the various Contract Items. No additional payment will be made.

The Contractor shall be solely responsible for the adequacy of his workmanship, materials and equipment.

C. Public Utility Installations and Structures

Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, house service connections, vaults, manholes and all other appurtenances and facilities pertaining thereto.

The Contractor shall protect all installations and structures from damage during the work. Access across any buried public utility installation or structure shall be made only in such locations and by means approved by the County. All required

protective devices and construction shall be provided by the Contractor at his expense. All existing public utilities damaged by the Contractor, which are shown on the Plans or have been located in the field by the utility, shall be repaired by the Contractor, at his expense, as approved by the County. No separate payment shall be made for such protection or repairs to public utility installations or structures.

Public utility installations or structures owned or controlled by the County or other governmental body, which are required by this contract to be removed, relocated, replaced or rebuilt by the Contractor not identified in any separate bid item shall be considered as a part of the general cost of doing the work and shall be included in the prices bid for the various contract items. No separate payment shall be made.

Where public utility installations or structures owned or controlled by the County or other governmental body are encountered during the course of the work, and are not indicated on the Plans or in the Specifications, and when, in the opinion of the County, removal, relocation, replacement or rebuilding is necessary to complete the work under this Contract, such work shall be accomplished by the utility having jurisdiction, or such work may be ordered, in writing by the County, for the contractor to accomplish. If such work is accomplished by the utility having jurisdiction, it will be carried out expeditiously and the Contractor shall give full cooperation to permit the utility to complete the removal, relocation, replacement or rebuilding as required. If such work is accomplished by the Contractor, it will be in accordance with the General and Supplemental General Conditions.

The Contractor shall give written notice to County and other governmental utility departments and other owners of public utilities of the location of his proposed construction operations, at least forty-eight hours in advance of breaking ground in any area or on any unit of the work. This can be accomplished by making the appropriate contact with the "Sunshine State One-Call of Florida, Incorporated Call Center" ("Call Sunshine") and per all requirements provided for in the Florida Underground Facilities Damage Prevention and Safety Act (Florida Statutes, Title XXXIII, Chapter 556).

The maintenance, repair, removal, relocation or rebuilding of public utility installations and structures, when accomplished by the Contractor as herein provided, shall be done by methods approved by the County.

1.02 PLANS AND SPECIFICATIONS

A. Plans

When obtaining data and information from the Plans, figures shall be used in preference to scaled dimensions, and large-scale drawings in preference to small-scale drawings.

B. Copies Furnished to Contractor

The Contractor shall furnish each of the subcontractors, manufacturers, and material men such copies of the Contract Documents as may be required for their work. Additional copies of the Plans and Specifications, when requested, may be furnished to the Contractor at cost of reproduction.

C. Supplementary Drawings

When, in the opinion of the County, it becomes necessary to explain more fully the work to be done or to illustrate the work further or to show any changes which may be required, drawings known as Supplementary Drawings, with specifications pertaining thereto, will be prepared by the County and five paper prints thereof will be given to the Contractor.

D. Contractor to Check Plans and Data

The Contractor shall verify all dimensions, quantities and details shown on the Plans, Supplementary Drawings, Schedules, Specifications or other data received from the County, and shall notify him of all errors, omissions, conflicts, and discrepancies found therein. Failure to discover or correct errors, conflicts or discrepancies shall not relieve the Contractor of full responsibility for unsatisfactory work, faulty construction or improper operation resulting therefrom nor from rectifying such conditions at his own expense. He will not be allowed to take advantage of any errors or omissions, as full instructions will be furnished by the County, should such errors or omissions be discovered. All schedules are given for the convenience of the County and the Contractor and are not guaranteed to be complete. The Contractor shall assume all responsibility for the making of estimates of the size, kind, and quality of materials and equipment included in work to be done under the Contract.

E. Specifications

The Technical Specifications consist of three parts: General, Products and Execution. The General Section contains General Requirements which govern the work. Products and Execution modify and supplement these by detailed requirements for the work and shall always govern whenever there appears to be a conflict.

F. Intent

All work called for in the Specifications applicable to this Contract, but not shown on the Plans in their present form, or vice versa, shall be of like effect as if shown or mentioned in both. Work not specified in either the Plans or in the Specifications but involved in carrying out their intent or in the complete and proper execution of the work, is required and shall be performed by the Contractor as though it were specifically delineated or described.

The apparent silence of the Specifications as to any detail, or the apparent omission from them of a detailed description concerning any work to be done and materials to be furnished, shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of the best quality is to be used, and interpretation of these Specifications shall be made upon that basis.

The inclusion of the Related Requirements (or work specified elsewhere) in the General part of the specifications is only for the convenience of the Contractor and shall not be interpreted as a complete list of related Specification Sections.

1.03 MATERIALS AND EQUIPMENT

A. Manufacturer

All transactions with the manufacturers or subcontractors shall be through the Contractor, unless the Contractor shall request, in writing to the County, that the manufacturer or subcontractor deal directly with the County. Any such transactions shall not in any way release the Contractor from his full responsibility under this Contract.

Any two or more pieces or material or equipment of the same kind, type or classification, and being used for identical types of services, shall be made by the same manufacturer.

B. Delivery

The Contractor shall deliver materials in ample quantities to insure the most speedy and uninterrupted progress of the work so as to complete the work within the allotted time. The Contractor shall also coordinate deliveries in order to avoid delay in, or impediment of, the progress of the work of any related Contractor.

C. Tools and Accessories

The Contractor shall, unless otherwise stated in the Contract Documents, furnish with each type, kind or size of equipment, one complete set of suitably marked high grade special tools and appliances which may be needed to adjust, operate, maintain or repair the equipment. Such tools and appliances shall be furnished in approved painted steel cases, properly labeled and equipped with good grade cylinder locks and duplicate keys.

Spare parts shall be furnished as specified.

Each piece of equipment shall be provided with a substantial nameplate, securely fastened in place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, weight and principal rating data.

D. Installation of Equipment.

The Contractor shall have on hand sufficient proper equipment and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character.

Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Plans, unless directed otherwise by the County during installation. All equipment shall be correctly aligned, leveled and adjusted for satisfactory operation and shall be installed so that proper and necessary connections can be made readily between the various units.

The Contractor shall furnish, install and protect all necessary anchor and attachment bolts and all other appurtenances needed for the installation of the devices included in the equipment specified. Anchor bolts shall be as approved by the County and made of ample size and strength for the purpose intended. Substantial templates and working drawings for installation shall be furnished.

The Contractor shall furnish all materials and labor for, and shall properly bed in non-shrink grout, each piece of equipment on its supporting base that rests on masonry foundations.

Grout shall completely fill the space between the equipment base and the foundation. All metal surfaces coming in contact with concrete or grout shall receive a coat of coal tar epoxy equal to Koppers 300M or provide a 1/32-inch neoprene gasket between the metal surface and the concrete or grout.

E. Service of Manufacturer's Engineer

The Contract prices for equipment shall include the cost of furnishing (as required by equipment specifications sections) a competent and experienced engineer or superintendent who shall represent the manufacturer and shall assist the Contractor, when required, to install, adjust, test and place in operation the equipment in conformity with the Contract Documents. After the equipment is placed in permanent operation by the County, such engineer or superintendent shall make all adjustments and tests required by the County to prove that such equipment is in proper and satisfactory operating condition and shall instruct such personnel as may be designated by the County in the proper operation and maintenance of such equipment.

1.04 INSPECTION AND TESTING

A. General

Inspection and testing of materials will be performed by the County unless otherwise specified.

For tests specified to be made by the Contractor, the testing personnel shall make the necessary inspections and tests and the reports thereof shall be in such form as will facilitate checking to determine compliance with the Contract Documents. Three (3) copies of the reports shall be submitted and authoritative certification thereof must be furnished to the County as a prerequisite for the acceptance of any material or equipment.

If, in the making of any test of any material or equipment, it is ascertained by the County that the material or equipment does not comply with the Contract, the Contractor will be notified thereof and he will be directed to refrain from delivering said material or equipment, or to remove it promptly from the site or from the work and replace it with acceptable material, without cost to the County.

Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized test codes of the ANSI, ASME, or the IEEE, except as may otherwise be stated herein.

The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the County formally takes over the operation thereof.

B. Costs

All inspection and testing of materials furnished under this Contract will be performed by the County or duly authorized inspection engineers or inspections bureaus without cost to the Contractor, unless otherwise expressly specified.

The cost of shop and field tests of equipment and of certain other tests specifically called for in the Contract Documents shall be borne by the Contractor and such costs shall be deemed to be included in the Contract price.

Materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract may be tested by the County for compliance. The Contractor shall reimburse the County for the expenditures incurred in making such tests on materials and equipment which are rejected for non-compliance.

C. Inspections of Materials

The Contractor shall give notice in writing to the County, at least two weeks in advance of his intention to commence the manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. Such notice shall contain a request for inspection, the date of

commencement and the expected date of completion of the manufacture of preparation of materials. Upon receipt of such notice, the County will arrange to have a representative present at such times during the manufacture as may be necessary to inspect the materials or he will notify the Contractor that the inspection will be made at a point other than the point of manufacture, or he will notify the Contractor that inspection will be waived. The Contractor must comply with these provisions before shipping any material. Such inspection shall not release the Contractor from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

D. Certificate of Manufacture

When inspection is waived or when the County so requires, the Contractor shall furnish to him authoritative evidence in the form of Certificates of Manufacture that the materials to be used in the work have been manufactured and tested in conformity with the Contract Documents. These certificates shall be notarized and shall include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.

E. Shop Tests of Operating Equipment

Each piece of equipment for which pressure, duty, capacity, rating, efficiency, performance, function or special requirements are specified shall be tested in the shop of the maker in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents. No such equipment shall be shipped to the work until the County notifies the Contractor, in writing, that the results of such tests are acceptable.

The cost of shop tests and of furnishing manufacturer's preliminary and shop test data of operating equipment shall be borne by the Contractor.

F. Preliminary Field Tests

As soon as conditions permit, the Contractor shall furnish all labor, materials, and instruments and shall make preliminary field tests of equipment. If the preliminary field tests disclose any equipment furnished under this Contract which does not comply with the requirements of the Contract Documents, the Contractor shall, prior to the acceptance tests, make all changes, adjustments and replacements required. The furnishing Contractor shall assist in the preliminary field tests as applicable.

G. Final Field Tests

Upon completion of the work and prior to final payment, all equipment and piping installed under this Contract shall be subjected to acceptance tests as specified or required to prove compliance with the Contract Documents.

The Contractor shall furnish labor, fuel, energy, water and all other materials, equipment and instruments necessary for all acceptance tests, at no additional cost to the County. The Supplier shall assist in the final field tests as applicable.

H. Failure of Tests

Any defects in the materials and equipment or their failure to meet the tests, guarantees or requirements of the Contract Documents shall be promptly corrected by the Contractor. The decision of the County as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive. If the Contractor fails to make these corrections or if the improved materials and equipment, when tested, shall again fail to meet the guarantees of specified requirements, the County, notwithstanding its partial payment for work, and materials and equipment, may reject the materials and equipment and may order the Contractor to remove them from the site at his own expense.

In case the County rejects any materials and equipment, then the Contractor shall replace the rejected materials and equipment within a reasonable time. If he fails to do so, the County may, after the expiration of a period of thirty (30) calendar days after giving him notice in writing, proceed to replace such rejected materials and equipment, and the cost thereof shall be deducted from any compensation due or which may become due the Contractor under his Contract.

I. Final Inspection

During such final inspections, the work shall be clean and free from water. In no case will the final pay application be prepared until the Contractor has complied with all requirements set forth and the County has made his final inspection of the entire work and is satisfied that the entire work is properly and satisfactorily constructed in accordance with the requirements of the Contract Document.

1.05 TEMPORARY STRUCTURES

A. Temporary Fences

If, during the course of the work, it is necessary to remove or disturb any fence or part thereof, the Contractor shall, at his own expense, if so ordered by the County, provide a suitable temporary fence which shall be maintained until the permanent fence is replaced. The County shall be solely responsible for the determination of the necessity for providing a temporary fence and the type of temporary fence to be used.

1.06 TEMPORARY SERVICES

A. First Aid

The Contractor shall keep upon the site, at each location where work is in progress, a completely equipped first aid kit and shall provide ready access thereto at all times when people are employed on the work.

1.07 LINES AND GRADES

A. Grade

All work under this Contract shall be constructed in accordance with the lines and grades shown on the Plans, or as given by the County. The full responsibility for keeping alignment and grade shall rest upon the Contractor.

B. Safeguarding Marks

The Contractor shall safeguard all points, stakes, grade marks, monuments and bench marks made or established on the work, bear the cost of reestablishing them if disturbed, and bear the entire expense of rectifying work improperly installed due to not maintaining or protecting or removing without authorization such established points, stakes and marks.

The Contractor shall safeguard all existing and known property corners, monuments and marks adjacent to but not related to the work and, if required, shall bear the cost of reestablishing them if disturbed or destroyed.

C. Datum Plane

All elevations indicated or specified refer to the Mean Sea Level Datum of the NAVD 1988 and/or NGVD 1929.

1.08 ADJACENT STRUCTURES AND LANDSCAPING

A. Responsibility

The Contractor shall also be entirely responsible and liable for all damage or injury as a result of his operations to all other adjacent public and private property, structures of any kind and appurtenances thereto met with during the progress of the work. The cost of protection, replacement in their original locations and conditions or payment of damages for injuries to such adjacent public and private property and structures affected by the work, whether or not shown on the Plans, and the removal, relocation and reconstruction of such items called for on the Plans or specified shall be included in the various Contract Items and no separate payments will be made therefore. Where such public and private property,

structures of any kind and appurtenances thereto are not shown on the Plans and when, in the opinion of the County, additional work is deemed necessary to avoid interference with the work, payment therefore will be made as provided for in the General Conditions.

Contractor is expressly advised that the protection of buildings, structures, tunnels, tanks, pipelines, etc. and related work adjacent and in the vicinity of his operations, wherever they may be, is solely his responsibility. Conditional inspection of buildings or structures in the immediate vicinity of the project which may reasonably be expected to be affected by the Work shall be performed by and be the responsibility of the Contractor.

Contractor shall, before starting operations, make an examination of the interior and exterior of the adjacent structures, buildings, facilities, etc., and record by notes, measurements, photographs, etc., conditions which might be aggravated by open excavation and construction. Repairs or replacement of all conditions disturbed by the construction shall be made to the satisfaction of the County. This does not preclude conforming to the requirements of the insurance underwriters. Copies of surveys, photographs, reports, etc., shall be given to the County.

Prior to the beginning of any excavations, the Contractor shall advise the County of all buildings or structures on which he intends to perform work or which performance of the project work will affect.

B. Protection of Trees

1. All trees and shrubs shall be adequately protected by the Contractor with boxes and otherwise and in accordance with ordinances governing the protection of trees. No excavated materials shall be placed so as to injure such trees or shrubs. Trees or shrubs destroyed by negligence of the Contractor or his employees shall be replaced by him with new stock of similar size and age, at the proper season and at the sole expense of the Contractor.
2. Beneath trees or other surface structures, where possible, pipelines may be built in short tunnels, backfilled with excavated materials, except as otherwise specified, or the trees or structures carefully supported and protected from damage.
3. The County may order the Contractor, for the convenience of the County, to remove trees along the line or trench excavation. If so ordered, the County will obtain any permits required for removal of trees. Such tree removal ordered shall be paid for under the appropriate Contract Items.

C. Lawn Areas

Lawn areas shall be left in as good condition as before the starting of the work. Where sod is to be removed, it shall be carefully removed, and later replaced, or the area where sod has been removed shall be restored with new sod.

D. Restoration of Fences

Any fence, or part thereof, that is damaged or removed during the course of the work shall be replaced or repaired by the Contractor and shall be left in as good a condition as before the starting of the work. The manner in which the fence is repaired or replaced, and the materials used in such work shall be subject to the approval of the County. The cost of all labor, materials, equipment, and work for the replacement or repair of any fence shall be deemed included in the appropriate Contract Item or items, or if no specific Item is provided therefore, as part of the overhead cost of the work, and no additional payment will be made therefore.

1.09 PROTECTION OF WORK AND PUBLIC

A. Barriers and Lights

During the prosecution of the work, the Contractor shall put up and maintain at all times such barriers and lights as will effectually prevent accidents. The Contractor shall provide suitable barricades, red lights, "danger" or "caution" or "street closed" signs and watchmen at all places where the work causes obstructions to the normal traffic or constitutes in any way a hazard to the public, in accordance with state and local requirements.

B. Smoke Prevention

A strict compliance with ordinances regulating the production and emission of smoke will be required. No open fires will be permitted.

C. Noise

The Contractor shall eliminate noise to as great an extent as practicable at all times. Air compressing plants shall be equipped with silencers and the exhaust of all engines or other power equipment shall be provided with mufflers. In the vicinity of hospitals and schools, special care shall be used to avoid noise or other nuisances. The Contractor shall strictly observe all local regulations and ordinances covering noise control.

D. Access to Public Services

Neither the materials excavated, nor the materials or plant used in the construction of the work shall be so placed as to prevent free access to all fire hydrants, valves or manholes.

E. Dust prevention

The Contractor shall prevent dust nuisance from his operations or from traffic by keeping the roads and/or construction areas sprinkled with water at all times.

1.10 CUTTING AND PATCHING

The Contractor shall do all cutting, fitting or patching of his portion of the work that may be required to make several parts thereof join and coordinate in a manner satisfactory to the County and in accordance with the Plans and Specifications. The work must be done by competent workmen skilled in the trade required by the restoration.

1.11 CLEANING

A. During Construction

During construction of the work, the Contractor shall, at all times, keep the site of the work and adjacent premises as free from material, debris and rubbish as is practicable and shall remove the same from any portion of the site if, in the opinion of the County, such material, debris, or rubbish constitutes a nuisance or is objectionable. The Contractor shall remove from the site all of his surplus materials and temporary structures when no further need therefore develops.

B. Final Cleaning

At the conclusion of the work, all equipment, tools, temporary structures and materials belonging to the Contractor shall be promptly taken away, and he shall remove and promptly dispose of all water, dirt, rubbish or any other foreign substances.

The Contractor shall thoroughly clean all equipment and materials installed by him and shall deliver such materials and equipment undamaged in a bright, clean, polished and new operating condition.

1.12 MISCELLANEOUS

A. Protection Against Siltation and Bank Erosion

1. The Contractor shall arrange his operations to minimize siltation and bank erosion on construction sites and on existing or proposed water courses and drainage ditches.
2. The Contractor, at his own expense, shall remove any siltation deposits and correct any erosion problems as directed by the County which results from his construction operations.

B. Protection of Wetland Areas

The Contractor shall properly dispose of all surplus material, including soil, in accordance with Local, State and Federal regulations. Under no circumstances shall surplus material be disposed of in wetland areas as defined by the Florida Department of Environmental Protection or Southwest Florida Water Management District.

C. Existing Facilities

The work shall be so conducted to maintain existing facilities in operation insofar as is possible. Requirements and schedules of operations for maintaining existing facilities in service during construction shall be as described in the Special Provisions.

D. Use of Chemicals

All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant, or of other classification, must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with instructions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01010

SUMMARY OF WORK

PART 1 – GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS/REQUIREMENTS INCLUDED

A. This Project, NWRF Belt Filter Press Improvements Design, consists of work at the NWRF as identified here.

1. The NWRF is located at 8500 69th St. E, Palmetto, FL 34221. In general, the existing treatment facilities at the NWRF include influent screening; grit removal; activated sludge process and secondary clarification; deep bed filtration; disinfection with sodium hypochlorite; and gravity belt thickeners for waste activated sludge. The plant is permitted for an annual average daily flow of 7.5 MGD.

NWRF Summary of Work:

a. Refurbish two (2) existing Belt Filter Presses (BFPs). The project will also but now limited to demolish two (2) polymer pumps and appurtenances plumbing, three (3) washwater booster pumps and appurtenances, polymer system and appurtenances, inclined screw conveyor and appurtenances, catwalk, and cake bin. The project will furnish and install one (1) polymer pump in a new location, two (2) sludge cake pumps, three (3) washwater booster pumps in a new location, (2) inclined screw conveyors, one (1) air compressor, cake loadout piping and valving, and appurtenances. As part of the project, there will be (2) sludge feed pumps, and one (1) polymer pump provided to the County to be kept on the shelf at NWRF and serve as replacement pumps.

b. Replace existing three (3) control panels at the catwalk with one (1) new control panel for all three (3) existing BFPs, panel to include Plant SCADA HMI only. Replace existing BFP three (3) control panel in the BFP electrical room, with two (2) new control panels; one (1) control panel per two BFPs. Each control panel will include a PLC, and only one (1) control panel will include Plant SCADA HMI.

c. Remove and replace existing polymer system with a new dry polymer system and furnish and install specified polymer system.

d. Remove four (4) existing control panels and provide one (1) new control panel(s) for three (3) polymer pumps.

e. Remove obsolete panels, exposed conduits and conductors with new.

f. Add a second truck load-out bay including associated civil improvements and rehab the existing truck load-out station to provide at least two (2) points for load-out. Provide lights, camera system, and power as required. Move existing fence affected by second truck load-out bay, and extend existing road as required

g. Replace existing lights in BFP building with new LED lights.

h. Install power over ethernet cameras to visually monitor BFPs, conveyors and truck load-out areas from the Administration Building Control Room. Include a POE switch in one of the new BFP control panels for connection to the new AXIS cameras. Run fiber from the POE switch back to Administration Building Control Room.

i. Provide new conduits and/or cables or replace as required. Replace BFP electrical including electrical power feeds, line, loads and control except fiber. Remove obsolete panels, exposed conduits and conductors.

j. Modify existing MCCs as required to make the required addition/modifications to the BFP's, Polymer system (including pumps), sludge conveyors, sludge transfer pump, and other items described above. and provide new VFD in the MCC.

B. The Contractor shall furnish all shop drawings, working drawings, labor, materials, equipment, tools, services and incidentals necessary to complete all work required by these Specifications and as shown on the Contract Drawings.

C. The Contractor shall perform the work complete, in place and ready for continuous service and shall include any repairs, replacements, and/or restoration required as a result of damages caused prior to acceptance by the County.

D. The Contractor shall furnish and install all materials, equipment and labor which is reasonably and properly inferable and necessary for the proper completion of the work, whether specifically indicated in the Contract Documents or not.

1.02 CONTRACTS

Construct all the Work under a single contract.

1.03 WORK SEQUENCE

A. All work done under this Contract shall be done with a minimum of inconvenience to the users of the system or facility. The Contractor shall coordinate his work with private property owners such that existing utility services are maintained to all users to the maximum extent possible.

B. The Contractor shall, if necessary and feasible, construct the work in stages to accommodate the County's use of the premises during the construction period; coordinate the construction schedule and operations with the County's Representative.

C. The Contractor shall, where feasible, construct the Work in stages to provide for public convenience and not close off public use of any facility until completion of construction to provide alternative usage.

1.04 CONSTRUCTION AREAS

A. The Contractor shall: Limit his use of the construction areas for work and for storage, to allow for:

1. Work by other Contractors.
2. County's Use.
3. Public Use.

B. Coordinate use of work site under direction of County's Representative.

C. Assume full responsibility for the protection and safekeeping of products under this Contract, stored on the site.

D. Move any stored products under the Contractor's control, which interfere with operations of the County or separate contractor.

E. Obtain and pay for the use of additional storage of work areas needed for Contractor operations.

1.05 COUNTY OCCUPANCY

A. It is assumed that portions of the Work will be completed prior to completion of the entire Work. Upon completion of construction of each individual facility, including testing, if the County, at its sole discretion, desires to accept the individual facility, the Contractor will be issued a dated certificate of completion and acceptance for each individual facility. The County will assume ownership and begin operation of the individual facility on that date and the three-year guaranty period shall commence on that date. The County has the option of not accepting the entire work as a whole until it is completed, tested and approved by the County.

1.06 PARTIAL COUNTY OCCUPANCY

The Contractor shall schedule his operations for completion of portions of the Work, as designated, for the County's occupancy prior to substantial completion of the entire work.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 WORK COVERED BY CONTRACT DOCUMENTS

The Contractor shall furnish all labor, materials, equipment, tools, services and incidentals to complete all the work required by the Contract.

The Contractor shall perform the work as specified and shown in Contract Documents in its entirety to be ready for continuous service, and shall include repairs, replacements, and restoration as required, including restoration and repairs not indicated in the Contract Documents that result from damages occurred during this construction.

The work shall be provided complete with all demolition and relocation of existing facilities; all temporary structures, piping, pumping, power and control facilities required to maintain continuous plant operation; all concrete, support piping and equipment, electrical power, control and lighting; instrumentation; and painting as shown and specified and shall include all specified commissioning requirements.

Contractor shall provide all supplies, manufactured articles and transportation and services, including fuel, power, water, and essential communications, costs and operations for permitting, dewatering, storage, temporary fencing and facilities, equipment for demolition, disposal, maintenance of operation during construction, interconnections to existing plant and utility facilities and bypassing, start-up and testing, restoration (normal not just from damages), operation and maintenance manuals, record documents, spare parts, test equipment, and all other appurtenances and miscellaneous required work required for completion of the work in accordance with the Contract Documents.

The Work shall be complete, and all work, materials, and services not expressly shown or called for in the Contract Documents which may be necessary for the complete and proper construction of the Work in good faith shall be performed, furnished, and installed by the Contractor as though originally so specified or shown, at no increase in cost to the County.

Prior to construction, the Contractor shall verify existing field conditions, piping, and utilities. The Contractor is required to perform necessary due diligence to determine the amount, quality, accuracy, and specific field reconnaissance required to adequately perform the work specified and shown in the Contract Documents. The Contractor will be

responsible for the coordination of this work with the County and permitting agencies having jurisdiction over the specified locations to be verified.

The Work to be done is shown on the Contract Documents entitled NWRF Belt Filter Improvements Design. The numbers and titles of all Drawings appear on the index sheets of the Drawings. All drawings so enumerated shall be considered an integral part of the Contract Documents as defined herein.

Certain Document Sections refer to Divisions of the Contract Specifications. Sections are each individually numbered portions of the Specifications (numerically) such as 08110, 13182, 15206, etc. The term Division is used as a convenience term meaning all Sections within a numerical grouping. For example, Division 16 would thus include Sections 16000 through 16999 and would mean all electrical specifications.

Drawings indicate the extent and general arrangement of the work. If any departures from the Drawings are deemed necessary by the Contractor to accommodate the materials and equipment that the Contractor proposes to furnish, Contractor shall notify the Engineer immediately. No such departures shall be made without the prior written approval of the County.

The specific equipment proposed for use by the Contractor on the project may require changes in structures, auxiliary equipment, piping, electrical, mechanical, controls or other work to provide a complete satisfactory operating installation. The Contractor shall submit to the County, for approval, all necessary Drawings and details showing such changes to verify conformance with the overall project structural and architectural requirements and overall project operating performance. The Bid Price shall include all costs in connection with the preparation of new drawings and details and all changes to construction work to accommodate the proposed equipment, including increases in the costs of other Contracts.

In the event that the Engineer is required to provide additional engineering services as a result of substitution of materials or equipment which are not "or equal" by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the County.

Structural design shown on the Contract Drawings is based upon typical weights for major items of equipment as indicated on the Contract Drawings and specified. If the equipment furnished differs from that specified in the Contract Documents such that actual weight exceeds the weight of specified equipment, the Contractor shall assume the responsibility for all costs of redesign and for any construction changes required to accommodate the equipment furnished, including the Engineer's expenses in connection therewith, provided that the original weight assumptions were correct.

In the event that the Engineer is required to provide additional engineering services as a result of Contractor's errors, omissions, or failure to conform to the requirements of the Contract Documents, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the County and shall be deducted from monies due the Contractor.

In the event the Work of this Contract is not completed within the time set forth in the Contract or within the time to which such completion may have been extended in accordance with the Contract Documents, the additional engineering or inspection charges incurred by the County may be charged to the Contractor and deducted from the monies due to the Contractor. Extra work or supplemental Contract work added to the original Contract, as well as extenuating circumstances beyond the control of the Contractor, will be given due consideration by the County before assessing engineering and inspection charges against the Contractor.

Charges for additional County's expenses shall be independent of any liquidated damages assessed in accordance with the Contract.

Substantial and Final Completion of the overall contract requirements are also subject to Liquidated Damages.

In the event the Work of this Contract is not completed within the time set forth in the Contract or within the time to which such completion may have been extended in accordance with the Contract Documents, the additional Engineering or inspection charges incurred by the County may be charged to the Contractor and deducted from the monies due.

The Contractor shall perform a field location investigation of the existing underground utilities and facilities in accordance with Section 01530 entitled “Protection of Existing Facilities”, shall have provided requirements, plans and schedules in accordance with Section 01340 entitled “Submittals” and shall have obtained all required permits, permissions and approvals prior to commencing with the Work.

At no time shall the Contractor undertake to close off any pipelines, or open valves, or take any other action that would affect the operation of the existing systems, except as specifically required by the Contract Documents, until after authorization is granted by the Engineer and Owner and after proper notification and coordination has been provided. Contractor shall provide prior notification to utility customers for any temporary disruption of service in accordance with the Policies and Procedures of Manatee County.

END OF SECTION

SECTION 01014

SEQUENCE OF WORK

PART 1 – GENERAL

1.01 CONTINUITY OF PLANT OPERATIONS

A. GENERAL

The existing NWRF is currently and continuously receiving and treating sewage, and those functions shall not be interrupted except as specified herein. The Contractor shall coordinate the work to avoid interference with normal operation of NWRF equipment and processes. Coordination procedures are defined in Section 01040.

B. BYPASSING

Bypassing of raw or screened sewage and solids is prohibited. In the event of accidental bypassing, the Contractor shall stop all work and immediately eliminate the bypass and restore proper operation. The County shall have the right to immediately employ any means to stop the bypassing without providing written notification to the Contractor. The Contractor shall not resume work until the bypassing is resolved.

The Contractor shall review and understand the operating permit for the plant.

- NRWRF FDEP Permit No. FLA 012617

C. SUBMITTALS

In accordance with these Contract Documents, the Contractor shall submit detailed maintenance of plant operations (MOPOs) for all tasks which will make it necessary to remove a pipeline, channel, electrical circuit, equipment or structure from service prior to beginning any related construction activity. Reference Section 01040 and Section 01310.

In addition to the detailed MOPOs required under Section 01040, the Contractor shall provide an overall detailed Project Sequencing Plan submitted in accordance with Section 01300, coordinated with the Project Schedule required under Section 01310, and which meets the requirements of these Contract Documents adjusted as necessary to meet the intent of the final project included in these Contract Documents.

The Project Sequencing Plan shall include:

1. Detailed description of the Contractor's methods and sequencing of operations and work,
2. Length of time required to complete each individual operation,
3. Equipment which the Contractor shall provide,
4. Required resources from the County,
5. List of deviations and/or exceptions from the sequence and schedule presented in the contract documents along with a detailed explanation for why the deviation is required and or justified.

1.02 SEQUENCE AND SCHEDULE OF CONSTRUCTION

Paragraph 01014-3.01 and 3.02 provide the Contractor with constraints regarding particular process areas. The Contractor shall not be allowed to deviate from the defined constraints in Paragraph 01014-3.01 and 3.02. Beyond these specific constraints, a sequencing plan is not provided and is left to the discretion of the Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

Specific issues that shall be addressed by the Contractor in the execution of the work for individual process areas are summarized here. These do not relieve the Contractor from evaluating each work area in accordance with the complete construction set and determining for themselves specific area issues. The Contractor is entirely responsible for ensuring that these constraints are upheld during the progression of their work.

3.02 SPECIFIC PROCESSES

A. Only one belt filter press may be taken offline at a time.

B. Polymer system shall have the ability to feed all sludge lines with only one sludge line out-of-service at any time.

C. New washwater booster pumps shall be installed prior to demolition of existing pumps.

D. Cake conveyance system shall include cake load out bypass while demolishing and have the ability to feed the truck load-out system at any time during construction and swap-out including a cake load out bypass during any demolition.

END OF SECTION

SECTION 01015

CONTROL OF WORK

PART 1 – GENERAL

1.01 WORK PROGRESS

The Contractor shall furnish personnel and equipment which will be efficient, appropriate and adequately sized to secure a satisfactory quality of work and a rate of progress which will ensure the completion of the work within the time stipulated in the Contract. If at any time such personnel appears to the County to be inefficient, inappropriate, or insufficient for securing the quality of work required for producing the rate of progress aforesaid, he may order the Contractor to increase the efficiency, change the character, or increase the personnel and equipment and the Contractor shall conform to such order. Failure of the County to give such order shall in no way relieve the Contractor of his obligations to secure the quality of the work and rate of progress required.

1.02 PRIVATE LAND

The Contractor shall not enter or occupy private land outside of easements, except by permission of the affected property owner.

1.03 WORK LOCATIONS

Work shall be located substantially as indicated on the drawings, but the County reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons.

1.04 OPEN EXCAVATIONS

A. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access to private property during construction shall be removed when no longer required. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the County may require special construction procedures such as limiting the length of open trench, prohibiting stacking excavated material in the street and requiring that the trench shall not remain open overnight.

B. The Contractor shall take precautions to prevent injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles which could be dangerous to the public shall be barricaded and well lighted at all times

when construction is not in progress.

1.05 DISTRIBUTION SYSTEMS AND SERVICES

A. The Contractor shall avoid interruptions to water, telephone, cable TV, sewer, gas, or other related utility services. He shall notify the County and the appropriate agency well in advance of any requirement for dewatering, isolating, or relocating a section of a utility, so that necessary arrangements may be made.

B. If it appears that utility service will be interrupted for an extended period, the County may order the Contractor to provide temporary service lines at the Contractor's expense. Inconvenience of the users shall be kept to the minimum, consistent with existing conditions. The safety and integrity of the systems are of prime importance in scheduling work.

1.06 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

A. The Contractor shall assume full responsibility for the protection of all buildings, structures and utilities, public or private, including poles, signs, services to building utilities, gas pipes, water pipes, hydrants, sewers, drains and electric and telephone cables and other similar facilities, whether or not they are shown on the Drawings. The Contractor shall carefully support and protect all such structures and utilities from injury of any kind. Any damage resulting from the Contractor's operation shall be repaired by the Contractor at his expense.

B. The Contractor shall bear full responsibility for obtaining locations of all underground structures and utilities (including existing water services, drain lines and sewers). Services to buildings shall be maintained and all costs or charges resulting from damage thereto shall be paid by the Contractor.

C. Protection and temporary removal and replacement of existing utilities and structures as described in this Section shall be a part of the work under the Contract and all costs in connection therewith shall be included in the unit prices established in the Bid.

D. If, in the opinion of the County, permanent relocation of a utility owned by the County is required, the County may direct the Contractor, in writing, to perform the work. Work so ordered will be paid for at the Contract unit prices, if applicable, or as extra work as classified in the General Conditions. If relocation of a privately-owned utility is required, the County will notify the utility to perform the work as expeditiously as possible. The Contractor shall fully cooperate with the County and utility and shall have no claim for delay due to such relocation. The Contractor shall notify public utility companies in writing at least 48 hours (excluding Saturdays, Sundays and legal holidays) before excavating near their utilities.

1.07 TEST PITS

Test pits for the purpose of locating underground pipeline or structures in advance of the construction shall be excavated and backfilled by the Contractor immediately after the utility location and the surface shall be restored in a manner equal or better than the original condition. No separate payment will be made.

1.08 CARE AND PROTECTION OF PROPERTY

A. The Contractor shall be responsible for the preservation of all public and private property and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition equal or better to that existing before the damage was done, or he shall make good the damage in another manner acceptable to the County.

B. All sidewalks which are disturbed by the Contractor's operations shall be restored to their original or better condition by the use of similar or comparable materials. All curbing shall be restored in a condition equal to the original construction and in accordance with the best modern practice.

C. Along the location of this work, all fences, walks, bushes, trees, shrubbery and other physical features shall be protected and restored in a thoroughly workmanlike manner unless otherwise shown on the drawings. Fences and other features removed by the Contractor shall be replaced in the location indicated by the County as soon as conditions permit. All grass areas beyond the limits of construction which have been damaged by the Contractor shall be regraded and sodded to equal or exceed original conditions.

D. Trees close to the work which drawings do not specify to be removed, shall be boxed or otherwise protected against injury. The Contractor shall trim all branches that are liable to damage because of his operations, but in no case shall any tree be cut or removed without prior notification to the County. All injuries to bark, trunk, limbs and roots of trees shall be repaired by dressing, cutting and painting according to approved methods, using only approved tools and materials.

E. The protection, removal and replacement of existing physical features along the line of work shall be a part of the work under the Contract and all costs in connection therewith shall be included in the unit and/or lump sum prices established under the items in the Bid.

1.09 MAINTENANCE OF TRAFFIC

A. Open pits, trenches, unpaved streets, debris, or other obstructions due to

construction that will prevent the normal flow of traffic during an extended construction stoppage, for any reason, shall be minimized. In the event an extended construction stoppage is found to be necessary, Contractor shall, at his own expense, provide normal traffic flow during extended construction stoppage. Extended stoppage will be defined by the County.

B. All excavated material shall be placed so that vehicular and pedestrian traffic may be maintained at all times. If the Contractor's operations cause traffic hazards, he shall repair the road surface, provide temporary roadways, erect wheel guards or fences, or take other safety measures which are satisfactory to the County.

C. Any changes to the traffic pattern require a Traffic Control Plan as detailed in section 01570 of this Specification.

1.10 WATER FOR CONSTRUCTION PURPOSES

A. In locations where, public water supply is available, the Contractor may purchase water for all construction purposes.

B. The Contractor shall be responsible for paying for all water tap fees incurred for the purpose of obtaining a potable water service or temporary use meter.

1.11 MAINTENANCE OF FLOW

The Contractor shall at his own cost, provide for the flow of sewers, drains and water courses interrupted during the progress of the work and shall immediately cart away and remove all offensive matter. The entire procedure of maintaining existing flow shall be fully discussed with the County well in advance of the interruption of any flow.

1.12 CLEANUP

During the course of the work, the Contractor shall keep the site of his operations in as clean and neat a condition as is possible. He shall dispose of all residue resulting from the construction work and at the conclusion of the work, he shall remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures and any other refuse remaining from the construction operations and shall leave the entire site of the work in a neat and orderly condition.

1.13 COOPERATION WITHIN THIS CONTRACT

A. All firms or person authorized to perform any work under this Contract shall cooperate with the General Contractor and his subcontractors or trades and shall assist in incorporating the work of other trades where necessary or required.

B. Cutting and patching, drilling and fitting shall be carried out where required by the trade or subcontractor having jurisdiction, unless otherwise indicated herein or

directed by the County.

1.14 PROTECTION OF CONSTRUCTION AND EQUIPMENT

A. All newly constructed work shall be carefully protected from injury in any way. No wheeling or walking or placing of heavy loads on it shall be allowed and all portions injured shall be reconstructed by the Contractor at his own expense.

B. All structures shall be protected in a manner approved by the County. Should any of the floors or other parts of the structures become heaved, cracked, or otherwise damaged, all such damaged portions of the work shall be completely repaired and made good by the Contractor, at his own expense and to the satisfaction of the County. If, in the final inspection of the work, any defects, faults, or omissions are found, the Contractor shall cause the same to be repaired or removed and replaced by proper materials and workmanship without extra compensation for the materials and labor required. Further, the Contractor shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein, for at least the warranty period described in the Contract.

C. Further, the Contractor shall take all necessary precautions to prevent damage to any structure due to water pressure during and after construction and until such structure is accepted and taken over by the County.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01030

SPECIAL PROJECT PROCEDURES

PART – GENERAL

1.01 PERMITS

Upon notice of award, the Contractor shall immediately apply for all applicable permits not previously obtained by the County to do the work from the appropriate governmental agency or agencies. No work shall commence until all applicable permits have been obtained and copies delivered to the County. The costs for obtaining all permits shall be borne by the Contractor.

1.02 CONNECTIONS TO EXISTING SYSTEM

The Contractor shall perform all work necessary to locate, excavate and prepare for connections to the existing systems all as shown on the Drawings or where directed by the County. The cost for this work and for the actual connection shall be included in the price bid for the project and shall not result in any additional cost to the County. The termination point for each contract shall be as shown on the Contract Drawings.

1.03 RELOCATIONS

The Contractor shall be responsible for the coordination of the relocation of structures, including but not limited to light poles, power poles, signs, sign poles, fences, piping, conduits and drains that interfere with the positioning of the work as set out on the Drawings. No relocation of the items under this Contract shall be done without approval from the County.

1.04 EXISTING UNDERGROUND PIPING, STRUCTURES AND UTILITIES

A. The attention of the Contractor is drawn to the fact that during excavation, the possibility exists of the Contractor encountering various utility lines not shown on the Drawings. The Contractor shall exercise extreme care before and during excavation to locate and flag these lines as to avoid damage to the existing lines.

B. It is the responsibility of the Contractor to ensure that all utility or other poles, the stability of which may be endangered by the close proximity of excavation, are temporarily stayed in position while work proceeds in the vicinity of the pole and that the utility or other companies concerned be given reasonable advance notice.

C. The existing utility locations are shown without express or implied representation, assurance, or guarantee that they are complete or correct or that they represent a true picture of underground piping to be encountered. The Contractor shall be responsible for notifying the various utility companies to locate their respective

utilities in advance of construction in conformance with all requirements provided for in the Florida Underground Facilities Damage Prevention and Safety Act (Florida Statutes, Title XXXIII, Chapter 556).

D. The existing piping and utilities that interfere with new construction shall be rerouted as shown, specified, or required. Before any piping and utilities not shown on the Drawings are disturbed, the Contractor shall notify the County and shall provide suggestions on how best to resolve the issue.

E. The Contractor shall exercise care in any excavation to locate all existing piping and utilities. All utilities which do not interfere with complete work shall be carefully protected against damage. Any existing utilities damaged in any way by the Contractor shall be restored or replaced by the Contractor at his expense as directed by the County.

F. It is intended that wherever existing utilities such as water, sewer, gas, telephone, electrical, or other service lines must be crossed, deflection of the pipe within recommended limits and cover shall be used to satisfactorily clear the obstruction unless otherwise indicated in the Drawings. However, when in the opinion of the County this procedure is not feasible, he may direct the use of fittings for a utility crossing as detailed on the Drawings. No deflections will be allowed in gravity sanitary sewer lines or in existing storm sewer lines.

1.05 SUSPENSION OF WORK DUE TO WEATHER

Refer to FDOT Standards and Specifications Book, Section 8.

1.06 HURRICANE PREPAREDNESS PLAN

A. Within 30 days of the date of Notice to Proceed, the Contractor shall submit to the County a Hurricane Preparedness Plan. The plan should outline the necessary measures which the Contractor proposes to perform at no additional cost to the County in case of a hurricane warning.

B. In the event of inclement weather, or whenever County shall direct, Contractor shall insure that he and his Subcontractors shall carefully protect work and materials against damage or injury from the weather. If, in the opinion of the County, any portion of work or materials is damaged due to the failure on the part of the Contractor or Subcontractors to protect the work, such work and materials shall be removed and replaced at the expense of the Contractor.

1.07 POWER SUPPLY

Electricity as may be required for construction and permanent power supply shall be secured and purchased by the Contractor.

1.08 SALVAGE

Any existing equipment or material, including, but not limited to, valves, pipes, fittings, couplings, etc., which is removed or replaced as a result of construction under this project may be designated as salvage by the County and if so shall be protected for a reasonable time until picked up by the County. Any equipment or material not worthy of salvaging, as directed by the County, shall be disposed of by the Contractor at no additional cost.

1.09 DEWATERING

A. The Contractor shall do all groundwater pumping necessary to prevent flotation of any part of the work during construction operations with his own equipment.

B. The Contractor shall pump out water and wastewater which may seep or leak into the excavations for the duration of the Contract and with his own equipment. He shall dispose of this water in an appropriate manner.

1.10 ADDITIONAL PROVISIONS

A. Before commencing work on any of the existing pipelines, structures or equipment, the Contractor shall notify the County, in writing, at least 10 calendar days in advance of the date he proposes to commence such work.

B. The Contractor shall provide, at his own expense, all necessary temporary facilities for access to and for protection of, all existing facilities. The County's personnel must have ready access at all times to the existing facilities. The Contractor is responsible for all damage to existing structures, equipment and facilities caused by his construction operations and must repair all such damage when and as ordered by the County.

1.11 CONSTRUCTION CONDITIONS

The Contractor shall strictly adhere to the specific requirements of the governmental unit(s) and/or agency(ies) having jurisdiction over the work. Wherever there is a difference in the requirements of a jurisdictional body and these Specifications, the more stringent shall apply.

1.12 PUBLIC NUISANCE

A. The Contractor shall not create a public nuisance including but not limited to encroachment on adjacent lands, flooding of adjacent lands, excessive noise or dust.

B. Sound levels must meet Manatee County Ordinance #87-34, (which amends Ordinance 81-3, The Manatee County Noise Control Ordinance). Sound levels in excess of such ordinance are sufficient cause to have the work halted until equipment can be quieted to these levels. Work stoppage by the County for excessive noise shall <u>not</u> relieve the Contractor of the other portions of this specification.

C. No extra charge may be made for time lost due to work stoppage resulting from the creation of a public nuisance.

1.13 WARRANTIES

A. All material supplied under these Specifications shall be warranted by the Contractor and the manufacturers for a period of three (3) years. Warranty period shall commence on the date of County acceptance.

B. The material shall be warranted to be free from defects in workmanship, design and materials. If any part of the system should fail during the warranty period, it shall be replaced at no expense to the County. All material and installation costs shall be 100% borne by the Contractor.

C. The manufacturer's warranty period shall run concurrently with the Contractor's warranty or guarantee period. No exception to this provision shall be allowed. The Contractor shall be responsible for obtaining warranties from each of the respective suppliers or manufacturers for all the material specified under these contract specifications,

D. In the event that the manufacturer is unwilling to provide a three-year warranty commencing at the time of County acceptance, the Contractor shall obtain from the manufacturer a four (4) year warranty starting at the time of equipment delivery to the job site. This four-year warranty shall not relieve the Contractor of the three-year warranty starting at the time of County acceptance of the equipment.

1.14 FUEL STORAGE & FILLING

A. If the contractor is storing fuel on site or doing his own fuel filling of portable equipment (other than hand-held equipment), he is responsible for any required response, clean-up or reporting required, at no additional cost to the county.

B. The Contractor shall prepare and submit a fuel storage / spill abatement plan prior to start of construction if required.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01040

COORDINATION WITH COUNTY'S OPERATIONS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Regulatory discharge requirements for the NWRF effluent requires continuous and adequate treatment and disinfection of wastewater to meet the NWRF Permit to Operate. At no time shall forward flow into the NWRF be required to be stopped to perform the Work.

B. Contractor's means and methods shall be implemented such that the existing plant shall remain in continuous satisfactory operation during the entire construction period except as absolutely required for the work. Work shall be so scheduled and conducted by Contractor such that it shall not reduce the quality of the NWRF effluent or cause odor or other nuisances. In performing the Work shown and specified, Contractor shall plan and schedule the Work to meet both the constraints outlined in this Section and all other sequencing and work requirements specified in these Contract Documents. The Contractor is specifically pointed to Section 01014 – Sequence of Work.

C. Contractor has the option of providing additional temporary facilities that can eliminate a constraint provided it is done without additional cost to the County, presents no safety hazards, and provided that all requirements of these Specifications are fulfilled.

D. Contractor shall be responsible for coordinating all shutdowns with the Engineer and County. Contractor shall, whenever possible, combine discrete shutdown procedures into a single shutdown when the duration of the shutdowns or the Work requirements allow such combining to occur on a unit process or work area. The intent of combining procedures is to minimize the impacts upon NWRF operations and processes by limiting the number of shutdowns required.

E. Contractor shall not shut-off or disconnect any operating system of the NWRF unless approved by the Engineer, in writing. All NWRF equipment operations and shutdowns shall be executed by the County, unless otherwise noted. Contractor shall seal County operated gates and valves to prevent unnecessary leakage. After Contractor's Work has been completed, Contractor shall remove the seal to the satisfaction of the Engineer.

F. Contractor shall refer to the Drawings and other Sections, for definition of the equipment, piping, material and appurtenances to be removed, turned over to the

County and stored on site, or to become the property of Contractor and removed from the site.

G. Contractor shall be responsible for design and supply of all temporary pipelines, valves, pumps, meters, spare parts, electrical, controls, and any other appurtenances required for the installation and operation of temporary bypass lines, pumping systems, or conveyance systems required to maintain operations of the NWRF during construction activities. All pumps shall be provided with magnetic flow meters capable of providing a 4-20 mADC output signal. Contractor shall submit to the Engineer, for review and approval, the design for all temporary lines, pumping, or conveyance systems at least thirty days prior to the commencement of the construction of the Work associated with the temporary facilities.

H. Contractor shall stage the work to maintain unobstructed access for emergency vehicles to all buildings, building Siamese connections, and fire hydrants.

I. Except as specifically allowed elsewhere in these Contract Documents or upon approval by the Engineer, outages, when required, shall be performed during low flow periods. Low flows are between 12:01 a.m. and 5:00 a.m. Individual outage durations shall not exceed 4 hours. At no time shall forward flow into the NWRF be required to be stopped to perform the Work.

1.02 GENERAL CONSTRAINTS

A. New units may only be used after the specified testing is completed and the units are accepted for use by the Engineer, in writing.

B. The following constraints shall be applied to all equipment appurtenant utility systems on the NWRF site.

1. Load limits on Access Roads: Existing and new underground facilities, such as electrical duct banks, pipelines, etc., in, under and crossing NWRF roads, have been designed for a maximum wheel load of AASHTO H-20. Contractor shall not exceed this weight limit and shall provide means of protecting the underground facilities.

2. Access to the NWRF site: An unobstructed traffic route through all NWRF gates shall be maintained at all times.

3. Safety Barriers: Contractors shall place safety barriers around unsafe areas located around operational areas accessible to NWRF personnel.

4. Personnel Access: personnel shall have access to all areas which remain in operation throughout the construction period.

5. Potable Water System: The existing potable water system shall be kept in operation at all times except as noted to perform the work specified.

6. Plumbing Facilities: Sanitary facilities in the existing structures shall be operational at all times for NWRF personnel, unless otherwise specified. All other building plumbing systems, such as roof and floor drains, pumping, etc., shall be maintained for all structures.

7. Storm drainage: Storm drainage on the site shall be operational at all times, unless otherwise specified.

8. Building Heating and Ventilating: In Contractor's Work areas and areas affected by Contractor's operations, building heating and ventilating shall be both provided and maintained in structures, including pipe galleries. The temperatures to be maintained in any area occupied by NWRF personnel, such as offices, lunchrooms, locker rooms, toilet rooms, facilities containing computer control equipment, etc., shall be at least 65°F and not greater than 80°F. The temperatures to be maintained in all other interior NWRF areas, whether new, exiting or temporary, shall be maintained at a minimum of 55°F and not greater than 90°F.

9. Power, Light and Communication Systems: Electric power, lighting service and communication systems shall be maintained in uninterrupted operation in all areas.

10. Sump Pumps and Sumps: All existing sumps shall be maintained in an operable condition with either existing pumps or temporary pumps provided by Contractor. Interim piping, power and controls shall be provided by Contractor, as required by the construction sequence and as directed by the Engineer.

11. Seal and Service Water Piping: A supply of service and seal water and the necessary connections to existing equipment shall be maintained during construction, unless otherwise specified. Interim piping shall be provided by Contractor, as required.

12. The County will assist Contractor in dewatering process tanks, wells, basins and other work areas. It is Contractor's responsibility to clean the tanks, wells, basins and work areas, and dispose off-site of the NWRF site and at their expense any residuals. The Contractor shall to maintain a clean and dry work area by pumping and disposing of all washdown and cleaning water, stormwater, and other liquids that accumulate in the work areas.

13. All shutdowns of existing systems or piping shall be performed by County personnel. All existing valves and gates shall be operated by County

personnel unless the Contractor has been provided written authorization by the Engineer to perform such activities.

14. Draining Process Pipes and Conduits:

    a. Unless otherwise specified, the contents of pipes and conduits undergoing modifications shall be transferred to the NWRF drain system using hoses, piping, or pumps.

    b. If a drain is not available on the pipe to be drained, then a wet tap shall be made by Contractor using a tapping saddle and valve approved by the Engineer. No uncontrolled spillage of a pipe's contents shall be allowed.

    c. Any spillage shall be brought to the Engineer's attention immediately. Contractor shall wash down any spillage to floor drains, sumps and sump pump discharge piping and then flush out by the system to prevent clogging and septic odors. In spillage is not suitable for drainage system, Contractor shall remove spillage by other method such as Vactor truck, as approved by the Engineer.

15. Temporary Partitions and Enclosures: Contractor shall provide temporary partitions and enclosures as necessary to maintain dust-free, heated and ventilated spaces in all areas which are adjacent to the Work and which must be kept operational by the SWWRF and SEWRF.

16. Dead End Valves of Pipe: Contractor shall provide blind flanges on all valves or pipes which dead-end a line on a temporary or permanent basis. Blind flanges shall be braced and blocked, as required or as directed by the Engineer in the field.

1.03 SHUTDOWNS

A. GENERAL

1. A shutdown shall be defined as a portion of the normal operation of a plant unit that has to be suspended or taken out of service in order to perform the specified Work. Note that shutdown does not mean a shutdown of the receipt of forward flow into the NWRF and at no time shall the NWRF not be allowed to receive forward flow from the collection system.

2. For each shutdown, Contractor shall conduct a hazard safety assessment, compile an inventory of labor, tools, safety equipment and materials required to perform the tasks, develop an estimate of the time required to complete each task, and prepare a written description of steps required to complete all task of the shutdown. In addition, the MOPO form provided in Section

01999 shall be completed for each shutdown. Contractor shall also request in writing from the Engineer, approval for each shutdown a minimum of 3 calendar days prior to the proposed shutdown date. No shutdown shall be initiated until the inventory of materials and labor is verified by the Engineer on site at least one week prior to the proposed start date. All shutdowns of existing systems or piping shall be performed by County personnel and all existing valves and gates shall be operated by County personnel unless the Contractor has been specifically authorized in writing by the Engineer to perform such activities.

3. Contractor shall arrange for a minimum of three meetings with the County and the Engineer for each shutdown. The first shall be a general planning strategy meeting for the shutdown. The second meeting shall review the roles of the Contractor, Engineer and County in the shutdown and shall, in detail, review all aspects of the shutdown. The shutdown plan and MOPO shall be presented and be final for this meeting. The first meeting shall be, at a minimum, 3 days before the desired shutdown and the second meeting shall be no more than 3 days before the shutdown. A final pre-shutdown meeting with the County and Engineer shall also be held immediately before the shutdown for final coordination purposes.

4. The Work required herein, and any other Work required by the Engineer which may interrupt the normal plant operations shall be accomplished at such times that will be convenient to the County.

5. Contractor shall also have on hand and located in close proximity to the Work area, all tools, equipment, spare parts and materials, both temporary and permanent, necessary to complete each Work category without interruption. Adequate numbers of personnel shall be scheduled for each shutdown, so that the Work shall be accomplished within the specified time frame. Prefabrication of all piping and other assemblies shall be completed, to the greatest degree possible, prior to any shutdowns. The Engineer shall inspect the work area, tools, equipment, spare parts and materials prior to the shutdown and shall be satisfied that Contractor has complied with these requirements, to the fullest extent possible, before shutdowns will be authorized. This review; however, does not relieve the Contractor from having full responsibility of the shutdown activity for having the appropriate tools, equipment, spare parts and materials, both temporary and permanent, necessary to complete each Work category without interruption.

6. If Contractor's procedures cause an unscheduled shutdown of the facilities, Contractor shall perform Work as necessary to immediately re-establish satisfactory operation. Contractor shall notify the Engineer, in writing, immediately of any unscheduled shutdown. Contractor shall permit County's personnel to work with Contractor's personnel, as required, to maintain the NWRF in continuous satisfactory operation. Unscheduled

shutdown and/or interruptions of continued safe and satisfactory operation of the facilities that result in any fines levied shall be the responsibility of Contractor if it is demonstrated that Contractor was negligent in his Work or did not exercise proper precautions in the conduct of his Work.

7. All Work requiring a portion of the NWRF to be out-of-service shall be performed during the scheduled shutdowns shown. It should be noted that NWRF staff will continue to perform administrative, operation and maintenance functions during shutdowns.

B. Shutdowns of Electrical Systems: Contractor in conjunction with the County and appropriate NWRF personnel shall lock out and tag circuit breakers and switches operated by the County and shall check cables and wires to be sure that they are de-energized to ground potential before Work begins. Upon completion of the Work, Contractor shall remove the locks and tags and notify the Engineer that the facilities are available for use.

1.04 OVERTIME

A. All overtime Work by Contractor necessary to conform to the requirements of this Section and related Sections shall be performed by Contractor, at no cost to the County and shall be performed in accordance with the General Conditions. Contractor shall make no claims for extra compensation as a result thereof.

1.05 MAINTENANCE OF PLANT OPERATIONS SCHEDULE AND NARRATIVE DESCRIPTIONS

A. In order to maintain a continuous plant operation during construction, a blank and a completed sample Maintenance of Plant Operations (MOPOs) Schedule is included in Section 01999. Within each MOPO item's procedural steps, time and scheduling constraints and milestone dates shall be outlined.

B. Contractor shall develop a detailed narrative description, in addition to that provided in the MOPO, for all shutdowns. These narrative descriptions shall be catalogued and submitted to the Engineer for review and approval within ninety days following the Notice to Proceed. Contractor shall maintain these narratives in a binder which shall be reviewable at any time by the Engineer. These narratives shall be clearly identifiable on and be able to be cross-referenced with the project schedule maintained by the Contractor. As adjustments are made or made necessary by the progression of the Work, the Contractor shall modify and resubmit these narrative descriptions.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01045

CUTTING AND PATCHING

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

A. The Contractor shall be responsible for all cutting, fitting and patching, including excavation and backfill, required to complete the work or to:

1. Make its several parts fit together properly.
2. Uncover portions of the work to provide for installation of ill-timed work.
3. Remove and replace defective work.
4. Remove and replace work not conforming to requirements of Contract Documents.
5. Provide penetrations of non-structural surfaces for installation of piping and electrical conduit.

PART 2 – PRODUCTS

2.01 MATERIALS

Comply with specifications and standards for each specific product involved.

PART 3 – EXECUTION

3.01 INSPECTION

A. Inspect existing conditions of project, including elements subject to damage or to movement during cutting and patching.

B. After uncovering work, inspect conditions affecting installation of products, or performance of work.

C. Report unsatisfactory or questionable conditions to County. Do not proceed with work until County has provided further instructions.

3.02 PREPARATION

A. Provide adequate temporary support as necessary to assure structural value to integrity of affected portion of work.

B. Provide devices and methods to protect other portions of project from damage.

C. Provide protection from elements for that portion of the project which may be exposed by cutting and patching work and maintain excavations free from water.

3.03 PERFORMANCE

A. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.

B. Execute excavating and backfilling by methods which will prevent settlement or damage to other work.

C. Fit and adjust products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

D. Restore work which has been cut or removed; install new products to provide completed work in accordance with the requirements of the Contract Documents.

E. Replace surfaces airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

F. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes.

END OF SECTION

SECTION 01050

FIELD ENGINEERING AND SURVEYING

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

A. The Contractor shall provide and pay for field surveying service required for the project.

B. The Contractor shall furnish and set all necessary stakes to establish the lines and grades as shown on the Contract Drawings and layout each portion of the Work of the Contract.

1.02 QUALIFICATION OF SURVEYOR AND ENGINEER

All construction staking shall be conducted by or under the supervision of a Florida Registered Professional Surveyor and Mapper. The Contractor shall be responsible for the layout of all such lines and grades, which will be subject to verification by the County.

1.03 SURVEY REFERENCE POINTS

A. Existing basic horizontal and vertical control points for the Project are designated on the Contract Drawings.

B. Locate and protect all survey monumentation, property corners and project control points prior to starting work and preserve all permanent reference points during construction. All costs associated with the replacement of all survey monumentation, property corners and project control points shall be borne by the Contractor.

Make no changes or relocations without prior written notice to County.

Report to County when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

Require surveyor to replace project control points which may be lost or destroyed.

Establish replacements based on original survey control.

1.04 PROJECT SURVEY REQUIREMENTS

The Contractor shall establish temporary bench marks as needed, referenced to data established by survey control points.

1.05 RECORDS

The Contractor shall employ a Professional Engineer or Surveyor registered in the State of Florida to verify survey data and properly prepare record drawings per Section 01720.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01090

REFERENCE STANDARDS

PART 1 – GENERAL

1.01 REQUIREMENTS

Abbreviations and acronyms used in Contract Documents to identify reference standards.

A. Application: When a standard is specified by reference, comply with requirements and recommendations stated in that standard, except when requirements are modified by the Contract Documents, or applicable codes established stricter standards.

B. Publication Date: The most recent publication in effect on the date of issue of Contract Documents, except when a specific publication date is specified.

1.02 ABBREVIATIONS, NAMES AND ADDRESSES OR ORGANIZATIONS

Obtain copies of reference standards direct from publication source, when needed for proper performance of work, or when required for submittal by Contract Documents.

AA Aluminum Association
818 Connecticut Avenue, N.W.
Washington, DC 20006

AASHTO American Association of State Highway and Transportation Officials
444 North Capital Street, N.W.
Washington, DC 20001

ACI American Concrete Institute
Box 19150
Reford Station
Detroit, MI 48219

AI Asphalt Institute
Asphalt Institute Building
College Park, MD 20740

AISC American Institute of Steel Construction
1221 Avenue of the Americas
New York, NY 10020

AISI American Iron and Steel Institute
1000 16th Street NW
Washington, DC 20036

ANSI American National Standards Institute
1430 Broadway
New York, NY 10018

ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
179l Tullie Circle, N.E.
Atlanta, GA 30329

ASME American Society of Mechanical Engineers
345 East 47th Street
New York, NY 10017

ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103

AWWA American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235

AWS American Welding Society
2501 N.W. 7th Street
Miami, FL 33125

CRSI Concrete Reinforcing Steel Institute
180 North LaSalle Street, Suite 2110
Chicago, IL 60601

FDEP Florida Department of Environmental Protection
3900 Commonwealth Blvd.
Tallahassee, Florida 32399

FDOT Florida Department of Transportation Standards Specifications for Road and Bridge Construction
Maps & Publication Sales - Mail Station 12
605 Suwannee St.
Tallahassee, FL 32399-0450

FS Federal Specification
General Services Administration Specifications and Consumer Information Distribution Section (WFSIS)

Washington Navy Yard, Bldg. 197
Washington, DC 20407

MCPW UTIL STD Manatee County Utility Engineering
4410-B 66th St. W.
Bradenton, FL 34210

MLSFA Metal Lath/Steel Framing Association
221 North LaSalle Street
Chicago, IL 60601

MMA Monorail Manufacturer's Association
1326 Freeport Road
Pittsburgh, PA 15238

NAAMM National Association of Architectural Metal Manufacturers
221 North LaSalle Street
Chicago, IL 60601

NEMA National Electrical Manufacturer's Assoc.
2101 L Street N.W.
Washington, DC 20037

OHSA Occupational Safety and Health Assoc.
5807 Breckenridge Pkwy., Suite A
Tampa, FL 33610-4249

PCA Portland Cement Association
5420 Old Orchard Road
Skokie, IL 20076

PCI Prestressed Concrete Institute
20 North Wacker Drive
Chicago, IL 60606

SDI Steel Door Institute
712 Lakewood Center North
Cleveland, OH 44107

SMACNA Sheet Metal and Air Conditioning Contractor's National Association
8224 Old Court House Road
Vienna, VA 22180

SSPC Steel Structures Painting Council
402 24th Street, Suite 600

Pittsburgh, PA 15213

SWFWMD Southwest Florida Water Management District
2379 Broad Street
Brooksville, FL 34604-6899

UL Underwriter's Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062

END OF SECTION

SECTION 01150

MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Payment for the various items in the Schedule of Prices Bid, as further specified herein, shall include all compensation to be received by the Contractor for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, taxes, materials, commissions, transportation and handling, bonds, permit fees, insurance, overhead and profit, and incidentals appurtenant to the items of Work being described, as necessary to complete the various items of the Work all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). Such compensation shall also include payment for any loss or damages arising directly or indirectly from the Work.

B. The Contractor's attention is called to the fact that the quotations for the various items of Work are intended to establish a total price for completing the Work in its entirety. Should the Contractor feel that the cost for any item of Work has not been established by the Schedule of Payment items or this Section, it shall include the cost for that Work in some other applicable bid item, so that its proposal for the project does reflect its total price for completing the Work in its entirety.

C. The following explanation of measurement and payment for the bid form items is made for information and guidance. The omission of reference to any item in this description shall not, however, alter the intent of the bid form or relieve the Contractor of the necessity of furnishing such as part of the contract at no additional costs.

D. All contract prices included in the Bid Form section will be full compensation for all shop drawings, working drawings, labor, materials, tools, equipment and incidentals necessary to complete the construction as shown on the Drawings and/or as specified in the Contract Documents to be performed under this Contract. Actual quantities of each item bid on a unit price basis will be determined upon completion of the construction in the manner set up for each item in this section of the Specifications. Payment for all items listed in the Bid Form will constitute full compensation for all work shown and/or specified to be performed under this Contract.

1.02 ESTIMATED QUANTITIES

A. The quantities shown are approximate and are given only as a basis of calculation upon which the award of the Contract is to be made. The County does not assume any responsibility for the final quantities, nor shall the Contractor claim misunderstanding because of such estimate of quantities. Final payment will be made only for satisfactorily completed quantity of each item.

1.03 WORK OUTSIDE AUTHORIZED LIMITS

A. No payment will be made for work constructed outside the authorized limits of work.

1.04 SUBMITTALS

A. The following shall be submitted.

1. Schedule of Values: Submit schedule within the time period in accordance with Division 0.

2. Application for Payment in accordance with Division 0.

3. Final Application for Payment in accordance with Division 0.

1.05 SCHEDULE OF VALUES

A. Prepare a schedule of values for the Work. See Section 01370 for details.

B. Unit Price Work: Reflect unit price, quantity and price breakdown from the Unit Price Sheet.

C. Summation of the complete schedule of values representing all the Work shall equal the Contract Price.

D. An unbalanced or front-end loaded schedule will not be acceptable.

1.06 APPLICATION FOR PAYMENT

A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.

B. Use detailed Application for Payment Form provided by the Engineer or County.

C. Include accepted schedule of values for each portion of Work and the unit price breakdown for the Work to be paid on unit price basis, and a listing of County-selected equipment, if applicable, and allowances, as appropriate.

D. Preparation:

1. Round values to nearest dollar.

2. List each Change Order and Written Amendment executed prior to date of submission as separate line item. Totals to equal those shown on the Transmittal Summary Form.

3. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form, a listing of materials on hand as applicable, and such supporting data as may be requested by Engineer or County.

E. Include partial releases of liens from all subcontractors and material suppliers for work paid for by previous applications for payment. Include invoices and paid invoices for materials paid for by previous applications for payment for materials stored on site.

1.07 MEASUREMENT—GENERAL

A. Where payment for items is shown to be paid for on a lump sum basis, no separate payment will be made for any item of work required to complete the lump sum items. Lump sum contracts shall be complete, tested and fully operable prior to request for final payment. Contractor may be required to provide a break-down of the lump sum totals.

B. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and Specifications as specified in National Institute of Standards and Technology, Handbook 44.

C.

Item	Method of Measurement
LS	Lump Sum—Unit is one; no measurement will be made

1.08 PAYMENT

A. GENERAL

1. Progress payments will be made monthly in accordance with the Contract Documents.

2. All lump sum items shall be paid on a percent complete basis.

3. The date for Contractor's submission of monthly Application for Payment shall be established at the Project Kickoff Meeting and shall be in accordance with Division 0.

B. Payment shall be by Contract Item as listed on the Bid Form and Bid Summary Sheet.

C. No separate payment will be made for the following items and the cost of such work shall be included in the applicable pay items of work. Final payments shall not be requested by the Contractor or made by the County until as-built (record) drawings have been submitted and approved by the County.

1. Shop Drawings, Working Drawings.
2. Clearing, grubbing and grading except as hereinafter specified.
3. Trench excavation, including necessary pavement removal and rock removal, except as otherwise specified.
4. Dewatering and disposal of surplus water.
5. Structural fill, backfill, and grading.
6. Replacement of unpaved roadways, and shrubbery plots.
7. Cleanup and miscellaneous work.
8. Foundation and borrow materials, except as hereinafter specified.
9. Testing and placing system in operation.
10. Any material and equipment required to be installed and utilized for the tests.
11. Pipe, structures, pavement replacement, asphalt and shell driveways and/or appurtenances included within the limits of lump sum work, unless otherwise shown.
12. Maintaining the existing quality of service during construction.
13. Maintaining or detouring of traffic.
14. Appurtenant work as required for a complete and operable system.
15. Seeding and hydro-mulching.
16. As-built Record Drawings.

1.09 BID FORM ITEM DESCRIPTION

A. **Bid Item No. 1 – NWRF Mobilization, Demobilization and Site Work (LS).** Payment for NWRF improvements will be made at the lump sum price named on the Bid Form and be on a percent complete basis. Bid Items No. 1 includes but is not limited to mobilization, demobilization and all associated site work (including but not limited to erosion control) and incidentals that is not covered in Bid Items No. 2 thru 7 as shown in Construction Documents and as required for a complete system and project. Partial payments for NWRF Mobilization, Demobilization and Site Work shall be made on a percent complete basis.

Bid Item No. 2 – NWRF Demolition (LS).
Payment for NWRF Demolition item will be made at the lump sum price named on the Bid Form and be on a percent complete basis. NWRF Demolition includes but is not limited to careful removal and disposal of existing polymer feed pumps, booster pumps, piping, valves, appurtenances, drives, and skids, and the polymer system. Also included is the lump sum price includes all removal, demolition, hauling, shipping, and freight as well as incidentals and other demolition as

shown/required to perform work as shown in Construction Documents. Partial payments for NWRF Demolition shall be made on a percent complete basis.

Bid Item No. 3 – NWRF BFP Improvements (LS).
Payment for NWRF BFP Improvements will be made at the lump sum price named on the Bid Form and be on a percent complete basis. Improvements includes but is not limited to rehabbing and installing two (2) existing belt filter presses, associated appurtenances, piping, valves, connecting electrical, and instrumentation. The lump sum price includes all shipping, freight, as well as incidentals (mounting, testing, etc.) and other improvements shown/required to perform work as shown in Construction Documents. Partial payments for NWRF BFP Improvements shall be made on a percent complete basis.

Bid Item No. 4 – NWRF Polymer Feed Pumps, Sludge Feed Pumps, Cake Load-out Pump and Booster Pumps Improvements (LS).
Payment for NWRF Polymer Feed Pumps Improvements will be made at the lump sum price named on the Bid Form and be on a percent complete basis. Improvements includes but is not limited to furnishing and installing new polymer feed, sludge feed, cake load-out pumps and booster pump system, associated piping, valves, appurtenances, and drives. The lump sum price includes all shipping, freight, as well as incidentals (mounting, testing, etc.) and other improvements shown/required to perform work as shown in Construction Documents. Partial payments for Polymer Feed Pumps, Sludge Feed Pumps, Cake Load-out Pumps and Booster Pumps Improvements shall be made on a percent complete basis.

Bid Item No. 5 – NWRF Polymer System Improvements (LS).
Payment for NWRF Polymer System Improvements will be made at the lump sum price named on the Bid Form and be on a percent complete basis. Improvements includes but is not limited to furnishing and installing new Polymer System, piping, valves, appurtenances, and drives. The lump sum price includes all shipping, freight, as well as incidentals (mounting, testing, etc.) and other improvements shown/required to perform work as shown in Construction Documents. Partial payments for NWRF Polymer System Improvements shall be made on a percent complete basis.

Bid Item No. 6 – NWRF Electrical and Instrumentation Improvements (LS).
Payment for NWRF Electrical and Instrumentation Improvements will be made at the lump sum price named on the Bid Form and be on a percent complete basis. Improvements includes but is not limited to removal of existing electrical and instrumentation as shown on the Contract Documents, replacement of main service switchgear, motor control centers, electrical power feeds, line, loads and control except fiber. Removal of obsolete panels, exposed conduits and conductors. Replacement of instrumentation and controls on all BFPs to facilitate automatic operation, which includes furnishing and installation of cameras at the BFP and truck load-out locations and furnishing and installation of televisions in the administration building. Replacement of all existing lighting. The item also

includes all SCADA integration of the controls specified and shown in the Contract Documents. The lump sum price includes all removal, demolition, hauling, shipping, freight, as well as incidentals (mounting, testing, etc.) and other improvements shown/required to perform work as shown in Construction Documents. Partial payments for NWRF Electrical and Instrumentation Improvements shall be made on a percent complete basis.

Bid Item No. 7 – NWRF Site Civil Improvements (LS).
Payment for site civil improvements will be made at the lump sum price named on the Bid Form and be on a percent complete basis. . The item includes but is not limited to all work associated with site preparation, site civil improvements including but not limited to furnishing and installing new asphalt pavement, adding drain to the second truck loadout bay, swale improvements, fence improvements, preparing an erosion control plan; designing, providing, maintaining, and removing temporary erosion and sedimentation controls and other work as mentioned in Contract Documents. Work includes grading, restoration, grassing, mulching, netting, watering, reseeding on-site surfaces, storm inlet protection, reseeding spoil and borrow area surfaces, interceptor ditches at ends of berms and at those locations which will ensure that erosion during construction will be either eliminated or maintained within acceptable limits as established by the County and satisfy any and all Federal, State, and County regulations. Temporary sedimentation controls include, but are not limited to silt dams, traps, barriers, sandbags, slope drains, silt fencing, and appurtenances at the foot of sloped surfaces. Item does include work associated with permanent restoration. Payment shall be based on a percent complete basis.

Bid Item No. 8 – NWRF Construction of Second Bay (LS).
Payment for construction of second bay will be made at the lump sum price named on the Bid Form and be on a percent complete basis. The item includes but is not limited to all work associated with construction truck loadout bay, new cake pumps, loadout system, and associated piping. Payment shall be based on a percent complete basis.

1.10 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.

2. Quantities of excavated material wasted or disposed of in manner not called for under Contract Documents.

3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.

4. Material not unloaded from transporting vehicle.

5. Defective Work not accepted by County.

6. Material remaining on hand after completion of Work.

1.11 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings or preliminary operation and maintenance manuals are acceptable to Engineer.

B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

1.12 ALLOWANCES

A. The allowances shall be used only at the discretion of and as ordered by the County for such items as unforeseen conditions, unforeseeable conflicts between existing elements of work and the proposed work, unit price items exceed estimated quantities, and any associated work requested by the County including all labor, materials, and services for modifications or extra work to complete the Project that was anticipated, but not specifically included in this Contract.

B. Any portion of these allowances that remain after all authorized payments have been made will be withheld from contract payments and will remain with the County. A deductive change order will be executed at the end of this contract prior to Final Payment to credit County with the remaining portion of the allowances.

1.13 SCHEDULE OF PAYMENT VALUE

A. The Contractor shall submit a Schedule of Payment Values for review within 10 calendar days upon receipt of purchase order and executed contract. The schedule shall contain the installed value of the component parts of Work for the purpose of making progress payments during the construction period and shall be consistent with the Unit Price Sheet.

B. The schedule shall be given in sufficient detail for proper identification of Work accomplished. The Schedule of Payment Values shall directly correlate to each activity outlined in the construction progress schedule and the construction network analysis (specified in the section entitled “Submittals”) to accurately relate construction progress to the requested payment. Each item shall include its proportional share of all costs including the Contractor's overhead, contingencies and profit. The sum of all scheduled items shall equal the total value of the Contract.

C. If the Contractor anticipates the need for payment for materials stored on the project site or off-site in bonded warehouse, it shall also submit a separate list covering the cost of materials, delivered and unloaded with taxes paid. This list shall also include the installed value of the item with coded reference to the Work items in the Schedule of Payment Values.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01152

REQUESTS FOR PAYMENT

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

Submit Applications for Payment to the Project Manager or as directed at the preconstruction meeting, in accordance with the schedule established by Conditions of the Contract and Agreement between County and Contractor.

1.02 FORMAT AND DATA REQUIRED

A. Submit payment requests in the form provided by the County with itemized data typed in accordance with the Bid Form.

B. Provide construction photographs in accordance with Contract Documents.

1.03 SUBSTANTIATING DATA FOR PROGRESS PAYMENTS

A. When the County requires substantiating data, Contractor shall submit suitable information with a cover letter.

B. Submit one copy of data and cover letter for each copy of application.

1.04 PREPARATION OF APPLICATION FOR FINAL PAYMENT

Fill in application form as specified for progress payments.

1.05 SUBMITTAL PROCEDURE

A. Submit applications for payment at the times stipulated in the Agreement.

B. Number: Three (3) copies of each application; all signed and certified by the Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01153

CHANGE ORDER PROCEDURES

PART 1 – GENERAL

1.01 DEFINITION

A. Change Order: A written order signed by the Owner, the Architect/Engineer and the Contractor authorizing a change in the Project Plans and/or Specifications and, if necessary, a corresponding adjustment in the Contract Sum and/or Contract Time, pursuant to Article V of the General Conditions of the Construction Agreement.

B. Administrative Change Adjustment: Minor change order under 10% of project cost or 20% time, does not have to be Board approved.

C. Field Directive: A written order issued by Owner which orders minor changes in the Work not involving a change in Contract Time, to be paid from the Owner's contingency funds.

D. Field Order: Minor change to contract work that does not require adjustment of contract sum or expected date of completion.

1.02 REQUIREMENTS INCLUDED

A. The Contractor shall promptly implement change order procedures:

1. Provide full written data required to evaluate changes.
2. Maintain detailed records of work done on a time-and-material/force account basis.
3. Provide full documentation to County on request.

B. The Contractor shall designate a member of the Contractor's organization who:

1. Is authorized to accept changes to the Work.
2. Is responsible for informing others in the Contractor's employ of the authorized changes into the Work.

1.03 PRELIMINARY PROCEDURES

A. Project Manager may initiate changes by submitting a Request to Contractor. Request will include:

1. Detailed description of the change, products, costs and location of the change in the Project.
2. Supplementary or revised Drawings and Specifications.
3. The projected time extension for making the change.
4. A specified period of time during which the requested price will be considered valid.
5. Such request is for information only and is not an instruction to execute the changes, nor to stop work in progress.

B. Contractor may initiate changes by submitting a written notice to the Project Manager, containing:

1. Description of the proposed changes.
2. Statement of the reason for making the changes.
3. Statement of the effect on the Contract Sum and the Contract Time.
4. Statement of the effect on the work of separate contractors.
5. Documentation supporting any change in Contract Sum or Contract Time, as appropriate.

1.04 FIELD ORDER CHANGE

A. In lieu of a Change Order, the Project Manager may issue a Field Order for the Contractor to proceed with additional work within the original intent of the Project.

B. Field Order will describe changes in the work, with attachments of backup information to define details of the change.

C. Contractor must sign and date the Field Order to indicate agreement with the terms therein.

1.05 DOCUMENTATION OF PROPOSALS AND CLAIMS

A. Support each quotation for a lump sum proposal and for each unit price which has not previously been established, with sufficient substantiating data to allow the County to evaluate the quotation.

B. On request, provide additional data to support time and cost computations:

1. Labor required.
2. Equipment required.
3. Products required.
    a. Recommended source of purchase and unit cost.
    b. Quantities required.
4. Taxes, insurance and bonds.

5. Credit for work deleted from Contract, similarly documented.
6. Overhead and profit.
7. Justification for any change in Contract Time.

C. Support each claim for additional costs and for work done on a time-and-material/force account basis, with documentation as required for a lump-sum proposal.

1. Name of the County's authorized agent who ordered the work and date of the order.
2. Date and time work was performed and by whom.
3. Time record, summary of hours work and hourly rates paid.
4. Receipts and invoices for:
   a. Equipment used, listing dates and time of use.
   b. Products used, listing of quantities.
   c. Subcontracts.

1.06 PREPARATION OF CHANGE ORDERS

A. Project Manager will prepare each Change Order.

B. Change Order will describe changes in the Work, both additions and deletions, with attachments as necessary to define details of the change.

C. Change Order will provide an accounting of the adjustment in the Contract Sum and in the Contract Time.

1.07 LUMP SUM/FIXED PRICE CHANGE ORDER

A. Project Manager initiates the form, including a description of the changes involved and attachments based upon documents and proposals submitted by the Contractor, or requests from the County, or both.

B. Once the form has been completed, all copies should be sent to Contractor for approval. After approval by Contractor, all copies should be sent to County for approval. The County will distribute executed copies after approval by the Board of County Commissioners.

1.08 UNIT PRICE CHANGE ORDER

A. Contents of Change Orders will be based on, either:

1. County's definition of the scope of the required changes.
2. Contractor's Proposal for a change, as approved by the County.
3. Survey of completed work.

B. The amounts of the unit prices to be:

1. Those stated in the Agreement.
2. Those mutually agreed upon between County and Contractor.

1.09 TIME AND MATERIAL/FORCE ACCOUNT CHANGE ORDER/ CONSTRUCTION CHANGE AUTHORIZATION

A. Refer to Article V.5.6 of the General Conditions of the Construction Agreement.

1.10 CORRELATION WITH CONTRACTOR'S SUBMITTALS

A. Periodically revise Schedule of Values and Application for Payment forms to record each change as a separate item of work, and to record the adjusted Contract Sum.

B. Periodically revise the Construction Schedule to reflect each change in Contract Time. Revise sub schedules to show changes for other items of work affected by the changes.

C. Upon completion of work under a Change Order, enter pertinent changes in Record Documents.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

A. The County shall schedule the pre-construction meeting, periodic progress meetings and special meetings, if required, throughout progress of work.

B. Representatives of contractors, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.

C. The Contractor shall attend meetings to ascertain that work is expedited consistent with Contract Documents and construction schedules.

1.02 PRE-CONSTRUCTION MEETING

A Attendance:

1. County's Engineer.
2. County's Project Manager
3. Contractor.
4. Resident Project Representative.
5. Related Labor Contractor's Superintendent.
6. Major Subcontractors.
7. Major Suppliers.
8. Others as appropriate.

B. Suggested Agenda:

1. Distribution and discussion of:
   a. List of major subcontractors.
   b. Projected Construction Schedules.
   c. Coordination of Utilities
2. Critical work sequencing.
3. Project Coordination.
   a. Designation of responsible personnel.
   b. Emergency contact persons with phone numbers.
4. Procedures and processing of:
   a. Field decisions.
   b. Submittals.
   c. Change Orders.
   d. Applications for Payment.
5. Procedures for maintaining Record Documents.
6. Use of premises:
   a. Office, work and storage areas.
   b. County's Requirements.

7. Temporary utilities.
8. Housekeeping procedures.
9. Liquidated damages.
10. Equal Opportunity Requirements.
11. Laboratory testing.
12. Project / Job meetings: Progress meeting, other special topics as needed.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 – GENERAL

1.01 GENERAL

A. The Contractor shall submit to the County for review and approval: working drawings, shop drawings, test reports and data on materials and equipment (hereinafter in this section called data), and material samples (hereinafter in this section called samples) as are required for the proper control of work, including, but not limited to those working drawings, shop drawings, data and samples for materials and equipment specified elsewhere in the Specifications and in the Contract Drawings.

B. The Contractor is to maintain an accurate updated submittal log and will bring this log to each scheduled progress meeting with the County. This log should include the following items:

1. Submittal description and number assigned.
2. Date to County.
3. Date returned to Contractor (from County).
4. Status of Submittal (No exceptions taken, returned for confirmation or resubmittal, rejected).
5. Date of Resubmittal and Return (as applicable).
6. Date material released (for fabrication).
7. Projected date of fabrication.
8. Projected date of delivery to site.
9. Projected date and required lead time so that product installation does not delay contact.
10. Status of O&M manuals submitted.

C. Submittals covered by these requirements include manufacturers' information, shop drawings, test procedures, test results, samples, requests for substitutions, and miscellaneous work-related submittals. Submittals shall also include, but not be limited to, all mechanical, electrical and electronic equipment and systems, materials, reinforcing steel, fabricated items, and piping and conduit details. The Contractor shall furnish all drawings, specifications, descriptive data, certificates, samples, tests, methods, schedules, and manufacturer's installation and other instructions as specifically required in the contract documents to demonstrate fully that the materials and equipment to be furnished and the methods of work comply with the provisions and intent of the contract documents.

D. The contractor shall submit copies of all permit applications, permit submittals, permit comments and permit approvals.

E. Within 10 calendar days after Notice to Proceed, Contractor shall submit a complete list of all anticipated submittals including shop drawings, submittals, and product data with an anticipated delivery date to the Engineer and review and approval times. This shall be reviewed during the Project Kickoff Meeting and shall be continuously updated and reviewed during Project Progress Meetings.

1.02 CONTRACTOR'S RESPONSIBILITIES

The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment or method of work shall be as described in the submittal. The Contractor shall verify that all features of all products conform to the specified requirements. Submittal documents shall be clearly edited to indicate only those items, models, or series of equipment, which are being submitted for review. All extraneous materials shall be crossed out or otherwise obliterated. The Contractor shall ensure that there is no conflict with other submittals and notify the Engineer in each case where his submittal may affect the work of another Contractor or the County. The Contractor shall coordinate submittals among his subcontractors and suppliers including those submittals complying with unit responsibility requirements specified in paragraph 11000-1.02 C and applicable technical sections.

The Contractor shall coordinate submittals with the work so that work will not be delayed. Contractor shall coordinate and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals. The Contractor shall not proceed with work related to a submittal until the submittal process is complete. For the Contractor to proceed a submittal shall be reviewed, commented and shall be returned to the Contractor stamped "No Exceptions Taken" or "Make Corrections Noted."

The Contractor shall certify on each submittal document that the Contractor has reviewed the submittal, verified field conditions, and complied with the contract documents.

The Contractor may authorize in writing a material or equipment supplier to deal directly with the Engineer regarding a submittal. These dealings shall be limited to contract interpretations to clarify and expedite the work.

The Engineer will review each submittal up to two times. The Contractor shall pay directly to the Engineer for all additional reviews on a time and materials basis but not to exceed 24 hours per submittal review.

It is the duty of the Contractor to check all drawings, data and samples prepared by or for him before submitting them to the County for review. Each and every copy of the Drawings and data shall bear Contractor's stamp showing that they have been so checked.

Shop drawings submitted to the County without the Contractor's stamp will be returned to the Contractor for conformance with this requirement. Shop drawings shall indicate any deviations in the submittal from requirements of the contract Documents.

Determine and verify:

1. Field measurements.
2. Field construction criteria.
3. Catalog numbers and similar data.
4. Conformance with Specifications and indicate all variances from the Specifications.

The Contractor shall furnish the County a schedule of Shop Drawing submittals fixing the respective dates for the submission of shop and working drawings, the beginning of manufacture, testing and installation of materials, supplies and equipment. This schedule shall indicate those that are critical to the progress schedule.

The Contractor shall not begin any of the work covered by a drawing, data, or a sample returned for correction until a revision or correction thereof has been reviewed and returned to him, by the County, with No Exceptions Taken or Approved As Noted.

The Contractor shall submit to the County all drawings and schedules sufficiently in advance of construction requirements to provide no less than twenty-one (21) calendar days for checking and appropriate action from the time the County receives them.

All material & product submittals, other than samples, may be transmitted electronically as a pdf file. All returns to the contractor will be as a pdf file only unless specifically requested otherwise.

The Contractor shall be responsible for and bear all cost of damages which may result from the ordering of any material or from proceeding with any part of work prior to the completion of the review by County of the necessary Shop Drawings.

1.03 CATEGORIES OF SUBMITTALS

A. GENERAL

Submittals fall into two general categories; submittals for review and comment, and submittals which are primarily for information only. Submittals which are for information only are generally specified as PRODUCT DATA in Part 2 of applicable specification sections.

B. SUBMITTALS FOR REVIEW AND COMMENT

All submittals except where specified to be submitted as product data for information only shall be submitted by the Contractor to the Engineer for review and comment.

C. SUBMITTALS (PRODUCT DATA) FOR INFORMATION ONLY

Where specified, the Contractor shall furnish submittals (product data) to the Engineer for Information only. Submittal requirements for operation and maintenance manuals, which are included in this category, are specified in Section 01730.

1.04 TRANSMITTAL PROCEDURE

A. GENERAL

Unless otherwise specified, submittals regarding material and equipment shall be accompanied by Transmittal Form 01300-A specified in Section 01999. Submittals for operation and maintenance manuals, information and data shall be accompanied by Transmittal Form 01730-A specified in Section 01999. A separate form shall be used for each specific item, class of material, equipment, and items specified in separate, discrete sections, for which the submittal is required. Submittal documents common to more than one piece of equipment shall be identified with all the appropriate equipment numbers. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.

A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted. Original submittal numbers shall have the following format: "XXX"; where "XXX" is the sequential number assigned by the Contractor. Resubmittals shall have the following format: "XXX-Y"; where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals, i.e., A, B, or C being the 1st, 2nd, and 3rd resubmittals, respectively. Submittal 25B, for example, is the second resubmittal of submittal 25.

B. DEVIATIONS FROM SPECIFICATION AND DRAWING REQUIREMENTS

Each submittal shall be accompanied with a copy of the related specification section, with addendum updates included, and all applicable and referenced paragraphs of other sections, with addendum updates included, with each paragraph check-marked (✓) to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Vendor, each deviation shall be underlined and denoted by a number in the margin to the right

of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Vendor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

If the Contractor proposes to provide material, equipment, or method of work which deviates from the project manual, he shall indicate so under "deviations" on the transmittal form accompanying the submittal copies. The deviations noted on the form shall summarize major deviations or groups of deviations. Each submittal shall be accompanied with a detailed list of all deviations with an explanation describing the justification for the deviation.

C. SUBMITTAL COMPLETENESS

Submittals which do not have all the information required to be submitted, including deviations, are not acceptable and will be returned without review.

1.05 REVIEW PROCEDURE

A. GENERAL

Submittals are specified for those features and characteristics of materials, equipment, and methods of operation which can be selected based on the Contractor's judgment of their conformance to the specified requirements. Other features and characteristics are specified in a manner which enables the Contractor to determine acceptable options without submittals. The review procedure is based on the Contractor's guarantee that all features and characteristics not requiring submittals conform as specified. Review shall not extend to means, methods, techniques, sequences or procedures of construction, or to verifying quantities, dimensions, weights or gages, or fabrication processes (except where specifically indicated or required by the project manual) or to safety precautions or programs incident thereto. Review of a separate item, as such, will not indicate approval of the assembly in which the item functions.

When the contract documents require a submittal, the Contractor shall submit the specified information as follows:

1. Submittals and Product Data shall be submitted electronically as a single PDF document.

The following submittals are excluded and require hard copies. A summary of the types of submittals and the number of copies required for review by the Engineer

is as follows:

Copies	Type of Submittal
2	Permit Applications, Permits & Permit Submittals
5	General Submittals & Plans of Operation
5	Construction Schedule
5	Schedule of Payment Items/ Values
5	Progress Estimates & Construction Photographs
8	Equipment Submittals and Shop Drawings
2	Certificates of Compliance
2	Product Samples
2	Project Record Documents
5	Technical Manuals, O&M Manuals & Spare Parts List
6	Application for Payment
3	Consent of Sureties, Partial/Final releases of Liens
2	Elevation Certificates

B. SUBMITTALS FOR REVIEW AND COMMENT

Unless otherwise specified, within 14 calendar days after receipt of a submittal for review and comment, the Engineer shall review and return three marked-up three copies of the submittal. The reproducible original will be retained by the Engineer. The returned submittal shall indicate one of the following actions:

1. If the review indicates that the material, equipment or work method complies with the project manual, submittal copies will be marked "NO EXCEPTIONS TAKEN." In this event, the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.

2. If the review indicates limited corrections are required, copies will be marked "MAKE CORRECTIONS NOTED." The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in O&M data, a corrected copy shall be provided.

3. If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "AMEND AND RESUBMIT." Except at his own risk, the Contractor shall not undertake work covered by this submittal until it has been revised, resubmitted and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

4. If the review indicates that the material, equipment, or work method does not comply with the project manual, copies of the submittal will be marked "REJECTED - SEE REMARKS." Submittals with deviations which have not been identified clearly may be rejected. Except at his own risk, the Contractor shall not undertake the work covered by such submittals until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

C. SUBMITTALS (PRODUCT DATA) FOR INFORMATION ONLY

Such information is not subject to submittal review procedures and shall be provided as part of the work under this contract and its acceptability determined under normal inspection procedures.

1.06 EFFECT OF REVIEW OF CONTRACTOR'S SUBMITTALS

Review of contract drawings, methods of work, or information regarding materials or equipment the Contractor proposes to provide, shall not relieve the Contractor of his responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the County's Representative or the County, or by any officer or employee thereof, and the Contractor shall have no claim under the contract on account of the failure, or partial failure, of the method of work, material, or equipment so reviewed. A mark of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" shall mean that the County has no objection to the Contractor, upon his own responsibility, using the plan or method of work proposed, or providing the materials or equipment proposed.

1.07 LIST OF SECTIONS REQUIRING SUBMITTALS

The following submittal list is provided as a courtesy to the Contractor and does not relieve the Contractor of analyzing in its entirety the Contract Documents and providing all submittals, shop drawings, product data and all other information specified, inferred or required to meet the intent of the Contract Documents.

1. Section 01014 Sequence of Work
2. Section 01310 Construction Schedule
3. Section 01380 Construction Photographs and Videos
    a. Preconstruction Photographs and Video
4. Section 01560 Environmental Controls
5. Section 01570 Traffic Regulation
6. Section 01590 County's Field Office

7.	Section 01664	Training
8.	Section 01730	Operation and Maintenance Data
9.	Section 01900	Structural Design and Anchorage Requirements for Nonstructural Components and Nonbuilding Structures
10.	Section 02100	Site Preparation
11.	Section 02270	Erosion, Sedimentation, and Dust Control
12.	Section 02444	Fencing
13.	Section 02513	Asphaltic Concrete Pavement
14.	Section 02614	Steel Pipes and Fittings
15.	Section 02615	Ductile Iron Pipe and Fittings
16.	Section 02622	PVC Pipe and Fittings
17.	Section 02640	Valves and Appurtenances
18.	Section 03300	Cast-in-Place Concrete
19.	Section 03410	Structural Precast Concrete
20.	Section 05501	Anchor Bolts
21.	Section 07100	Waterproofing, Dampproofing and Caulking
22.	Section 09900	Coating Systems
23.	Section 11000	General Requirements for Equipment
24.	Section 11002	Rigid Equipment Mounts
25.	Section 11025	Belt Filter Press Refurbishment
26.	Section 11050	General Requirements for Pumping Equipment
27.	Section 11060	Electric Motors
28.	Section 11069	Adjustable Frequency Drives
29.	Section 11350	Dry Polymer Activation System and Appurtenances
30.	Section 11390	Progressive Cavity Pumps

31.	Section 11391	Progressive Cavity Sludge Pumps
32.	Section 11392	Progressive Cavity Dewatered Sludge Pumps
33.	Section 14553	Shaftless Screw Conveyors
34.	Section 15050	Piping Systems
35.	Section 15085	Piping Connections
36.	Section 15094	Pipe Hangers and Supports
37.	Section 15095	Piping Appurtenances
38.	Section 15147	Solenoid Valves
39.	Section 15180	Power Actuated Valve and Gate Schedules
40.	Section 16000	General Requirements for Electrical Work
41.	Section 16176	Local Control Panels
42.	Section 16262	Manual Transfer Switches
43.	Section 16431	Arc Flash Analysis, Short Circuit Study, and Protective Device Coordination Report
44.	Section 17000	General Requirements for Instrumentation and Control
45.	Section 17110	Instrument and Control Panels
46.	Section 17211	Process Taps and Primary Elements
47.	Section 17216	Process Switches
48.	Section 17310	Programmable Logic Controller
49.	Section 17315	Process Control System Development and Programming
50.	Section 17316	Process Control Software System
51.	Section 17318	Industrial Computer Workstations and Displays
52.	Section 17715	Security Surveillance System
53.	Section 17765	Fiber Optic Communication System
54.	Section 17995	Control Strategies

1.08 LIST OF SECTIONS REQUIRING PRODUCT DATA

Reference the individual specification sections.

1.09 COUNTY'S REVIEW OF SHOP DRAWINGS AND WORKING DRAWINGS

A. The County's review of drawings, data and samples submitted by the Contractor shall cover only general conformity to the Specifications, external connections and dimensions which affect the installation.

B. The review of drawings and schedules shall be general and shall not be construed:

1. As permitting any departure from the Contract requirements.
2. As relieving the Contractor of responsibility for any errors, including details, dimensions and materials.
3. As approving departures from details furnished by the County, except as otherwise provided herein.

C. If the drawings or schedules as submitted describe variations and show a departure from the Contract requirements which the County finds to be in the interest of the County and to be so minor as not to involve a change in Contract Price or time for performance, the County may return the reviewed drawings without noting any exception.

D. When reviewed by the County, each of the Shop and Working Drawings shall be identified as having received such review being so stamped and dated. Shop Drawings stamped "REJECTED" and with required corrections shown shall be returned to the Contractor for correction and resubmittal.

E. Resubmittals will be handled in the same manner as first submittals. On resubmittals, the Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, to revisions other than the corrections requested by the County on previous submissions. The Contractor shall make any corrections required by the County.

F. If the Contractor considers any correction indicated on the drawings to constitute a change to the Contract Drawings or Specifications, the Contractor shall give written notice thereof to the County.

G. The County shall review a submittal/resubmittal a maximum of three (3) times after which cost of review shall be borne by the Contractor. The cost of engineering shall be equal to the County's actual payroll cost.

H. When the Shop and Working Drawings have been completed to the satisfaction of the County, the Contractor shall carry out the construction in accordance

therewith and shall make no further changes therein except upon written instructions from the County.

I. No partial submittals shall be reviewed. Incomplete submittals shall be returned to the Contractor and shall be considered not approved until resubmitted.

1.10 SHOP DRAWINGS

A. When used in the Contract Documents, the term "Shop Drawings" shall be considered to mean Contractor's plans for material and equipment which become an integral part of the Project. These drawings shall be complete and detailed. Shop Drawings shall consist of fabrication, drawings, setting drawings, schedule drawings, manufacturer's scale drawings and wiring and control diagrams. Cuts, catalogs, pamphlets, descriptive literature and performance and test data, shall be considered only as supportive to required Shop Drawings as defined above.

B. Drawings and schedules shall be checked and coordinated with the work of all trades involved, before they are submitted for review by the County and shall bear the Contractor's stamp of approval and original signature as evidence of such checking and coordination. Drawings or schedules submitted without this stamp of approval and original signature shall be returned to the Contractor for resubmission.

C. Each Shop Drawing shall have a blank area 3-1/2 inches by 3-1/2 inches, located adjacent to the title block. The title block shall display the following:

1. Number and title of the drawing.
2. Date of Drawing or revision.
3. Name of project building or facility.
4. Name of contractor and subcontractor submitting drawing.
5. Clear identification of contents and location of the work.
6. Specification title and number.

D. If drawings show variations from Contract requirements because of standard shop practice or for other reasons, the Contractor shall describe such variations in his letter of transmittal. If acceptable, proper adjustment in the contract shall be implemented where appropriate. If the Contractor fails to describe such variations, he shall not be relieved of the responsibility of executing the work in accordance with the Contract, even though such drawings have been reviewed.

E. Data on materials and equipment shall include, without limitation, materials and equipment lists, catalog sheets, cuts, performance curves, diagrams, materials of construction and similar descriptive material. Materials and equipment lists shall give, for each item thereon, the name and location of the supplier or manufacturer, trade name, catalog reference, size, finish and all other pertinent data.

F. For all mechanical and electrical equipment furnished, the Contractor shall provide a list including the equipment name and address and telephone number of the manufacturer's representative and service company so that service and/or spare parts can be readily obtained.

G. All manufacturers or equipment suppliers who proposed to furnish equipment or products shall submit an installation list to the County along with the required shop drawings. The installation list shall include at least five installations where identical equipment has been installed and have been in operation for a period of at least one (1) year.

H. Only the County will utilize the color "red" in marking shop drawing submittals.

1.11 WORKING DRAWINGS

A. When used in the Contract Documents, the term "working drawings" shall be considered to mean the Contractor's fabrication and erection drawings for structures such as roof trusses, steelwork, precast concrete elements, bulkheads, support of open cut excavation, support of utilities, groundwater control systems, forming and false work; underpinning; and for such other work as may be required for construction of the project.

B. Copies of working drawings as noted above, shall be submitted to the County where required by the Contract Documents or requested by the County and shall be submitted at least thirty (30) days (unless otherwise specified by the County) in advance of their being required for work.

C. Working drawings shall be signed by a registered Professional Engineer, currently licensed to practice in the State of Florida and shall convey, or be accompanied by, calculation or other sufficient information to completely explain the structure, machine, or system described and its intended manner of use. Prior to commencing such work, working drawings must have been reviewed without specific exceptions by the County, which review will be for general conformance and will not relieve the Contractor in any way from his responsibility with regard to the fulfillment of the terms of the Contract. All risks of error are assumed by the Contractor; the County and Engineer shall not have responsibility therefor.

1.12 SAMPLES

A. The Contractor shall furnish, for the review of the County, samples required by the Contract Documents or requested by the County. Samples shall be delivered to the County as specified or directed. The Contractor shall prepay all shipping charges on samples. Materials or equipment for which samples are required shall not be used in work until reviewed by the County.

B. Samples shall be of sufficient size and quantity to clearly illustrate:

1. Functional characteristics of the product, with integrally related parts and attachment devices.
2. Full range of color, texture and pattern.
3. A minimum of two samples of each item shall be submitted.

C. Each sample shall have a label indicating:

1. Name of product.
2. Name of Contractor and Subcontractor.
3. Material or equipment represented.
4. Place of origin.
5. Name of Producer and Brand (if any).
6. Location in project.
   (Samples of finished materials shall have additional markings that will identify them under the finished schedules.)
7. Reference specification paragraph.

D. The Contractor shall prepare a transmittal letter in triplicate for each shipment of samples containing the information required above. He shall enclose a copy of this letter with the shipment and send a copy of this letter to the County. Review of a sample shall be only for the characteristics or use named in such and shall not be construed to change or modify any Contract requirements.

E. Reviewed samples not destroyed in testing shall be sent to the County or stored at the site of the work. Reviewed samples of the hardware in good condition will be marked for identification and may be used in the work. Materials and equipment incorporated in work shall match the reviewed samples. If requested at the time of submission, samples which failed testing or were rejected shall be returned to the Contractor at his expense.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01310

CONSTRUCTION SCHEDULE & PROJECT RESTRAINTS

PART 1 – GENERAL

1.01 GENERAL

A. Construction under this contract must be coordinated with the County and accomplished in a logical order to maintain utilization and flow through existing facilities and public properties and rights-of-way and to allow construction to be completed within the time allowed by Contract Documents and in the manner set forth in the Contract.

1.02 CONSTRUCTION SCHEDULING GENERAL PROVISIONS

A. No work shall be done between 7:00 p.m. and 7:00 a.m. nor on weekends or legal holidays without written permission of the County. However, emergency work may be done without prior permission.

B. Night work may be established by the Contractor as regular procedure with the written permission of the County. Such permission, however, may be revoked at any time by the County if the Contractor fails to maintain adequate equipment and supervision for the proper execution and control of the work at night.

C. Due to potential health hazards and requirements of the State of Florida and the U.S. Environmental Protection Agency, existing facilities must be maintained in operation.

D. The Contractor shall be fully responsible for providing all temporary piping, plumbing, electrical hook-ups, lighting, temporary structure, or other materials, equipment and systems required to maintain the existing facility's operations. All details of temporary piping and temporary construction are not necessarily shown on the Drawings or covered in the Specifications. However, this does not relieve the Contractor of the responsibility to ensure that construction will not interrupt proper facility operations.

E. The Contractor shall designate an authorized representative of his firm who shall be responsible for development and maintenance of the schedule and of progress and payment reports. This representative of the Contractor shall have direct project control and complete authority to act on behalf of the Contractor in fulfilling the commitments of the Contractor's schedule.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS

A. The Contractor shall submit a critical path schedule as described herein.

B. The planning, scheduling, management and execution of the work is the sole responsibility of the Contractor. The progress schedule requirement is established to allow County to review Contractor's planning, scheduling, management and execution of the work; to assist County in evaluating work progress and make progress payments and to allow other contractors to cooperate and coordinate their activities with those of the Contractor.

2.02 FORM OF SCHEDULES

A. Prepare schedules using the latest version of Microsoft Project, or other County approved software, in the form of a horizontal bar chart diagram. The diagram shall be time-scaled and sequenced by work areas. Horizontal time scale shall identify the first work day of each week.

B. Activities shall be at least as detailed as the Schedule of Values. Activity durations shall be in whole working days. In addition, man-days shall be shown for each activity or tabulated in an accompanying report.

C. Diagrams shall be neat and legible and submitted on sheets at least 8-1/2 inches by 11 inches suitable for reproduction. Scale and spacing shall allow space for notations and future revisions.

2.03 CONTENT OF SCHEDULES

A. Each monthly schedule shall be based on data as of the last day of the current pay period.

B. Description for each activity shall be brief but convey the scope of work described.

C. Activities shall identify all items of work that must be accomplished to achieve substantial completion, such as items pertaining to Contractor's installation and testing activities; items pertaining to the approval of regulatory agencies; contractor's time required for submittals, fabrication and deliveries; the time required by County to review all submittals as set forth in the Contract Documents; items of work required of County to support pre-operational, startup and final testing; time required for the relocation of utilities. Activities shall also identify interface milestones with the work of other contractors performing work under separate contracts with County.

D. Schedules shall show the complete sequence of construction by activities. Dates for beginning and completion of each activity shall be indicated as well as projected percentage of completion for each activity as of the first day of each month.

E. Submittal schedule for shop drawing review, product data, and samples shall show the date of Contractor submittal and the date approved submittals will be required by the County, consistent with the time frames established in the Specifications.

F. For Contract change orders granting time extensions, the impact on the Contract date(s) shall equal the calendar-day total time extension specified for the applicable work in the Contract change orders.

G. For actual delays, add activities prior to each delayed activity on the appropriate critical path(s). Data on the added activities of this type shall portray all steps leading to the delay and shall further include the following: separate activity identification, activity description indicating cause of the delay, activity duration consistent with whichever set of dates below applies, the actual start and finish dates of the delay or, if the delay is not finished, the actual start date and estimated completion date.

H. For potential delays, add an activity prior to each potentially delayed activity on the appropriate critical path(s). Data for added activities of this type shall include alternatives available to mitigate the delay including acceleration alternatives and further show the following: separate activity identification, activity description indicating cause of the potential delay and activity duration equal to zero work days.

2.04 SUPPORTING NARRATIVE

A. Status and scheduling reports identified below shall contain a narrative to document the project status, to explain the basis of Contractor's determination of durations, describe the Contract conditions and restraints incorporated into the schedule and provide an analysis pertaining to potential problems and practical steps to mitigate them.

B. The narrative shall specifically include:

1. Actual completion dates for activities completed during the monthly report period and actual start
   dates for activities commenced during the monthly report period.
2. Anticipated start dates for activities scheduled to commence during the following monthly report period.

3. Changes in the duration of any activity and minor logic changes.
4. The progress along the critical path in terms of days ahead or behind the Contract date.
5. If the Monthly Status Report indicates an avoidable delay to the Contract completion date or interim completion dates as specified in the Agreement, Contractor shall identify the problem, cause and the activities affected and provide an explanation of the proposed corrective action to meet the milestone dates involved or to mitigate further delays.
6. If the delay is thought to be unavoidable, the Contractor shall identify the problem, cause, duration, specific activities affected and restraints of each activity.
7. The narrative shall also discuss all change order activities whether included or not in the revised/current schedule of legal status. Newly introduced change order work activities and the CPM path(s) that they affect, must be specifically identified. All change order work activities added to the schedule shall conform with the sequencing and Contract Time requirements of the applicable Change Order.
8. Original Contract date(s) shall not be changed except by Contract change order. A revision need not be submitted when the foregoing situations arise unless required by County. Review of a report containing added activities will not be construed to be concurrence with the duration or restraints for such added activities; instead the corresponding data as ultimately incorporated into the applicable Contract change order shall govern.
9. Should County require additional data, this information shall be supplied by Contractor within 10 calendar days.

2.05 SUBMITTALS

A. Contractor shall submit estimated and preliminary progress schedules (as identified in the Terms and Conditions of the Contract and the General Conditions), monthly status reports, a start-up schedule and an as-built schedule report all as specified herein.

B. All schedules, including estimated and preliminary schedules, shall be in conformance with the Contract Documents.

C. The finalized progress schedule discussed in the Contract Documents shall be the first monthly status report and as such shall be in conformance with all applicable specifications contained herein.

D. Monthly Status Report submittals shall include a time-scaled (days after notice to proceed) diagram showing all contract activities and supporting narrative. The initial detailed schedule shall use the notice to proceed as the start date. The finalized schedule, if concurred with by County, shall be the work plan to be used

by the contractor for planning, scheduling, managing and executing the work.

E. The schedule diagram shall be formatted as above. The diagram shall include (1) all detailed activities included in the preliminary and estimated schedule submittals, (2) calendar days prior to substantial completion, (3) summary activities for the remaining days. The critical path activities shall be identified, including critical paths for interim dates, if possible.

F. The Contractor shall submit progress schedules with each application for payment.

2.06 MONTHLY STATUS REPORTS

A. Contractor shall submit detailed schedule status reports on a monthly basis with the Application for Payment. The first such status report shall be submitted with the first Application for Payment and include data as of the last day of the pay period. The Monthly Report shall include a "marked-up" copy of the latest detailed schedule of legal status and a supporting narrative including updated information as described above. The Monthly Report will be reviewed by County and Contractor at a monthly schedule meeting and Contractor will address County's comments on the subsequent monthly report. Monthly status reports shall be the basis for evaluating Contractor's progress.

B. The "marked-up" diagram shall show, for the latest detailed schedule of legal status, percentages of completion for all activities, actual start and finish dates and remaining durations, as appropriate. Activities not previously included in the latest detailed schedule of legal status shall be added, except that contractual dates will not be changed except by change order. Review of a marked-up diagram by County will not be construed to constitute concurrence with the time frames, duration, or sequencing for such added activities; instead the corresponding data as ultimately incorporated into an appropriate change order shall govern.

2.07 STARTUP SCHEDULE

A. At least 60 calendar days prior to the date of substantial completion, Contractor shall submit a time-scaled (days after notice to proceed) diagram detailing the work to take place in the period between 60 days prior to substantial completion, together with a supporting narrative. County shall have 10 calendar days after receipt of the submittal to respond. Upon receipt of County's comments, Contractor shall make the necessary revisions and submit the revised schedule within 10 calendar days. The resubmittal, if concurred with by County, shall be the Work Plan to be used by Contractor for planning, managing, scheduling and executing the remaining work leading to substantial completion.

B. The time-scaled diagram shall use the latest schedule of legal status for those

activities completed ahead of the last 60 calendar days prior to substantial completion and detailed activities for the remaining 60-day period within the time frames outlined in the latest schedule of legal status.

C. Contractor will be required to continue the requirement for monthly reports, as outlined above. In preparing this report, Contractor must assure that the schedule is consistent with the progress noted in the startup schedule.

2.08 REVISIONS

A. All revised Schedule Submittals shall be made in the same form and detail as the initial submittal and shall be accompanied by an explanation of the reasons for such revisions, all of which shall be subject to review and concurrence by County. The revision shall incorporate all previously made changes to reflect current as-built conditions. Minor changes to the approved submittal may be approved at monthly meetings; a minor change is not considered a revision in the context of this paragraph.

B. A revised schedule submittal shall be submitted for review when required by County.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01370

SCHEDULE OF VALUES

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

A. The Contractor shall submit to the County a Schedule of Values allocated to the various portions of the work, within 10 days after date of Notice to Proceed.

B. Upon request of the County, the Contractor shall support the values with data which will substantiate their correctness.

C. The Schedule of Values shall be used only as the basis for the Contractor's Applications for Payment.

1.02 FORM AND CONTENT OF SCHEDULE OF VALUES

A. Schedule of Values will be considered for approval by County upon Contractor's request. Identify schedule with:

1. Title of Project and location.
2. Project number.
3. Name and address of Contractor.
4. Contract designation.
5. Date of submission.

B. Schedule of Values shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction.

C. Follow the table of contents for the Contract Document as the format for listing component items for structures:

1. Identify each line item with the number and title of the respective major section of the specification.
2. For each line item, list sub values of major products or operations under item.

D. Follow the bid sheets included in this Contract Documents as the format for listing component items for pipe lines.

E. The sum of all values listed in the schedule shall equal the total Contract sum.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01380

CONSTRUCTION PHOTOGRAPHS AND VIDEOS

PART 1 – GENERAL

1.01 REQUIRMENTS INCLUDED

A. The Contractor shall employ a competent photographer to take construction record photographs or perform video, recording including furnishing all labor, materials, equipment and incidentals necessary to obtain photographs and/or video recordings of all construction areas.

B. Preconstruction record information shall consist of video recordings on digital video disks (DVD).

C. Construction progress information shall consist of photographs and digital photographs on a USB flash drive.

1.02 QUALIFICATIONS

A. All photography shall be done by a competent camera operator who is fully experienced and qualified with the specified equipment.

B. For the video recording, the audio portion should be done by a person qualified and knowledgeable in the specifics of the Contract, who shall speak with clarity and diction to be easily understood.

1.03 PROJECT PHOTOGRAPHS

A. Provide one print of each photograph with each pay application.

B. Provide one USB flash drive with digital photographs with each pay application.

C. Negatives:
   1. The Contractor shall require that photographer maintain protected digital files for a period of two years from date of substantial completion of the project.
   2. Photographer shall agree to furnish additional prints to County at commercial rates applicable at time of purchase. Photographer shall also agree to participate as required in any litigation requiring the photographer as an expert witness.

D. The Contractor shall pay all costs associated with the required photography and prints. Any parties requiring additional photography or prints shall pay the

photographer directly.

E. All project photographs shall be a single weight, color image. All finishes shall be smooth surface and glossy and all prints shall be 8 inches x 10 inches.

F. Each print shall have clearly marked on the back, the name of the project, the orientation of view, the date and time of exposure, name and address of the photographer and the photographers numbered identification of exposure.

G. All project photographs shall be taken from locations to adequately illustrate conditions prior to construction, or conditions of construction and state of progress. The Contractor shall consult with the County at each period of photography for instructions concerning views required.

1.04 VIDEO RECORDINGS

A. Video, recording shall be done along all routes that are scheduled for construction. Video, recording shall include full, recording of both sides of all streets and the entire width of easements plus 10 feet on each side on which construction is to be performed. All video recording shall be in full color.

B. A complete view, in sufficient detail with audio description of the exact location shall be provided.

C. The engineering plans shall be used as a reference for stationing in the audio portion of the recordings for easy location identification.

D. Two complete sets of video recordings shall be delivered to the County on digital video disks (DVD) for the permanent and exclusive use of the County prior to the start of any construction on the project.

E. All video recordings shall contain the name of the project, the date and time of the video, recording, the name and address of the photographer and any other identifying information required.

F. Construction shall not start until preconstruction video recordings are completed, submitted and accepted by the County. In addition, no progress payments shall be made until the preconstruction video recordings are accepted by the County.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01410

TESTING AND TESTING LABORATORY SERVICES

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

A. County shall employ and pay for the services of an independent testing laboratory to perform testing specifically indicated on the Contract Documents or called out in the Specifications. County may elect to have materials and equipment tested for conformity with the Contract Documents at any time.

1. Contractor shall cooperate fully with the laboratory to facilitate the execution of its required services.
2. Employment of the laboratory shall in no way relieve the Contractor's obligations to perform the work of the Contract.

1.02 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

A. Laboratory is not authorized to:

1. Release, revoke, alter or enlarge on requirements of Contract Documents.
2. Approve or accept any portion of the Work.
3. Perform any duties of the Contractor.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel; provide access to Work and/or to Manufacturer's operations.

B. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.

C. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other material mixes which require control by the testing laboratory.

D. Materials and equipment used in the performance of work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. Standard specifications for quality and workmanship are indicated in the Contract Documents. The County may require the Contractor to provide statements or certificates from the manufacturers and fabricators that the materials and equipment provided by them are manufactured or fabricated in full accordance with the standard specifications for quality and workmanship indicated in the

Contract Documents. All costs of this testing and providing statements and certificates shall be a subsidiary obligation of the Contractor and no extra charge to the County shall be allowed on account of such testing and certification.

E. Furnish incidental labor and facilities:

1. To provide access to work to be tested.
2. To obtain and handle samples at the project site or at the source of the product to be tested.
3. To facilitate inspections and tests.
4. For storage and curing of test samples.

F. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.

1. When tests or inspections cannot be performed due to insufficient notice, Contractor shall reimburse County for laboratory personnel and travel expenses incurred due to Contractor's negligence.

G. Employ and pay for the services of the same or a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required for the Contractor's convenience and as approved by the County.

H. If the test results indicate the material or equipment complies with the Contract Documents, the County shall pay for the cost of the testing laboratory. If the tests and any subsequent retests indicate the materials and equipment fail to meet the requirements of the Contract Documents, the contractor shall pay for the laboratory costs directly to the testing firm or the total of such costs shall be deducted from any payments due the Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

**END OF SECTION*

SECTION 01510

TEMPORARY AND PERMANENT UTILITIES

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

A. The Contractor shall be responsible for furnishing all requisite temporary utilities, i.e., power, water, sanitation, etc. The Contractor shall obtain and pay for all permits required as well as pay for all temporary usages. The Contractor shall remove all temporary facilities upon completion of work.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

A. Comply with National Electric Code.

B. Comply with Federal, State and Local codes and regulations and with utility company requirements.

C. Comply with County Health Department regulations.

PART 2 – PRODUCTS

2.01 MATERIALS, GENERAL

A. Materials for temporary utilities may be "used". Materials for electrical utilities shall be adequate in capacity for the required usage, shall not create unsafe conditions and shall not violate requirements of applicable codes and standards.

2.02 TEMPORARY ELECTRICITY AND LIGHTING

A. Arrange with the applicable utility company for temporary power supply. Provide service required for temporary power and lighting and pay all costs for permits, service and for power used.

2.03 TEMPORARY WATER

A. The Contractor shall arrange with Manatee County Utilities Customer Service office to provide water for construction purposes, i.e., meter, pay all costs for installation, maintenance and removal, and service charges for water used.

B. The Contractor shall protect piping and fitting against freezing.

2.04 TEMPORARY SANITARY FACILITIES

A. The Contractor shall provide sanitary facilities in compliance with all laws and regulations.

B. The Contractor shall service, clean and maintain facilities and enclosures.

PART 3 – EXECUTION

3.01 GENERAL

A. The Contractor shall maintain and operate systems to assure continuous service.

B. The Contractor shall modify and extend systems as work progress requires.

3.02 REMOVAL

A. The Contractor shall completely remove temporary materials and equipment when their use is no longer required.

B. The Contractor shall clean, and repair damage caused by temporary installations or use of temporary facilities.

END OF SECTION

SECTION 01530

PROTECTION OF EXISTING FACILITIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Contractor shall be responsible for the preservation and protection of property adjacent to the work site against damage or injury as a result of their operations under this Contract. Any damage or injury occurring on account of any act, omission or neglect on the part of the Contractor shall be restored in a proper and satisfactory manner or replaced by and at the expense of the Contractor to an equal or superior condition than previously existed.

B. Contractor shall comply promptly with such safety regulations as may be prescribed by the County or the local authorities having jurisdiction and shall, when so directed, properly correct any unsafe conditions created by, or unsafe practices on the part of, his employees. In the event of the Contractor's failure to comply, the County may take the necessary measures to correct the conditions or practices complained of, and all costs thereof will be deducted from any monies due the Contractor. Failure of the County to direct the correction of unsafe conditions or practices shall not relieve the Contractor of their responsibility hereunder.

C. In the event of any claims for damage or alleged damage to property as a result of work under this Contract, the Contractor shall be responsible for all costs in connection with the settlement of or defense against such claims. Prior to commencement of work in the vicinity of property adjacent to the work site, the Contractor, at their own expense, shall take such surveys as may be necessary to establish the existing condition of the property. Before final payment can be made, the Contractor shall furnish satisfactory evidence that all claims for damage have been legally settled or sufficient funds to cover such claims have been placed in escrow, or that an adequate bond to cover such claims has been obtained.

1.02 PROTECTION OF WORK AND MATERIAL

A. During the progress of the work and up to the date of final payment, the Contractor shall be solely responsible for the care and protection of all work and materials covered by the Contract.

B. All work and materials shall be protected against damage, injury or loss from any cause whatsoever, and the Contractor shall make good any such damage or loss at

his own expense. Protection measures shall be subject to the approval of the County.

1.03 BARRICADES, WARNING SIGNS AND LIGHTS

A. The Contractor shall provide, erect and maintain as necessary, strong and suitable barricades, danger signs and warning lights along all roads accessible to the public, as required by the authority having jurisdiction, to insure safety to the public. All barricades and obstructions along public roads shall be illuminated at night and all lights for this purpose shall be kept burning from sunset to sunrise.

B. The Contractor shall provide and maintain such other warning signs and barricades in areas of and around their respective work as may be required for the safety of all those employed in the work, the County's operating personnel, or those visiting the site.

C. In the case of a conflict between this Specification Section and the Contractor's Safety Plan, the more stringent requirement of the two documents shall govern.

1.04 EXISTING UTILITIES AND STRUCTURES

A. The term existing utilities shall be deemed to refer to both publicly-owned and privately-owned utilities such as electric power and lighting, telephone, water, gas, storm drains, process lines, sanitary sewers and all appurtenant structures.

B. Where existing utilities and structures are indicated on the Drawings, it shall be understood that all of the existing utilities and structures affecting the work may not be shown and that the locations of those shown are approximate only. It shall be the responsibility of the Contractor to ascertain the actual extent and exact location of existing utilities and structures. In every instance, the Contractor shall notify the proper authority having jurisdiction and obtain all necessary directions and approvals before performing any work in the vicinity of existing utilities.

C. Prior to beginning any excavation work, the Contractor shall, through field investigations, determine any conflicts or interferences between existing utilities and new utilities to be constructed under this project. This determination shall be based on the actual locations, elevations, slopes, etc., of existing utilities as determined in the field investigations, and locations, elevation, slope, etc. of new utilities as shown on the Drawings. If an interference exists, the Contractor shall bring it to the attention of the County as soon as possible. If the County agrees that an interference exists, they shall modify the design as required. Additional costs to the Contractor for this change shall be processed through a Change Order as detailed elsewhere in these Contract Documents.

D. The work shall be carried out in a manner to prevent disruption of existing services and to avoid damage to the existing utilities. Temporary connections

shall be provided, as required, to insure uninterruption of existing services. Any damage resulting from the work of this Contract shall be promptly repaired by the Contractor at their own expense in a manner satisfactory to the County or the respective authority having jurisdiction over such work. Where it is required by the authority having jurisdiction that they perform their own repairs or have them done by others, the Contractor shall be responsible for all costs thereof.

E. Where excavations by the Contractor require any utility lines or appurtenant structures to be temporarily supported and otherwise protected during the construction work, such support and protection shall be provided by the Contractor. All such work shall be performed in a manner satisfactory to the County or the respective authority having jurisdiction over such work. In the event the Contractor fails to provide proper support or protection to any existing utility, the County may, at his discretion, have the respective authority to provide such support or protection as may be necessary to insure the safety of such utility, and the costs of such measures shall be paid by the Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01560

ENVIRONMENTAL CONTROLS

PART 1 – GENERAL

1.01 SITE MAINTENANCE

The Contractor shall keep the work site clean and free from rubbish and debris. Materials and equipment shall be removed from the site when they are no longer necessary. Upon completion of the work and before final acceptance, the work site shall be cleared of equipment, unused materials, and rubbish to present a clean and neat appearance.

1.02 TEMPORARY DAMS

Except in time of emergency, earth dams are not acceptable at catch basin openings, local depressions, or elsewhere. Temporary dams of sand bags, asphaltic concrete, or other acceptable material will be permitted to protect the work, provided their use does not create a hazard or nuisance to the public. Such dams shall be removed from the site as soon as they are no longer necessary.

Temporary waterlight leak containment filters shall be provided by the contractor for chemical, fuel, manual storage, etc. Temporary facilities shall be removed and properly disposed of after construction is completed.

1.03 TEMPORARY DRAINAGE

The Contractor shall control and eliminate the sources of pollutants in stormwater through the development and implementation of a Stormwater Management Plan (SWMP) as required and in accordance with local regulations. The Contractor shall provide the SWMP to the Engineer at least three weeks prior to ground disturbance. The SWMP must detail Best Management Practices (BMPs) that will be implemented during construction, which may include enlarging or supplementing existing stormwater facilities and temporary controls that will protect receiving waters and adjacent properties. BMPs should focus on reducing the source of sediment but may also include sediment removal controls. Existing stormwater facilities shall be protected during construction and all temporary BMPs shall be removed once the site is stabilized. Contractor shall perform inspections as required by the local regulations. Contractor shall keep the SWMP and inspection records on site (in the construction office trailer) at all times.

1.04 AIR POLLUTION CONTROL

The Contractor shall not discharge smoke, dust, and other contaminants into the atmosphere that violate the regulations of any legally constituted authority. He shall also abate dust

nuisance by cleaning, sweeping, and sprinkling with water, or other means as necessary. The use of water, in amounts which result in mud on public streets, is not acceptable as a substitute for sweeping or other methods.

1.05 NOISE CONTROL

Between 7:30 p.m. and 7:00 a.m., noise from Contractor's operations shall not exceed limits established by applicable laws unless a variance is accepted.

1.06 GROUND AND GROUNDWATER CONTAMINATION

The Contractor shall comply with all federal, state and local laws and regulations which apply to water pollution and soil contamination.

In order to minimize the possibility of water or soil contamination due to spills of crankcase oil, gasoline and other fuels, the Contractor shall designate an area for the storage and handling of lubricants, fuels and other supplies which is acceptable to the Engineer. The Contractor shall comply with all applicable federal, state and local rules and regulations related to the storage of fuels and chemicals and the reporting and cleanup of spills.

1.07 FLUORESCENT LIGHT BULBS, HIGH INTENSITY DISCHARGE BULBS AND BALLASTS

Disturbing, removing, replacing, and disposal of fluorescent or High Intensity discharge (HID) lamps or ballasts is authorized under the scope of this project provided the Contractor complies with requirements outlined within this paragraph.

A. FLUORESCENT LIGHT BALLASTS

Fluorescent light ballasts manufactured after 1979 that do not contain PCBs are marked by the manufacturer with the words “No PCBs”. If a fluorescent light ballast is not marked with the words “No PCBs” it shall be considered to contain PCBs.

Non-PCB ballasts shall be recycled by the contractor. The Contractor shall provide containers for the collection of these ballasts, and the Contractor shall carefully place all ballasts in these containers and close the lid securely. The labels on the containers shall be left intact, unmarked, uncovered, and otherwise completely legible. The labels shall state “Universal Waste Ballasts.”

PCB-containing fluorescent light ballasts that are intact and non-leaking shall be recycled by the Contractor. The Contractor shall provide containers for the collection of these recyclable materials. The Contractor shall carefully place these ballasts into the containers provided and shall tightly close the container when it is full. The labels on the containers shall be left intact, unmarked,

uncovered, and otherwise completely legible. The labels shall state "Universal Waste Ballasts-PCBs." The Contractor shall manage these materials as if these materials were hazardous waste.

PCB-containing light ballasts that were not previously identified as leaking but are discovered by the Contractor to be leaking prior to removal from fixtures shall cause the Contractor to stop work on the site and immediately notify the Engineer or the County.

PCB-containing fluorescent light ballasts that have been damaged by the Contractor (made to leak) shall cause the Contractor to stop work on the site immediately and notify the Engineer. The Contractor shall carefully place the damaged ballasts into steel UN stamped drums approved by DOT for shipping Hazardous Waste and shall securely close the lids. The ballasts shall then be transported off site by the Contractor and incinerated at an offsite facility by the Contractor in accordance with 40 CFR 761.75.

B. FLUORESCENT LIGHT TUBES AND HIGH INTENSITY DISCHARGE (HID) LAMPS

All fluorescent tubes and HID lamps that are removed as part of this work shall be removed intact and recycled by the Contractor to be handled as "universal waste lamps." The Contractor shall provide containers for the collection of these recyclable materials. The Contractor will carefully place all light tubes and/or lamps in these containers, keep the lid securely closed at all times, and protect the containers from precipitation. Containers shall be labeled in accordance with State Universal Waste requirements for storage and shipping. The labels shall state "Universal Waste Fluorescent Lamps" or "Universal Waste HID Lamps." These two materials must be collected separately.

It is imperative that the Contractor does not discard fluorescent light tubes or HID lamps on site in dumpsters or other debris collection containers and shall take appropriate actions to manage them properly.

C. POLYCHLORINATED BIPHENYLS (PCBs)

If the Contractor believes they have discovered a PCB containing item not specified in the contract or Phase II ESA during the execution of work, the Contractor shall stop work on the site immediately and notify the Engineer. The Contractor shall not use or install any equipment containing PCBs on the plant.

1.08 ILLEGAL DISCHARGE

At no time shall the Contractor release or dump solvents, paints, gasoline or other fuels or oils into any portion of the plants sewers or process facilities.

1.09 HAZARDOUS WASTES

The Contractor shall comply with all federal, state, and local laws and regulations which apply to the removal and disposal of any and all hazardous wastes encountered during demo of old structures, utilities, and materials required by this project.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

**END OF SECTION*

SECTION 01570

TRAFFIC REGULATION

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

A. The Contractor shall be responsible for providing safe and expeditious movement of traffic through construction zones. A construction zone is defined as the immediate areas of actual construction and all abutting areas which are used by the Contractor and which interfere with the driving or walking public.

B. The Contractor shall remove temporary equipment and facilities when no longer required, restore grounds to original or to specified conditions.

1.02 TRAFFIC CONTROL

A. The necessary traffic control shall include, but not be limited to, such items as proper construction warning signs, signals, lighting devices, markings, barricades, channelization and hand signaling devices. The Contractor shall be responsible for installation and maintenance of all devices and detour routes and signage for the duration of the construction period. The Contractor shall utilize the appropriate traffic plan from the FDOT Maintenance of Traffic Standards, Series 600 of the FDOT Roadway & Traffic Design Standards, Latest Edition.

B. Should there be the necessity to close any portion of a roadway carrying vehicles or pedestrians the Contractor shall submit a Traffic Control Plan (TCP) at least 5 days before a partial or full day closure, and at least 8 days before a multi-day closure. TCP shall be submitted, along with a copy of their accreditation, by a certified IMSA or ATSA Traffic Control Specialist.

1. At no time will more than one (1) lane of a roadway be closed to vehicles and pedestrians without an approved road closure from the County Transportation Department. With any such closings, adequate provision shall be made for the safe expeditious movement of each.
2. All traffic control signs must be in place and inspected at least 1 day in advance of the closure. Multi-day closures notification signs shall be in place at least 3 days in advance of the closure. All signs must be covered when no in effect and checked twice a day by the Worksite Traffic Supervisor when they are in effect.

C. The Contractor shall be responsible for removal, relocation, or replacement of any traffic control device in the construction area which exists as part of the normal

preconstruction traffic control scheme. Any such actions shall be performed by the Contractor under the supervision and in accordance with the instructions of the applicable highway department unless otherwise specified.

D. The Contractor will consult with the County immediately on any vehicular or pedestrian safety or efficiency problem incurred as a result of construction of the project.

E. The Contractor shall provide ready access to businesses and homes in the project area during construction. The Contractor shall be responsible for coordinating this work with affected homeowners.

F. When conditions require the temporary installation of signs, pavement markings and traffic barriers for the protection or workers and traffic, the entire array of such devices shall be depicted on working drawings for each separate stage of work. These drawings shall be submitted to the County for review and approval prior to commencement of work on the site.

G. Precast concrete traffic barriers shall be placed adjacent to trenches and other excavations deeper than six inches below the adjacent pavement surface.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

**END OF SECTION*

SECTION 01580

PROJECT IDENTIFICATION AND SIGNS

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

A. Furnish, install and maintain County project identification signs.

B. Remove signs on completion of construction.

C. Allow no other signs to be displayed except for traffic control and safety.

1.02 PROJECT IDENTIFICATION SIGN (COUNTY)

A. Two painted signs, of not less than 32 square feet (3 square meters) area, with painted graphic content to include:

1. Title of Project.
2. Name of County.
3. Names and titles of authorities as directed by County.
4. Prime Contractor.

B. Graphic design, style of lettering and colors: As approved by the County.

C. Erect on the site at a lighted location of high public visibility, adjacent to main entrance to site, as approved by the County

1.03 INFORMATIONAL SIGNS

A. Painted signs with painted lettering, or standard products.

1. Size of signs and lettering: as required by regulatory agencies, or as appropriate to usage.
2. Colors: as required by regulatory agencies, otherwise of uniform colors throughout project.

B. Erect at appropriate locations to provide required information.

1.04 QUALITY ASSURANCE

A. Sign Painter: Professional experience in type of work required.

B. Finishes, Painting: Adequate to resist weathering and fading for scheduled construction period.

1.05 PUBLIC NOTIFICATION

A. Door Hangers: The Contractor shall generate and distribute door hangers to all residents who will be impacted by project construction.

1. Residents impacted include anyone who resides inside, or within 500 feet of project limits of construction.

B. Door Hangers shall be distributed prior to start of construction of the project. Hangers shall be affixed to doors of residents via elastic bands or tape.

EXAMPLE:

PLEASE PARDON THE INCONVENIENCE WHILE THE ROADWAY IS BEING RECONSTRUCTED IN YOUR NEIGHBORHOOD

This project consists of belt filter press facility improvements. The project is expected to begin in Fall 2019 and be completed in Winter 2020.

Location Map

WE HOPE TO KEEP ANY INCONVENIENCE TO A MINIMUM.
HOWEVER, IF YOU HAVE ANY PROBLEMS, PLEASE CONTACT THE FOLLOWING:

A. Contractor
Contractor Address
Contractor Phone (Site Phone)

Project Manager
PM Address
PM Phone No. & Ext.

B. Project Inspector
Inspector Phone Number

AFTER HOURS EMERGENCY NUMBER – (941) 747-HELP
THANK YOU FOR YOUR UNDERSTANDING AND PATIENCE
MANATEE COUNTY GOVERNMENT – PROJECT MANAGEMENT DEPT.

PART 2 – PRODUCTS

2.01 SIGN MATERIALS

A. Structure and Framing: May be new or used, wood or metal, in sound condition structurally adequate to work and suitable for specified finish.

B. Sign Surfaces: Exterior softwood plywood with medium density overlay, standard large sizes to minimize joints.

1. Thickness: As required by standards to span framing members, to provide even, smooth surface without waves or buckles.

C. Rough Hardware: Galvanized.

D. Paint: Exterior quality, as specified in the Contract Documents.

PART 3 – EXECUTION

3.01 PROJECT IDENTIFICATION SIGN

A. Paint exposed surface or supports, framing and surface material; one coat of primer and one coat of exterior paint.

B. Paint graphics in styles, size and colors selected.

3.02 MAINTENANCE

The Contractor shall maintain signs and supports in a neat, clean condition; repair damages to structures, framing or sign.

3.03 REMOVAL

The Contractor shall remove signs, framing, supports and foundations at completion of project.

END OF SECTION

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SECTION 01590

COUNTY'S FIELD OFFICE

PART 1 – GENERAL

1.01 REQUIRMENTS

Contractor shall furnish, install and maintain one temporary field office during the entire construction period for the sole use of the County.

1.02 OTHER REQUIRMENTS

A. Prior to installation of the County's field office, the Contractor shall consult with the County on location, access and related facilities.

B. All site use approvals shall be obtained by the Contractor.

C. Upon completion of construction. The Contractor shall remove the field office and restore the site to its original condition.

1.03 REQUIREMENTS FOR FACILITIES

A. Construction:
   1. The field office shall be structurally sound, weather tight, with floors raised aboveground.
   2. At Contractor's option, portable or mobile buildings may be used.

B. Office for Field Engineer:
   1. A separate office for sole use of the County with secure entrance doors, key and lock shall be provided.
   2. Area: 250 sq. ft. minimum, with minimum dimension of 8 feet.
   3. Windows:
      a. Minimum of three (3).
      b. Operable sash and insect screens.
      c. Locate field office to provide maximum view of construction areas.
   4. Furnishings:
      a. Two standard size chairs and desks with three drawers each.
      b. One drafting table: 39"x72"x36" high, with one equipment drawer.
      c. One metal, double-door storage cabinet with lock and key.
      d. One plan rack to hold a minimum of six sets of project drawings.
      e. One standard four-drawer legal-size metal filing cabinet w/ lock and key.
      f. Six linear feet of bookshelves.

g. One swivel arm chair.
h. Two straight chairs.
i. One drafting table stool.
j. One waste basket.
k. One tackboard, 36"x30".
l. One fire extinguisher.
m. One first aid kit.

5. Services:
   a. Adequate lighting.
   b. Exterior lighting at entrance door.
   c. Automatic heating and mechanical cooling equipment to maintain comfort conditions.
   d. Minimum of four 110-volt duplex electric convenience outlets, at least one on each wall.
   e. Electric distribution panel: Two circuits minimum 110-volt, 60 hertz service.
   f. Convenient access to drinking water and toilet facilities.
   g. Telephone: One private direct line instrument.
   h. Fax: combination fax/duplicator.

PART 2 – PRODUCTS

2.01 MATERIALS, EQUITMENT, FURNISHINGS

May be new or used, but must be serviceable, adequate for required purpose and must adhere to all applicable codes or regulations including the Manatee County Building Codes.

PART 3 – EXECUTION

3.01 PREPARATION

Fill and grade site as necessary for temporary structure to provide positive surface drainage.

3.02 INSTALLATION

A. Construct temporary field office on proper foundation and provide connections for all utility services.
   1. Secure portable or mobile building when used.
   2. Provide steps and landings shall be provided at entrance doors.

END OF SECTION

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

A. Material and equipment incorporated into the work:

1. Conform to applicable specifications and standards.
2. Comply with size, make, type and quality specified, or as specifically approved in writing by the County.
3. Manufactured and Fabricated Products:
    a. Design, fabricate and assemble in accordance with the best engineering and shop practices.
    b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.
    c. Two or more items of the same kind shall be identical and manufactured by the same manufacturer.
    d. Products shall be suitable for service conditions.
    e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
4. Do not use material or equipment for any purpose other than that for which it is specified.
5. All material and equipment incorporated into the project shall be new.

1.02 MANUFACTURER'S INSTRUCTIONS

A. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to County. Maintain one set of complete instructions at the job site during installation and until completion.

B. Handle, install, connect, clean, condition and adjust products in strict accordance with such instructions and in conformity with specified requirements. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with County prior to proceeding. Do not proceed with work without clear instructions.

1.03 TRANSPORTATION AND HANDLING

A. Arrange deliveries of products in accordance with construction schedules,

coordinate to avoid conflict with work and conditions at the site.

1. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
2. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals and that products are properly protected and undamaged.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

1.04 SUBSTITUTIONS AND PRODUCT OPTIONS

Contractor's Options:

1. For products specified only by reference standard, select any product meeting that standard.
2. For products specified by naming one or more products or manufacturers and "or equal", Contractor must submit a request for substitutions of any product or manufacturer not specifically named in a timely manner so as not to adversely affect the construction schedule.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01620

STORAGE AND PROTECTION

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

Provide secure storage and protection for products to be incorporated into the work and maintenance and protection for products after installation and until completion of Work.

1.02 STORAGE

A. Store products immediately on delivery and protect until installed in the Work, in accord with manufacturer's instructions, with seals and labels intact and legible.

B. Exterior Storage

1. Provide substantial platform, blocking or skids to support fabricated products above ground to prevent soiling or staining.

a. Cover products, subject to discoloration or deterioration from exposure to the elements, with impervious sheet coverings. Provide adequate ventilation to avoid condensation.

b. Prevent mixing of refuse or chemically injurious materials or liquids.

C. Arrange storage in manner to provide easy access for inspection.

1.03 MAINTENANCE OF STORAGE

A. Maintain periodic system of inspection of stored products on scheduled basis to assure that:

1. State of storage facilities is adequate to provide required conditions.
2. Required environmental conditions are maintained on continuing basis.
3. Surfaces of products exposed to elements are not adversely affected. Any weathering of products, coatings and finishes is not acceptable under requirements of these Contract Documents.

B. Mechanical and electrical equipment which requires servicing during long term storage shall have complete manufacturer's instructions for servicing accompanying each item, with notice of enclosed instructions shown on exterior of package.

1. Equipment shall not be shipped until approved by the County. The intent of this requirement is to reduce on-site storage time prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the County.
2. All equipment having moving parts such as gears, electric motors, etc. and/or instruments shall be stored in a temperature and humidity-controlled building approved by the County until such time as the equipment is to be installed.
3. All equipment shall be stored fully lubricated with oil, grease, etc. unless otherwise instructed by the manufacturer.
4. Moving parts shall be rotated a minimum of once weekly to insure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
5. Lubricants shall be changed upon completion of installation and as frequently as required, thereafter during the period between installation and acceptance.
6. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

1.04 PROTECTION AFTER INSTALLATION

A. Provide protection of installed products to prevent damage from subsequent operations. Remove when no longer needed, prior to completion of work.

B. Control traffic to prevent damage to equipment and surfaces.

C. Provide coverings to protect finished surfaces from damage.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

** END OF SECTION **

SECTION 01661

MECHANICAL TEST STANDARDS

1.0 PURPOSE

This document defines mechanical test standards and pre-testing requirements for new mechanical systems to verify that the installation and equipment comply with specifications and intended use as well as with regulatory and safety requirements and is ready for startup.

2.0 CLEANING TERMS AND DEFINITIONS

2.1 RECIRCULATION FLUSH

Where a single batch of water is recirculated under pressure at a prescribed velocity in a closed path through a strainer, filter, or demineralizer to remove debris and water impurities.

2.2 VELOCITY FLUSH

A cleaning technique that utilizes the capability of a rapid flowing stream of liquid to scrub, sweep, or scour foreign material from the internal walls and surface of the system. Particles picked up by the circulating liquid are flushed to waste or trapped and collected on a fine mesh screen or filter. Effective flushing velocities shall exceed the design flow rate through the equipment.

2.3 BOILER ACID CLEANING (NOT USED)

2.4 PRE-BOILER CHEMICAL CLEANING (NOT USED)

3.0 PRESSURE TESTING TERMS AND DEFINITIONS

3.1 HYDROSTATIC TEST

Controlled injection of high-pressure water to a filled system to demonstrate structural integrity of the associated piping and pressure vessels. A hydraulic test pump is used to produce a selected pressure generally 1.25 to 1.5 times the design pressure. The test will be maintained at least ten minutes, adhering to specified temperature requirements to prevent brittle fracture.

3.2 PNEUMATIC TEST

The pneumatic test pressure shall not be less than or more than 1.1 times the design pressure of the piping system. The test pressure shall not exceed the maximum allowable test of any non-isolated components, such as vessels, pumps, or valves in the system. The test pressure may be applied with an air compressor or with inert gas

from pressurized storage and must be maintained for a minimum of ten minutes. Specific requirements shall be verified from applicable codes for each project.

3.3 LEAK TESTING

Leak testing is the pressurizing with water or other fluids to demonstrate the tightness of flanges, manholes, and other mechanical closures of piping and equipment. A pressure less than the setting of relief devices is applied from permanently installed pumping equipment at shutoff head or source pressure of system fluid.

3.4 STATIC TESTING

Static testing is pressurizing by filling with water or other fluids to demonstrate the tightness of open vessels such as atmospheric tanks, condensers, and associated piping. A head pressure is applied equal to the highest available static head within the system.

4.0 PERFORMANCE TESTING TERMS AND DEFINITIONS

4.1 TEST SPECIFICATION

An outline of the tests to be performed and the criteria to be satisfied (based on design requirements) for safe and satisfactory performance of the system. It provides necessary design values including operating tolerances, set points, and reference materials for the preparation of detailed pre-operational and/or acceptance test procedures.

5.0 REVIEWS AND VERIFICATIONS PRIOR TO EQUIPMENT TESTING

Prior to equipment testing, Contractor shall at a minimum review and verify the following. Contractor shall note any deficiencies by listing them on the corresponding system punch list and they shall be corrected prior to initiation of equipment testing.

5.1 SAFE AND CLEAN OPERATING CONDITIONS

Contractor at a minimum shall perform the following to verify safe and clean operating conditions prior to equipment startup.

1. Clean up oil slicks, water puddles, dirty and oily equipment, rags, debris, etc. Flag all protrusions; flag all head and knee breakers.

2. Verify safe access to valves, platforms, and ladders.

3. Verify that there no holes in the platforms and that guardrails installed.

4. Is there fire fighting equipment available when needed?

5.2 WORKABLE SYSTEM

Contractor at a minimum shall perform the following to verify a workable system prior to equipment startup.

1. Verify that all necessary equipment is ready for initial operation. Verify that there are no missing pumps, valves, sections of pipe, blind flanges, etc.

2. Verify that any necessary jumpers are installed or other temporary equipment for flushing, etc. is in place.

3. Verify that appropriate flush reports and pressure test reports are complete.

5.3 INSTRUMENTATION

Contractor at a minimum shall perform the following to verify that primary instrumentation systems are operable prior to equipment startup.

1. Verify that pressure indicators, temperature indicators, solenoid valves, safety valves, pressure switches, limit switches, etc., needed for equipment operation are installed, calibrated and checked out.

2. Verify with instrumentation discipline lead that the instrumentation is in good working order.

3. Verify that all instrument set points are correct for the process they serve.

4. Verify that construction and start-up loop records, and calibration reports are complete.

5.4 POWER SUPPLIES

Contractor at a minimum shall perform the following to verify that power supplies are properly operable prior to equipment startup.

1. Verify that all power sources needed for the system and components are available.

2. Verify that conduit boxes are closed.

3. Verify that breakers are properly tagged and locked where required.

4. Verify that Motor Acceptance, Megger Records, and Ground Resistance Forms are completed.

5.5 PIPING

Contractor at a minimum shall perform the following to verify that piping is correctly connected and ready prior to equipment startup.

1. Verify that piping is correctly installed and routed per the Contract Documents and piping submittals.

2. Verify that the piping is correct per the specifications.

3. Verify that there are no open or partially completed welds.

4. Verify that there are no open ends (blind flanges, missing plugs, etc.).

5. Verify that there are no plastic or wooden plugs in the lines.

6. Verify that there are properly functioning vents on all high points and drains on low points.

7. Verify that debris, planking, rags, etc., have been removed from the lines.

8. Verify that no pipe growth interferences have occurred.

5.6 PIPE SUPPORTS AND HANGARS

Contractor at a minimum shall perform the following to verify that piping is correctly supported and ready prior to equipment startup.

1. Verify that the supports are they the correct size and type per the pipe support submittals and the Contract Documents.

2. Verify that the supports are they correctly installed per the pipe support submittals and the Contract Documents.

3. Verify that the pipes have the correct amount of supports per the pipe support submittals and the Contract Documents.

4. Verify that no bolts or nuts are missing.

5. Verify that locking nuts are tight.

6. Verify that temporary supports have been removed and replaced with the permanent supports per the pipe support submittals and the Contract Documents.

5.7 PIPE CONNECTIONS

Contractor at a minimum shall perform the following to verify that piping is correctly connected and ready prior to equipment startup.

1. Verify that the correct connection type, size and material have been used.

2. Verify that correct gaskets have been used and are in place.

3. Verify that there are no missing or loose bolts and nuts.

4. Verify that mating flanges are tightened evenly.

5. Verify that flange bolts are not too long or too short. (Normal is two threads showing.)

6. Verify that the bolt threads lubricated.

7. Verify that insulating flanges are installed where called for and are they correctly installed.

5.8 VALVES

Contractor at a minimum shall perform the following to verify that piping valving is correctly installed and ready prior to equipment startup.

1. Verify correct valve type, size and material.

2. Verify the correct installation of the valves.

3. Verify that the handwheels and locknuts are installed.

4. Verify that the stems are clean and lubricated.

5. Verify that the stem protector is installed.

6. Verify that the gland or packing nuts are tight and installed.

7. Verify that the control valves are checked out and functional.

8. Verify that the motor operators are orientated for manual operation.

5.9 PUMPS, FANS AND ALL MOTOR DRIVEN EQUIPMENT

Contractor at a minimum shall perform the following prior to equipment startup.

1. Review and be familiar with the manufacturer's installation instructions.

2. Review and be familiar with the manufacturer's operating instructions.

3. Verify that the equipment foundation is complete per the Contract Documents.

4. Verify that the lubrication system in order, that the correct level of lubrication is in place, and that the lubrication tag is attached.

5. Verify that coupling guards are installed and secured.

6. Verify that the suction and discharge piping flanges and gaskets installed correctly.

7. Verify that equipment connection fittings are correctly installed.

8. Verify that the suction and discharge piping is adequately supported. The equipment shall not support the piping and a stress connection shall be verified.

9. Verify that seal water and other secondary piping is complete.

10. Verify that the Equipment Release, Lubrication Records, Alignment Records and Inspection Reports are complete?

11. Verify that filters and strainers for lube oil and pumps are installed where required.

12. Verify that pump vents and drains are installed.

13. Verify that all necessary instrumentation is installed, calibrated, and adequately mounted.

14. Verify that all safety shutdown/start-up devices have been demonstrated operational by simulation.

15. Verify that there has been no vibration damage.

16. Verify that the installation of insulation complete.

17. Verify that drainage is available and adequate.

18. Verify that there no plugged or clogged drains.

19. Verify that dampers and linkages are freely moving, connected, lubricated, and correctly positioned. Verify that all position indicators are clearly visible and correctly installed.

20. Verify that lift lugs are available and installed.

21. Verify that bearing temperature and vibration sensors are connected to its indicator.

22. Verify that pump or fan isolation systems are correct in order operate in a dual or tandem system as required by the Contract Documents.

23. Verify that temporary suction strainers are installed in the correct orientation and removed when required.

5.10 PRESSURE INDICATORS

Contractor at a minimum shall perform the following to verify that pressure indicators are correctly installed and ready prior to equipment startup.

1. Verify that it has the correct range and is calibrated.

2. Verify that it is correctly mounted and that vibration proofing is included.

3. Verify that the pointer is intact, on zero, and not damaged.

4. Verify that the glass and face are clean and intact.

5. Verify that snubbers are installed if required.

5.11 TEMPERATURE INDICATORS

Contractor at a minimum shall perform the following to verify that temperature indicators are correctly installed and ready prior to equipment startup.

1. Verify that it has the correct range and is calibrated.

2. Verify that the pointer is intact, on zero, and not damaged.

3. Verify that the glass and face are clean and intact.

5.12 THERMO WELLS

Contractor at a minimum shall perform the following to verify that the thermo wells are correctly installed and ready prior to equipment startup.

1. Verify that the material is correct.

2. Verify that the thermo wells are welded in correctly.

3. Verify that the thermo wells are capped with screwed cap and fastened to chain.

5.13 FLOW SIGHT GLASSES

Contractor at a minimum shall perform the following to verify that the flow sight glasses are correctly installed and ready prior to equipment startup.

1. Verify that it is mounted in the correct flow direction.

2. Verify that the glass is clean and intact.

5.14 DRAIN TRAPS

Contractor at a minimum shall perform the following to verify that the flow sight glasses are correctly installed and ready prior to equipment startup.

1. Verify that the drain traps are the correct size and material.

2. Verify that the drain traps are correctly installed for flow direction.

5.15 "Y" STRAINERS

Contractor at a minimum shall perform the following to verify that the Y-strainers are correctly installed and ready prior to equipment startup.

1. Verify correct size and material.

2. Verify that the strainer is correctly installed for flow direction.

3. Verify that the screen is inside, clean and intact.

5.16 COATING, LABELING AND INSULATION

Contractor at a minimum shall perform the following to verify that pipe coating, labeling and insulation is correct prior to equipment startup.

1. Verify that the piping and equipment is correctly coated and labeled with correct nomenclature and flow arrows in accordance with Section 09900.

2. Verify that piping is correctly insulated per the Contract Documents.

5.17 CATHODIC PROTECTION

Contractor at a minimum shall perform the following to verify that the cathodic protection systems are ready prior to equipment startup.

1. Verify that flanges and washers are correctly installed and that no current is passing between two mating flanges.

2. Verify that cathodic protection is correctly located per the Contract Documents.

6.0 EQUIPMENT LUBRICATION AND MAINTENANCE

6.1 RESPONSIBILITIES

During startup the equipment and systems are under the control of the Contractor and shall be maintained within the guidelines of this Section and the vendor requirements and recommendations. The startup will be overseen by the County or

County's representative; however, it is entirely the Contractors responsibility to startup and maintain the equipment during startup and testing.

6.2 COUNTY INTERFACE

At any time, the County may elect to use its own personnel to assist in performing startup. Contractor shall coordinate with the County to determine when and how the County will assist; however, this assistance shall not be assumed during bidding.

6.3 DOCUMENTATION

It is imperative that after performing any routine or special maintenance on equipment, the work must be documented in the following places:

A. JOBSITE MAINTENANCE LOGBOOK

Contractor shall create and maintain a logbook that is devoted entirely to documenting preventative maintenance and lubrication performed on equipment and/or systems during startup. The logbook shall be completed as the work is performed by the.

B. LUBRICATION AND MAINTENANCE SCHEDULE STATUS SHEET

Contractor shall prepare for all major mechanical components a Lubrication and Maintenance Schedule (LMS). This schedule shall list all activities that are to be performed on the equipment and the intervals between them. Contractor shall attach to this schedule a log sheet that is to be signed and dated by the technician who performed the work.

6.4 INSPECTIONS

Contractor shall perform a complete inspection of the plant daily, to verify that all equipment under its control is in proper working order for it. The daily inspection shall include but not be limited to monitoring for obvious leaks (water and oil), abnormal noises, excessive vibration, unusual rubbing or over-heating. Any problems shall be immediately reported and logged in the Maintenance Logbook.

Equipment inspections required or recommended by the equipment supplier shall be followed by the Contractor while the Contractor has control of the equipment. At a minimum the following shall be checked on a daily, weekly and monthly basis.

1. Daily

   At a minimum, the following items shall be inspected on a daily walk-down inspection.

   a. Fuel Handling

i. Check for oil leaks/spills around conveyors.

ii. Check belts for tension, wear and tracking.

iii. Check all chain driven motors for lubrication.

iv. Inspect oil levels in motors and gears.

b. Compressors

i. Check oil levels, observe any leaks.

ii. Inspect air filter, clean/replace as required.

iii. Drain condensate from air receiver/filters.

iv. Check for unusual noises or vibration.

v. Verify proper lead/lag switching.

vi. Check air dryer performance.

c. Pumps

i. Inspect flanges for leaks.

ii. Check level of drip oilers.

iii. Note any water or oil leaks.

iv. Check bearings for high temperature/vibration.

d. Motors

i. Check oil level.

ii. Check bearing temperatures.

iii. Check for unusual vibrations.

e. Fans

i. Check bearing oil levels.

ii. Check bearing temperatures.

iii. Check for unusual vibrations.

f. Screw Conveyors

i. Inspect chain drives.

ii. Check bearing temperatures.

iii. Check gear oil levels.

g. Rotating Machinery

i. Check chain drives.

ii. Check shear pins.

iii. Check bearing temperatures.

iv. Check gear oil levels.

2. Weekly

The following items shall be inspected on a weekly basis.

a. Fuel Handling

i. Check rotary valves.

ii. Inspect all chain driven equipment for looseness of chain.

iii. Listen for abnormal noises and/or vibrations.

b. Compressors

i. Check oil levels.

ii. Inspect for loose fittings/foundation bolts.

iii. Check I/C for obvious problems.

c. Pumps

i. Check oil levels, add as required.

ii. Check vibration.

iii. Inspect for loose fittings/foundation bolts.

iv. Inspect I/C for obvious problems.

v. Perform test of diesel fire pump.

d. Motors

i. Clean off inlet screen to motor cooling.

ii. Check coupling and foundation bolts.

e. Fans

i. Check oil levels and temperatures.

ii. Inspect for loose fittings/foundation bolts.

iii. Check vibration.

f. Screw Conveyors

i. Lubricate chain drives.

ii. Check bearing temperatures.

g. Electrical

i. Check water levels in all batteries.

ii. Check charging current/voltage of UPS system.

iii. Perform walk down of generator(s).

iv. Check emergency diesel.

v. Check oil levels in transformers.

vi. Check nitrogen pressure in transformers.

vii. Check temperature of transformers.

viii. Walk-down switchgear rooms.

ix. Visually check switchyard.

h. Turbines

i. Add oil as required.

ii. Check movement of trip and non-return valves.

iii. Check for loose fittings/foundation bolts.

3. Monthly

The following items shall be inspected on a monthly basis.

a. Fuel Handling

i. Grease all idlers on belts.

ii. Inspect and change oil on gear boxes.

iii. Check all belts for proper tension.

iv. Check all belts/chains for wear points.

v. Check shear pins.

vi. Re-torque bolts tightened to a specification.

b. Compressors

i. Re-torque bolts tightened to a specification.

ii. Perform a complete vibration check.

iii. Draw an oil sample and inspect.

iv. Wipe off equipment and clean surrounding area.

c. Pumps

i. Grease all bearings.

ii. Perform a complete vibration check.

iii. Wipe off equipment and clean surrounding area.

iv. Rotate redundant pumps.

d. Motors

i. Perform a complete vibration check.

ii. Wipe off equipment and clean surrounding area.

e. Electrical

i. Perform test of UPS system.

ii. Perform test of emergency diesel generator.

iii. Check pressure of transformer nitrogen cylinder.

f. Instrumentation and Controls

i. Begin routine calibration of I/C per schedule.

ii. Check pressures in CEMS gas cylinders weekly.

7.0 CLEANING AND FLUSHING

All piping shall be thoroughly cleaned of debris and scale. Generally fluid handling lines shall be flushed with water, thoroughly drained, and where critical air blown.

Gas handling piping may be water flushed, gas blown or air blown. Water shall be blown from the gas lines upon completion. Gas piping to the compressors or turbines shall be free of all water. All low temperature lines and cryogenic equipment shall be blown clear with oil free and moisture free gas. Air utility piping may be cleaned with their normal media.

7.1 CLEANING METHODS

The types of cleaning methods that may be used for pipe cleaning are as follows:

a. Velocity flushes.

b. Re-circulation flushes.

c. Gas or Air blows.

d. Manual cleaning.

1. Velocity Flushes

Velocity flushes shall consist of single pass flushes through piping from a suitable water supply. This type of flush is normally used on piping where an adequate supply of water combined with pumping capacity is available to maintain acceptable water velocities for a duration long enough for acceptable cleaning.

The cleaning shall be performed as follows:

a. The highest attainable water velocity shall be used for this flush. A minimum velocity of 1.2 times the normal service velocity shall be used.

b. A flush shall be completed when the effluent water and piping internal surfaces meet the acceptance criteria established for that system.

2. Recirculation Flushes

Recirculation flushes shall consist of flushes in a closed loop in any given system. This type of flush could be a lube oil flush or one in a closed cooling system.

When possible, the following steps shall be followed when cleaning a water system:

a. Where possible, flush downwards or horizontally.

b. There must be no risk of carrying debris into complicated or inaccessible equipment.

c. No debris shall be allowed to collect at 'pockets' in the system.

d. Where practical, use vessels as reservoirs and flush away from the vessel.

e. There must be no chance of debris being flushed back into a section that has already been cleared.

f. Flush only one route at a time so that there is no doubt as to the direction of flow.

g. Flush through open lines. Do not restrict flow.

h. Flush through all drains and vents.

i. Flush main headers first and then laterals working systematically, outwards from the water source.

Remove all flow restrictors, i.e. meters and orifices. Remove all non-return valve flappers, relief valves, micro strainers, pressure reducers and control valves before flushing to avoid fouling or damage. Close all instrument taps, including level gauge cocks. Install spool pieces with strainer baskets on pump suctions or in locations predetermined during flush preparation.

Fill the system completely with the flushing medium. Vent where possible.

Operate the system pumps monitoring pump discharge pressure and motor amperages. Monitor the differential pressure across the strainer.

3. Gas and Air Blows

Gas and air blows shall consist of blowing the service medium through the system piping to atmosphere. This method of cleaning shall normally be used on systems such as instrument and service air, and gas systems.

Always avoid blowing dirty piping into cleaned piping.

All piping shall be thoroughly cleaned of debris and scale. It is preferred that interconnecting pipe work be blown clear on completion of hydrostatic testing. Once the pipe has been checked for cleanliness and dryness it can be mounted in position. All low temperature and cryogenic equipment must be blown clear with oil-free and moisture-free gas.

Air utility piping may be cleaned by blowing with their normal media.

a. Air Blows

The air shall be oil-free and moisture-free.

The velocity of air shall be at least 30 ft/s in order to remove debris. In order to achieve the air velocities necessary for effective cleaning out of equipment it is preferable to fill vessels with air up to normal working pressure, and then to depressurize rapidly through the equipment to be cleaned.

Where possible, blow downwards or horizontally.

There must be no risk of carrying debris into complicated or inaccessible equipment.

No debris shall be allowed to collect at “pockets” in the system.

There must be no chance of debris being blown back into a section that has already been cleared.

Where practical, use vessels as reservoirs and blow away from the vessel.

All orifices plates, non-return valve flappers, relief valves, micro strainers, pressure reducers and control valves must be removed before blowing to avoid fouling or damage.

Close all instrument taps, including level gauge cocks.

Blow only one route at a time so that there is no doubt as to the direction of flow.

Blow through open lines. Do not restrict flow.

Blow through all drains and vents.

Blow main headers first and then laterals, working systematically outwards form the air source.

b. Gas Blows

Gas handling piping may be water flushed, pigged or air blown and in some cases gas blown. Water shall be blown from the gas lines upon completion. Gas piping to the compressors or turbines must be free of all water. All low temperature lines and cryogenic equipment must be blown clear with oil free and moisture free gas. Air utility piping may be cleaned with their normal media.

4. Manual Cleaning

In the case of rework or when removing temporary equipment, manual cleaning may be utilized on components and large piping which permit personnel access for cleaning. The four allowed methods of manual cleaning are:

a. Grinding and Polishing

To remove scale or smooth surface irregularities, austenitic stainless steels and carbon steel surfaces may be ground or polished with aluminum oxide or silicon carbide impregnated fabric wheels, or with grinding wheels with resin or rubber bonded grit.

Grinding or polishing on stainless steels shall only be done with wheels, which have been used exclusively on stainless steel.

b. Wire Brushing

Wire brushing may be used on class B, C, and D surfaces, to remove paint, coatings, or loosely adherent oxides. Wire brushing of stainless steel or nickel alloy made surfaces shall be performed with stainless steel wire brushes, which have been used exclusively on stainless steel or nickel alloy surfaces. Particulate contaminants resulting from wire brushing must be removed.

c. Solvent Degreasing

Solvent degreasing may be performed on any metallic surface using the appropriate solvent as shown in Tables 4.1 and 4.2. The surface may be cleaned by wiping, immersion, or filling the vessel or surface with solvent. Chlorinated solvents shall not be used on stainless steel surfaces; these solvents decompose in the presence of moisture forming hydrochloric acid. In addition, kerosene and other similar solvents, which leave a greasy non-volatile residue, shall not be used.

Acetone, alcohol, and similar hazardous solvents must be used with great caution in order to prevent fires, skin burns, or toxic effects when inhaled.

The following preventive measures shall be applied:

i. All personnel must review the MSDS sheets on all solvents being used at your site.

ii. Adequate ventilation must be provided to protect personnel from solvent vapors. Safety cans or polyethylene squeeze bottles must be used to prevent excessive concentrations of vapors in working areas.

iii. Cloths soaked in solvent shall be rinsed in water to minimize hazards.

iv. Explosion-proof lights must be used while working with solvents.

v. When solvents are used in enclosed or semi-enclosed areas, the “buddy system” shall be in effect.

vi. Solvent cleaning will be followed by service (or better) quality water washing in order to remove all solvent residue. Approved solvents and/or service water will be used with lint-free rags only.

vii. Take count of rags being used. Make sure to dispose of used rags properly.

viii. Cleaning of equipment such as large piping, pump casings, and valves shall be considered complete when it meets the acceptance criteria for the cleanliness class designated for the system.

d. Alkaline Degreasing

Stainless steel and carbon steel surfaces (with exception of cleanliness Class A surfaces), may be degreased with a non-toxic wetting agent combined with mild alkaline-phosphate based cleaning compounds.

For small areas, Turco 4215, for example, is commercially available. For large scale flushing, a solution may be prepared using the following:

i. Demineralized water.

ii. Trisodium phosphate (NA_3 PO_4); 0.5 to 0.75% by weight.

iii. Disodium phosphate (Na_2 HPO_4 with a ratio of Na_2 HPO_4 to Na_3 HPO_4 between 1:4 and 1:1).

iv. The solution and metal temperatures must not exceed 150°F during degreasing. Thorough rinsing, using service or better quality water must immediately follow cleaning before the alkaline solution dries out on the component surfaces.

e. Cleaning Solvents

Solvents used for cleaning shall be of quality equal to or greater than the grades specified in the tables below. Solvents may be new or redistilled. Redistilled solvents shall be of quality equal to or greater than the new solvent. Ten (10) gallons per product is the maximum allowable for external cleaning without proper review from the Safety Department. In all applications insure proper protective clothing and equipment is used, adequate ventilation and boundaries roped off with No Smoking/No Hot Work signs attached and clearly visible.

Chemicals acceptable in solvent cleaning operations on any surface:

SOLVENT	GRADE FED. SPEC. NO.	
Ethyl Alcohol	95% - USP	------
Methyl Alcohol	Technical	O-M-232-E
Naptha	Technical	TT-N-95B
Acetone	Technical	O-A-51F
Isopropyl Alcohol	A or B	TT-I-735a

Chemicals acceptable for use on crevice free, open, freely evaporative surfaces, provided that solvent is removed by evaporation, drying, or similar method before any subsequent fabrication or cleaning operations are performed:

SOLVENT	GRADE FED. SPEC. NO.	
Trichloroethylene	Technical	O-T-634B
Perchloroethylene	Technical	O-P-191
Trichloroethane	Technical	O-T-620

f. Wipe Cleaning

Accessible surfaces may be wiped clean with a lint-free cloth moistened with inhibited water, an approved solvent, or alkaline solution.

7.2 DOCUMENTATION

Contractor shall complete and maintain accurate records to provide adequate documentation showing which section of a system was flushed and to what extent. These records shall include:

1. Flushing Procedure

Indicating the cleaning method and acceptance criteria in systematic details. Each step is signed off indicating its completion.

2. Mark- up Piping and Instrument Diagram (P&ID)

   Mark- up Piping and Instrument Diagram (P&ID) showing the flow path for each flush. Also show the boundary of the flush and temporary piping required to perform this flush.

3. System Flush Report providing the results of the flush and certifying that the flush has been adequately completed.

7.3 PRECAUTIONS

The following general precautions shall be taken during all flushing:

1. Conduct system flushes within the limits and restrictions of pump, NPSH, motor current, motor consecutive starts, pump curve, strainer differential pressure, and vibration limits on rotating equipment.

2. Where possible, pump suction piping shall be flushed to waste before the pump is started.

3. All flushing shall progress in a logical sequence so that no "dirty" system is flushed into a clean one. For example, main headers shall be flushed first with the branch lines closed. After that all branch lines, vents, drains and trap lines, instrument lines, etc., are flushed in sequence.

4. Pressurize temporary piping slowly to verify leak tightness.

5. Temporary piping shall be routed to avoid splashing, spraying, or flooding. Added precautions shall be taken against inadvertent wetting of electrical equipment.

6. Sump pumps shall be in service prior to the start of the flush.

7. Flushing of long risers shall be done if possible in the direction of gravity.

8. All flow elements or other devices, which could be damaged by debris during flushing, shall be removed, identified, and carefully stored.

9. Only instruments required for safe operation of the equipment shall be in service during the initial flush. Instrument lines shall be flushed only after the process lines are thoroughly flushed.

10. Control valves shall not be used for throttling or flow control during flushing operations if any other practical alternative is available.

7.4 LAY-UP

If the system is not put into operation immediately after cleaning and flushing, it shall be placed in lay-up status to prevent contamination.

8.0 PIPE SYSTEM CLEANLINESS

8.1 CLEANLINESS CLASSIFICATION AND ENDPOINTS

There are four cleanliness classifications ranging from Class "A" through Class "D". Class "A" is a very high level of cleanliness and applies to such items as delicate instruments. Class "B" is a high level of cleanliness, usually specified for stainless steel systems, since carbon steel and low alloy steel surfaces will rapidly rust upon exposure to even atmospheric moisture. Class "C" is an intermediate level of cleanliness, generally applicable to condensate and feedwater systems, and closed cooling water systems. Class "D" is a lower level of cleanness and is applicable to fire protection, open service water, and other systems that require a nominal degree of cleanliness. Prior to testing, Contractor shall clean the pipelines to levels of cleanliness indicated herein.

8.2 CLEANLINESS ENDPOINTS

1. Class "A" Cleanliness

   A very high level of cleanliness in which there is no evidence of contamination of a surface either under visual examination, with or without magnification, or with the aide of sensitive detection methods. Class "A" cleanliness applies to special items such as delicate instruments, and other close tolerances or carefully controlled surfaces or assemblies. Such items shall receive their required level of cleanliness at the point of manufacture and cleanliness must be maintained at the construction site. Normally, any required site cleanliness inspection and/or re-cleaning should only be performed by the vendor's representative or under their direction.

2. Class "B" Cleanliness

   The surface shall appear "metal clean" when examined without magnification under a lighting level (background plus supplementary lighting) of at least 100 foot candles.

   The surface shall be free of particulate contaminants such as sand, metal chips, weld slag, etc.

   The surface shall be free of organic films and contaminants such as oils, paint, and preservatives as determined by a visual examination or an organic solvent dampened white cloth or an equivalent alternate method.

3. Class "C" Cleanliness

   Surfaces shall meet the requirements for class "B" cleanliness with the exception of the following:

Thin uniform rust films which can be removed by hand brushing or wiping are acceptable on carbon steel surfaces but hard rust which forms in a crusty film and tends to break off in pieces or flakes and/or heavy rusting such as a continuous film of appreciable thickness which forms due to lengthy exposure to aerated water or condensed moisture is not acceptable for carbon steel and must be removed.

4. Class "D" Cleanliness

Tightly adherent mill scale on carbon steel surfaces is acceptable. Paint or preservative coatings on carbon steel surfaces that will not peel or flake when exposed to cold water flushing, or air flowing are acceptable.

8.3 PIPING CLEANLINESS CLASSIFICATION

The following identifies the piping cleanliness requirements based on the pipe service.

Symbol	Service	Cleanliness Classification
ABE	Aeration Basin Effluent	C
CD	Chemical Drain	C
CHEM	Chemical	B
CS	Chemical System	B
CW	Cold Water	B
DSL	Digested Sludge	B
FA	Foul Air	B
FECL	Ferric Chloride	B
HW	Hot Water	C
IA	Instrument Air	B
NIT	Nitrogen	B
OF	Overflow	C
PD	(Gravity) Process Drain	C
PE	Primary Effluent	C
PLW	Chlorinated Plant Water	C
PW	Potable Water	C
RS	Raw Sewage	C
SRS	Screened Raw Sewage	C
THS	Thickened Sludge	C
D	Drain	C
V	Vent	C

Symbol	Service	Cleanliness Classification

9.0 ROTATING EQUIPMENT VIBRATION TESTING

9.1 ACCEPTANCE CRITERIA

All rotating equipment shall be vibration testing in accordance with the requirements herein and as otherwise indicated in these Contract Documents. Vibration acceptance is based upon vibration displacement and vibration velocity measurements. Unacceptability of either displacement or velocity measurement shall render the status of the equipment as unacceptable.

Vibration levels as a function of rpm shall not fall above the fair line as shown on the general machinery vibration severity chart.

1. Electrical Motors

   The maximum allowable vibration displacement standards for electric motors operating at the indicated speeds are:

   Peak to Peak

Speed (rpm)	Vibration Displacement (mils)
3000 and greater	1.0
1500 – 2999	2.0
1000 – 1499	2.5
999 and under	3.0

   The vibration velocity shall not exceed 0.34 inches per second.

2. Centrifugal Pumps

   Centrifugal pumps operating between 60 and 8000 rpm and within 10% of rated capacity shall not exceed the vibration displacement level indicated on the chart. The vibration velocity shall not exceed 0.34 inches per second.

3. Axial and Centrifugal Fans

   For axial and centrifugal fans operating between 400 and 8000 rpm and as near to normal operating conditions as feasible, vibration displacement

shall not exceed the fair line as shown on the severity chart, nor shall the vibration velocity exceed 0.10 inches per second.

9.2 PROCEDURE

Vibration measurements shall be made with broadband test instruments. Filters shall not be used for purposes of this procedure.

Test instruments shall include a tachometer for measuring the actual rotating speed of equipment. Selection shall be based on the range of speeds to be measured.

By visual and hand contact methods, Contractor shall observe vibration conditions on all horizontal and vertical rotating equipment. Unless requested by the Engineer in instances where the machine is obviously unacceptably vibrating, the Contractor does not need to record actual vibration readings on motor driven equipment with motors less than 10 HP motors.

Contractor shall take initial displacement and velocity vibration readings on all large horsepower (100 HP and over) motors and turbines with the motor/turbine uncoupled from its driven equipment, and repeat the procedure with the equipment coupled.

When taking readings, the vibration velocity and the vibration displacement shall be recorded. In initial testing, if either displacement or velocity of vibration is found in excess of acceptable criteria, equipment alignment shall be rechecked. If alignment is determined not to be the cause of vibration, then more sophisticated monitoring equipment and specialist personnel shall be employed to determine the frequency of vibration and to help ascertain the problem. In any case, the engineering specialist shall be notified as well as the equipment vendor if the frequency of vibration is determined not to correspond to the rotation speed.

1. Horizontal Equipment

   Horizontal equipment vibration readings shall be taken with hand-held or magnetic vibration pickups on or as near as possible to each accessible bearing housing and always on a solid surface. Measurement positions shall include the following:

   a. Horizontal and vertical readings that are perpendicular (or radial) to the rotating shaft.

   b. Axial readings that are parallel to the rotating shaft.

   c. When friction type sleeve bearings are encountered, horizontal and vertical shaft readings shall be taken with a magnetic type pickups attached to the bearing housing.

2. Vertical Equipment

Vertical equipment vibration readings shall be taken with hand-held or magnetic vibration pickups on or as near as possible to the top motor bearing and always on a solid surface. Many times this bearing will be covered by a plastic cap, thus measurements must be made on the adjacent casing. Vibration measurements on this bearing shall be performed and recorded in both the coupled and uncoupled modes. Measurement positions shall include the following.

a. Horizontal readings that are perpendicular (or radial) to the rotating shaft, and perpendicular to each other.

b. Axial readings that are parallel to the shaft.

Vibration reading locations shall be selected to conform with specific reference points such as pump suction or discharge, as applicable, and are taken consistently with these reference points to facilitate future reproduction of the test.

10.0 PLANT LAY-UP

Laying up plant equipment is usually required when the system or component is going to be taken out of operation for a length of time. The length of time governs the method of lay-up.

10.1 SHORT TERM LAY-UP

1. General

Short term lay-up is required when a system or component is taken out of service for up to one (1) month. The lay-up usually entails leaving the system with the fluid inside and adding a chemical to prevent oxygen corrosion. In some cases it may be necessary to circulate and periodically test the fluid to ensure proper lay-up conditions are maintained.

2. Specific Instructions

When it is determined that a short-term lay-up is required, Contractor shall review the vendor instructions and submit a plan in accordance with Section 01300 to the Engineer for the lay-up. This plan shall include the following:

a. Estimated duration of lay-up.

b. Type and quantity of chemical required.

c. List of any temporary equipment required.

d. Freeze potential.

e. Any special items that shall be noted i.e., system configuration, safety, etc.

10.2 LONG TERM LAY-UP

1. General

Long term lay-up is required when a system or component is taken out of service for longer than one (1) month. The lay-up generally entails leaving the system with the fluid inside and adding a chemical to prevent oxygen corrosion, or dry with either a desiccant inside or open with air circulation. In some cases it may be necessary to circulate and periodically test the fluid to ensure proper lay-up conditions are maintained.

2. Specific Instructions

When it is determined that a long-term lay-up is required, the Contractor shall review the vendor instructions and submit a long-term lay-up plan to the Engineer in accordance with Section 01300. This plan shall include the following:

a. Estimated duration of lay-up.

b. Type and quantity of chemical required.

c. List of any temporary equipment required.

d. Ambient conditions surrounding the lay-up.

e. Any special items that shall be noted.

END OF SECTION

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SECTION 01664

TRAINING

PART 1 – GENERAL

1.01 DESCRIPTION

This section contains requirements for training the Manatee County's (referred to as County or Owner) personnel, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this contract.

The basic elements of the training are the vendors (equipment) training and the design engineers (process) training. A plan for coordination and completion of the training will be developed during the construction phase in concert with the Contractor and submitted to the County for review.

The training will begin with many of the routine and non-complicated equipment items and continue in the following weeks while the commissioning staff is available. The later training will incorporate the more complex equipment and systems, and those elements which are unique to NWRF.

1.02 QUALITY ASSURANCE

Where required by the detailed specifications, the Contractor shall provide on-the-job training of the County's personnel. The training sessions shall be conducted by qualified, experienced, factory-trained representatives of the various equipment manufacturers. Training shall include instruction in both operation and maintenance of the subject equipment.

1.03 SUBMITTALS

The following information shall be submitted to the Engineer in accordance with the provisions of Section 01300. The material shall be reviewed and accepted by the Engineer as a condition precedent to receiving progress payments in excess of 50 percent of the contract amount and not less than three (3) weeks prior to the provision of training.

1. An overall Training Plan encompassing all aspects of the Work in accordance with intent of this Section. Training plan shall discuss general approach for each training session and general scheduling of these training sessions. Plan shall be adjusted monthly once training has been initiated and resubmitted as the Work progresses.

2. Lessons plans for each training session to be conducted by the manufacturer's representatives. In addition, training manuals, handouts, visual aids, and other reference materials shall be included

3. Subject of each training session, identity and qualifications of individuals to be conducting the training, and tentative date and time of each training session.

PART 2 – PRODUCTS

2.01 GENERAL

Where specified, the Contractor shall conduct training sessions for the County's personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Training shall take place at the site of the work and under the conditions specified in the following paragraphs. Approved operation and maintenance manuals shall be available prior to the date scheduled for the individual training session.

2.02 LOCATION

Training sessions shall take place at the site of the work or as identified by the County and Engineer. Training may take place at the NWRF training conference room.

2.03 LESSON PLANS

Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan shall contain a time allocation for each subject.

One complete set of originals of the lesson plans, training manuals, handouts, visual aids, and reference material shall be the property of the County and shall be suitably bound for proper organization and easy reproduction. The Contractor shall furnish ten copies of necessary training manuals, handouts, visual aids and reference materials at least one (1) week prior to each training session.

2.04 FORMAT AND CONTENT

Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, training session shall cover the following subjects for each item of equipment or system:

1. Familiarization

a. Review catalog, parts lists, drawings, etc., which have been previously provided for the SWWRF and SEWRF files and operation and maintenance manuals.

b. Check out the installation of the specific equipment items.

c. Demonstrate the unit and indicate how all parts of the specifications are met.

d. Answer questions.

2. Safety

a. Using material previously provided, review safety references.

b. Discuss proper precautions around equipment.

3. Operation

a. Using material previously provided, review reference literature.

b. Explain all modes of operation (including emergency).

c. Check out County's personnel on proper use of the equipment.

4. Preventive Maintenance

a. Using material previously provided, review preventive maintenance (PM) lists including:

i. Reference material.

ii. Daily, weekly, monthly, quarterly, semiannual, and annual jobs.

b. Show how to perform PM jobs.

c. Show County's personnel what to look for as indicators of equipment problems.

5. Corrective Maintenance

a. List possible problems.

b. Discuss repairs--point out special problems.

c. Open equipment and demonstrate procedures, where practical.

6. Parts

   a. Show how to use previously provided parts list and order parts.

   b. Check over spare parts on hand. Make recommendations regarding additional parts that should be available.

7. Local Representatives

   a. Where to order parts: name, address, telephone.

   b. Service problems:

      i. Who to call.

      ii. How to get emergency help.

8. Operation and Maintenance Manuals

   a. Review any other material submitted.

   b. Update material, as required.

2.05 VIDEO RECORDING:

The County will retain the services of a commercial video taping service to record each training session. After taping, the material will be edited and supplemented with professionally produced graphics to provide a permanent record. The Contractor shall advise all manufacturers providing training sessions that the material will be video taped and shall make available to the County's videotaping contractor such utility services and accommodation as may be required to facilitate the production of the video tape record.

PART 3 – EXECUTION

Training shall be conducted in conjunction with the operational testing and commissioning periods. Classes shall be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. The Contractor shall arrange to have the training conducted on consecutive days, with no more than 6 hours of classes scheduled for any one day. Concurrent classes shall not be allowed. Training shall be certified on Form 11000-B specified in Section 01999.

Acceptable operation and maintenance manuals for the specific equipment shall be provided to the County prior to the start of any training. Video taping shall take place concurrently with all training sessions.

The following services shall be provided for each item of equipment or system as required in individual specification sections. Additional services shall be provided, where specifically required in individual specification sections.

1. As a minimum classroom equipment training for operations personnel will include:

    a. Using slides and drawings, discuss the equipment's specific location in the NWRF and an operational overview.

    b. Purpose and plant function of the equipment.

    c. A working knowledge of the operating theory of the equipment.

    d. Start-up, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.

    e. Identify and discuss safety items and procedures.

    f. Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.

    g. Operator detection, without test instruments, of specific equipment trouble symptoms.

    h. Required equipment exercise procedures and intervals.

    i. Routine disassembly and assembly of equipment if applicable (as judged by the County on a case-by-case basis) for purposes such as operator inspection of equipment.

2. As a minimum, hands-on equipment training for operations personnel will include:

    a. Identify location of equipment and review the purpose.

    b. Identifying piping and flow options.

    c. Identifying valves and their purpose.

    d. Identifying instrumentation:

        i. Location of primary element.

        ii. Location of instrument readout.

iii. Discuss purpose, basic operation, and information interpretation.

e. Discuss, demonstrate, and perform standard operating procedures and round checks.

f. Discuss and perform the preventative maintenance activities.

g. Discuss and perform start-up and shutdown procedures.

h. Perform the required equipment exercise procedures.

i. Perform routine disassembly and assembly of equipment if applicable.

j. Identify and review safety items and perform safety procedures, if feasible.

3. Classroom equipment training for the maintenance and repair personnel will include:

a. Theory of operation.

b. Description and function of equipment.

c. Start-up and shutdown procedures.

d. Normal and major repair procedures.

e. Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.

f. Routine and long-term calibration procedures.

g. Safety procedures.

h. Preventative maintenance such as lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to major repairs such as replacement of major equipment part(s) with the use of special tools, bridge cranes, welding jigs, etc.

4. Hands-on equipment training for maintenance and repair personnel shall include:

a. Locate and identify equipment components.

b. Review the equipment function and theory of operation.

c. Review normal repair procedures.

d. Perform start-up and shutdown procedures.

e. Review and perform the safety procedures.

f. Perform County approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

PART 4 – DEVELOPMENT OF TRAINING SCHEDULE

The Contractor along with the County will develop a training syllabus and schedule which will include development time for all vendor specific training documentation and the duration of each training activity. The training schedule will utilize the overall project schedule to establish training dates based on equipment receipt and required project needs.

END OF SECTION

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SECTION 01700

CONTRACT CLOSEOUT

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

Comply with requirements stated in Conditions of the Contract and in Specifications for administrative procedures in closing out the work.

1.02 SUBSTANTIAL COMPLETION

A. The Contractor shall submit the following items when the Contractor considers the work to be substantially complete:

1. A written notice that the work, or designated portion thereof, is substantially complete.
2. A list of items to be completed or corrected.

B. Within a reasonable time after receipt of such notice, the County shall make an inspection to determine the status of completion.

C. Project record documents and operations and maintenance manuals must be submitted before the project shall be considered substantially complete.

D. If the County determines that the work is not substantially complete:

1. The County shall notify the Contractor in writing, stating the reasons.
2. The Contractor shall remedy the deficiencies in the work and send a second written notice of substantial completion to the County.
3. The County shall reinspect the work.

E. When the County finds that the work is substantially complete:

1. The Engineer shall prepare and deliver to the County a tentative Certificate of Substantial Completion (Manatee County Project Management Form PMD-8) with a tentative list of the items to be completed or corrected before final payment.
2. The Engineer shall consider any objections made by the County as provided in Conditions of the Contract. When the Engineer considers the work substantially complete, he will execute and deliver to the County a definite Certificate of Substantial Completion (Manatee County Project Management Form PMD-8) with a revised tentative list of items to be

completed or corrected.

1.03 FINAL INSPECTION

A. When the Contractor considered the work to be complete, he shall submit written certification stating that:

1. The Contract Documents have been reviewed.
2. The work has been inspected for compliance with Contract Documents.
3. The work has been completed in accordance with Contract Documents.
4. The equipment and systems have been tested in the presence of the County's representative and are operational.
5. The work is completed and ready for final inspection.

B. The County shall make an inspection to verify the status of completion after receipt of such certification.

C. If the County determines that the work is incomplete or defective:

1. The County shall promptly notify the Contractor in writing, listing the incomplete or defective work.
2. The Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to County that the work is complete.
3. The County shall reinspect the work.

D. Upon finding the work to be acceptable under the Contract Documents, the County shall request the Contractor to make closeout submittals.

E. For each additional inspection beyond a total of three (3) inspections for substantial and final completion due to the incompleteness of the work, the Contractor shall reimburse the County's fees.

1.04 CONTRACTOR'S CLOSEOUT SUBMITTALS TO COUNTY

A. Project Record Documents (prior to substantial completion).

B. Operation and maintenance manuals (prior to substantial completion).

C. Warranties and Bonds.

D. Evidence of Payment and Release of Liens: In accordance with requirements of General and Supplementary Conditions.

E. Certification letter from Florida Department of Transportation and Manatee County Department of Transportation, as applicable.

F. Certificate of Insurance for Products and Completed Operations.

G. Final Reconciliation, Warranty Period Declaration, and Contractor's Affidavit (Manatee County Project Management Form PMD-9).

1.05 FINAL ADJUSTMENT OF ACCOUNTS

A. Submit a final statement of accounting to the County.

B. Statement shall reflect all adjustments to the Contract Sum:

1. The original Contract Sum.
2. Additions and deductions resulting from:
    a. Previous Change Orders
    b. Unit Prices
    c. Penalties and Bonuses
    d. Deductions for Liquidated Damages
    e. Other Adjustments
3. Total Contract Sum, as adjusted.
4. Previous payments.
5. Sum remaining due.

C. Project Management shall prepare a final Change Order, reflecting approved adjustments to the Contract Sum which were not previously made by Change Orders.

1.06 FINAL APPLICATION FOR PAYMENT

Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Conditions of the Contract.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01710

CLEANING

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

Execute cleaning during progress of the work and at completion of the work, as required by the General Conditions.

1.02 DISPOSAL REQUIREMENTS

Conduct cleaning and disposal operations to comply with all Federal, State and Local codes, ordinances, regulations and anti-pollution laws.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.

B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.

C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 – EXECUTION

3.01 DURING CONSTRUCTION

A. Execute periodic cleaning to keep the work, the site and adjacent properties free from accumulation of waste materials, rubbish and wind-blown debris, resulting from construction operations.

B. Provide on-site containers for the collection of waste materials, debris and rubbish.

C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.02 DUST CONTROL

A. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.

B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.03 FINAL CLEANING

A. Employ skilled workmen for final cleaning.

B. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.

C. Prior to final completion or County occupancy, Contractor shall conduct an inspection of sight-exposed interior and exterior surfaces and all work areas to verify that the entire work is clean.

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 – STANDARDS

1.01 MINIMUM RECORD DRAWING STANDARDS FOR ALL RECORD DRAWINGS SUBMITTED TO MANATEE COUNTY

A. Record drawings shall be submitted to at least the level of detail in the contract documents. It is anticipated that the original contract documents shall serve as at least a background for all record information. Original drawings in CAD format is required by the County.

B. Drawings shall meet the criteria of paragraph 2.04 D below and as mentioned in Section 1.14 Record Drawings in the Manatee County Public Works Standards, Part I Utilities Standards Manual approved June 2015.

PART 2 – STANDARDS

2.01 REQUIRMENTS INCLUDED

A. Contractor shall maintain at the site for the County one record copy of:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. County's field orders or written instructions.
6. Approved shop drawings, working drawings and samples.
7. Field test records.
8. Construction photographs.

2.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Store documents and samples in Contractor's field office apart from documents used for construction.

1. Provide files and racks for storage of documents.
2. Provide locked cabinet or secure storage space for storage of samples.

B. File documents and samples in accordance with CSI format.

C. Maintain documents in a clean, dry, legible, condition and in good order. Do not

use record documents for construction purposes.

D. Make documents and samples available at all times for inspection by the County.

2.03 MARKING DEVICES

A. Provide felt tip marking pens for recording information in the color code designated by the County.

2.04 DRAWING PREPARATION

A. Record information concurrently with construction progress.

B. Do not conceal any work until required information is recorded.

C. Drawings; Legibly mark to record actual construction:

1. All underground piping with elevations and dimensions. Changes to piping location. Horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements. Actual installed pipe material, class, etc. Locations of drainage ditches, swales, water lines and force mains shall be shown every 200 feet (measured along the centerline) or alternate lot lines, whichever is closer. Dimensions at these locations shall indicate distance from centerline of right-of-way to the facility.
2. Field changes of dimension and detail.
3. Changes made by Field Order or by Change Order.
4. Details not on original contract drawings.
5. Equipment and piping relocations.
6. Locations of all valves, fire hydrants, manholes, water and sewer services, water and force main fittings, underdrain cleanouts, catch basins, junction boxes and any other structures located in the right-of-way or easement, shall be located by elevation and by station and offset based on intersection P.I.'s and centerline of right-of-way. For facilities located on private roads, the dimensioning shall be from centerline of paving or another readily visible baseline.
7. Elevations shall be provided for all manhole rim and inverts; junction box rim and inverts; catch basin rim and inverts; and baffle, weir and invert elevations in control structures. Elevations shall also be provided at the PVI's and at every other lot line or 200 feet, whichever is less, of drainage swales and ditches. Benchmarks and elevation datum shall be indicated.
8. Slopes for pipes and ditches shall be recalculated, based on actual field measured distances, elevations, pipe sizes, and type shown. Cross section of drainage ditches and swales shall be verified.
9. Centerline of roads shall be tied to right-of-way lines. Elevation of roadway centerline shall be given at PVI's and at all intersections.

10. Record drawings shall show bearings and distances for all right-of-way and easement lines, and property corners.
11. Sidewalks, fences and walls, if installed at the time of initial record drawing submittal, shall be located every 200 feet or alternate lot lines, whichever is closer. Dimensions shall include distance from the right-of-way line and the back of curb and lot line or easement line.
12. Sanitary sewer mainline wyes shall be located from the downstream manhole. These dimensions shall be provided by on-site inspections or tele viewing of the sewer following installation.
13. Elevations shall be provided on the top of operating nuts for all water and force main valves.
14. Allowable tolerance shall be ± 6.0 inches for horizontal dimensions. Vertical dimensions such as the difference in elevations between manhole inverts shall have an allowable tolerance of ± 1/8 inch per 50 feet (or part thereof) of horizontal distance up to a maximum tolerance of ± 2 inch.
15. Properly prepared record drawings on mylar, together with two copies, shall be certified by a design professional (Engineer and/or Surveyor registered in the State of Florida), employed by the Contractor, and submitted to the County.

D. Specifications and Addenda; Legibly mark each Section to record:

1. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed.
2. Changes made by field order or by change order.

E. Shop Drawings (after final review and approval):

1. Five sets of record drawings for each process equipment, piping, electrical system and instrumentation system.

2.05 SUBMITTAL

A. Prior to substantial completion and prior to starting the bacteria testing of water lines, deliver signed and sealed Record Documents and Record Drawings to the County. These will be reviewed and verified by the inspector. If there are any required changes or additions, these shall be completed, and the entire signed and sealed set resubmitted prior to final pay application.

B. The Contractor shall employ a Professional Engineer or Surveyor registered in the State of Florida to verify survey data and properly prepare record drawings. Record drawings shall be certified by the professional(s) (Engineer or Surveyor licensed in Florida), as stipulated by the Land Development Ordinance and submitted on signed and sealed paper drawings, signed and dated mylar drawings together with an AutoCAD version on a recordable compact disk (CD).

C. The CD shall contain media in AutoCAD Version 2017 or later, or in any other CAD program compatible with AutoCAD in DWG or DXF form. All fonts, line types, shape files, external references, or other pertinent information used in the drawing and not normally included in AutoCAD shall be included on the media with a text file or attached noted as to its relevance and use.

D. Accompany submittal with transmittal letter, containing:

1. Date.
2. Project title and number.
3. Contractor's name and address.
4. Title and number of each Record Document.
5. Signature of Contractor or his authorized representative.

Note: The data required to properly prepare these record drawings shall be obtained at the site, at no cost to the County by the responsible design professional or his/her duly appointed representative. The appointed representative shall be a qualified employee of the responsible design professional or a qualified inspector retained by the responsible design professional on a project-by-project basis.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01730

OPERATING AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

A. Compile product data and related information appropriate for County's maintenance and operation of products furnished under Contract.

Prepare operating and maintenance data as specified in this and as referenced in other pertinent sections of Specifications.

B. Instruct County's personnel in maintenance of products and equipment and systems.

C. Provide three (3) sets of operating and maintenance manuals for each piece of equipment provided within this Contract.

1.02 FORM OF SUBMITTALS

A. Prepare data in form of an instructional manual for use by County's personnel.

B. Format:

1. Size: 8-1/2-inch x 11 inch
2. Paper: 20 pound minimum, white, for typed pages
3. Text: Manufacturer's printed data or neatly typewritten
4. Drawings:
   a. Provide reinforced punched binder tab, bind in with text.
   b. Fold larger drawings to size of text pages.
5. Provide fly-leaf for each separate product or each piece of operating equipment.
   a. Provide typed description of product and major component parts of equipment.
   b. Provide indexed tabs.
6. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:
   a. Title of Project.
   b. Identity of separate structures as applicable.
   c. Identity of general subject matter covered in the manual.

C. Binders:

1. Commercial quality three-ring binders with durable and cleanable plastic covers.
2. Maximum ring size: 1 inch.
3. When multiple binders are used, correlate the data into related consistent groupings.

1.03 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit three copies of complete manual in final form.

B. Content for each unit of equipment and system, as appropriate:

1. Description of unit and component parts.
   a. Function, normal operating characteristics and limiting conditions.
   b. Performance curves, engineering data and tests.
   c. Complete nomenclature and commercial number of replaceable parts.
2. Operating Procedures:
   a. Start-up, break-in, routine and normal operating instructions.
   b. Regulation, control, stopping, shut-down and emergency instructions.
   c. Summer and winter operating instructions.
   d. Special operating instructions.
3. Maintenance Procedures:
   a. Routine operations.
   b. Guide to "trouble-shooting".
   c. Disassembly, repair and reassembly.
   d. Alignment, adjusting and checking.
4. Servicing and lubricating schedule.
   a. List of lubricants required.
5. Manufacturer's printed operating and maintenance instructions.
6. Description of sequence of operation by control manufacturer.
7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
   a. List of predicted parts subject to wear.
   b. Items recommended to be stocked as spare parts.
8. As installed control diagrams by controls manufacturer.
9. Each contractor's coordination drawings.
   a. As installed color-coded piping diagrams.
10. Charts of valve tag numbers, with location and function of each valve.
11. List of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage.
12. Other data as required under pertinent sections of specifications.

C. Content, for each electric and electronic system, as appropriate:

1. Description of system and component parts.
   a. Function, normal operating characteristics and limiting conditions.
   b. Performance curves, engineering data and tests.
   c. Complete nomenclature and commercial number of replaceable parts.
2. Circuit directories of panelboards.
   a. Electrical service.
   b. Controls.
   c. Communications.
3. As-installed color-coded wiring diagrams.
4. Operating procedures:
   a. Routine and normal operating instructions.
   b. Sequences required.
   c. Special operating instructions.
5. Maintenance procedures:
   a. Routine operations.
   b. Guide to "trouble-shooting".
   c. Disassembly, repair and reassembly.
   d. Adjustment and checking.
6. Manufacturer's printed operating and maintenance instructions.
7. List of original manufacture's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage.
8. Prepare and include additional data when the need for such data becomes apparent during instruction of County's personnel.

D. Prepare and include additional data when the need for such data becomes apparent during instruction on County's personnel.

E. Additional requirements for operating and maintenance data: Respective sections of Specifications.

1.04 SUBMITTAL SCHEDULE

A. Submit one copy of completed data in final form fifteen days prior to substantial completion.

1. Copy will be returned after substantial completion, with comments (if any).

B. Submit two copies of approved data in final form. Final acceptance will not be provided until the completed manual is received and approved.

1.05 INSTRUCTION OF COUNTY'S PERSONNEL

A. Prior to final inspection or acceptance, fully instruct County's designated operating and maintenance personnel in operation, adjustment and maintenance of

products, equipment and systems.

B. Operating and maintenance manual shall constitute the basis of instruction.

1. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01740

WARRANTIES AND BONDS

PART 1 – GENERAL

1.01 REQUIREMENTS INCLUDED

A. Compile specified warranties and bonds.

B. Compile specified service and maintenance contracts.

C. Co-execute submittals when so specified.

D. Review submittals to verify compliance with Contract Documents.

E. Submit to County for review and transmittal.

1.02 SUBMITTAL REQUIREMENTS

A. Assemble warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers and subcontractors.

B. Number of original signed copies required: Two each.

C. Table of Contents: Neatly typed, in orderly sequence. Provide complete information for each item.

1. Product or work item.
2. Firm, with name of principal, address and telephone number.
3. Scope.
4. Date of beginning of warranty, bond or service and maintenance contract.
5. Duration of warranty, bond or service maintenance contract.
6. Provide information for County's personnel:
   a. Proper procedure in case of failure.
   b. Instances which might affect the validity of warranty or bond.
7. Contractor, name of responsible principal, address and telephone number.

1.03 FORM OF SUBMITTALS

A. Prepare in duplicate packets.

B. Format:

1. Size 8-1/2 inch x 11 inch punched sheets for standard 3-ring binder. Fold larger sheets to fit into binders.
2. Cover: Identify each packet with typed or printed title "WARRANTIES AND BONDS". List:
   a. Title of Project.
   b. Name of Contractor.

C. Binders: Commercial quality, three-ring, with durable and cleanable plastic covers.

1.04 TIME OF SUBMITTALS

A. Make submittals within ten days after date of substantial completion and prior to final request for payment.

B. For items of work, where acceptance is delayed materially beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.05 SUBMITTALS REQUIRED

A. Submit warranties, bonds, service and maintenance contracts as specified in respective sections of Specifications.

B. Approval by the County of all documents required under this section is a pre-requisite to requesting a final inspection and final payment

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01900

STRUCTURAL DESIGN AND ANCHORAGE REQUIREMENTS FOR NONSTRUCTURAL COMPONENTS AND NONBUILDING STRUCTURES

PART 1 – GENERAL

1.01 SUMMARY

A. SCOPE

This section specifies the minimum structural requirements for the design, anchorage and bracing of architectural/mechanical/HVAC/electrical components, equipment, and systems, and non-building structures. Design of supports, attachments and bracing for all parts or elements of the architectural, mechanical, HVAC and electrical systems shall be provided in accordance with this section. The requirements of this section shall apply to the design of the structural elements and features of equipment and to platforms/walkways that are provided with equipment or non-building structures.

This section applies to nonstructural components that are permanently attached to structures, and non-building structures as defined below in paragraph 1.01-B and ASCE 7-10. Note that equipment is defined as a non-structural component and tanks are defined as a non-building structure.

Design shall be in accordance with the criteria listed within this section and shall conform to the provisions of the design codes listed within this section. Engineering design is not required for attachments, anchorage, or bracing detailed on the drawings or where the size of attachments, anchorage, or bracing is defined in the technical specification sections.

B. DEFINITIONS:

1. STRUCTURES: The structural elements of a building that resist gravity, wind, and other types of loads. Structural components include columns, posts, beams, girders, joists, bracing, floor or roof sheathing, slabs or decking, load-bearing walls, and foundations.

2. NONSTRUCTURAL COMPONENTS: The nonstructural portions of a building include every part of the building and all its contents, except the structural portions, that carry gravity loads and that may also be required to resist the effects of wind, impact, and temperature loads. Nonstructural components include, but are not limited to, ceilings, partitions, windows, equipment, piping, ductwork, furnishings, lights, etc.

3. NONBUILDING STRUCTURES: All self-supporting structures that carry gravity loads and that may also be required to resist the effects of wind, impact, and temperature loads. No building structures include, but are not limited to, pipe racks, storage racks, stacks, tanks, vessels and structural towers that support tanks and vessels.

1.02 QUALITY ASSURANCE

A. QUALITY CONTROL BY THE COUNTY:

Special Inspection of nonstructural components and non-building structures, and their anchorages shall be performed by the Special Inspector under contract with the County and in conformance with the 2014 Florida Building Code. Special Inspector(s) and laboratory shall be acceptable to the County in their sole discretion. Special Inspection is in addition to, but not replacing, other inspections and quality control requirements herein. Where sampling and testing required herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.

B. REFERENCES:

Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization, or if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced. When conflicting requirements occur, the most stringent requirements will govern the design.

Reference	Title
AAMA	American Architectural Manufacturer's Association
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
ACI 360	Specification for Structural Steel Buildings
ASCE 7	Minimum Design Loads for Buildings and Other Structures

Reference	Title
ASTM C635	Standard Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
ASTM C636	Standard Practice for Installation for Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.2	Structural Welding Code – Stainless Steel
FBC	Florida Building Code with local amendments
NFPA-13	Standard for the Installation of Sprinkler Systems
OSHA	U.S. Dept. of Labor, Occupational Safety and Health Administration

1.03 SUBMITTALS

For structural elements of nonstructural components and non-building structures required to be designed per this specification section, drawings and design calculations shall be stamped by a Florida licensed professional engineer qualified to perform structural engineering.

Submit drawings and calculations no less than four weeks in advance of the installation of any component to be anchored to the structure or installation of any structural member to which the component will be attached.

A. The following submittals shall be provided in accordance with Section 01300:

1. List of all nonstructural components and non-building structures requiring wind design and anchorage.

2. Shop drawings showing details of complete wind bracing and anchorage attachment assemblies including connection hardware, and embedment into concrete.

3. Shop drawings showing plans, elevations, sections and details of equipment support structures and non-building structures, including anchor bolts, structural members, platforms, stairs, ladders, and related attachments.

4. Identify all interface points with supporting structures or foundations, as well as the size, location, and grip of all required attachments and anchor bolts. Clearly indicate who will be providing each type of attachment/anchor bolt. Equipment vendor shall design anchor bolts, including embedment into concrete, and submit stamped calculations.

5. Calculations for all supports, bracing, and attachments shall clearly indicate the design criteria applied in the design calculations. Concrete embedment calculations shall be coordinated with thickness and strength of concrete members. Submit a tabulation of the magnitude of unfactored (service level) equipment loads at each support point, broken down by type of loading (dead, live, wind, etc.). Indicate impact factors applied to these loads in the design calculations.

6. Product Data: Manufacturer's certificates of compliance with the loading requirements of this section.

1.04 DESIGN CODES

The following standard codes have application at this site for:

Buildings/Structures:	Florida Building Code 2014 and ASCE 7-10
Reinforced concrete:	ACI 350-06 for Concrete Liquid Containing Tanks, ACI 318-11 for all other reinforced concrete
Structural steel:	AISC 360-10
Welding:	AWS Welding Codes, Latest Edition
Occupational health and safety requirements:	U.S. Dept. of Labor, Occupational Safety and Health Administration (OSHA)

When conflicting requirements occur, the most stringent requirements will govern the design.

1.05 DESIGN LOADS

All nonstructural components and non-building structures shall be designed for the following loads. Wind and snow loads shall not be applied to nonstructural components and non-building structures that are located inside buildings.

A. DEAD LOADS:

An additional allowance will also be added for piping and conduit when supported and hung from the underside of equipment and platforms.

Typical allowance for piping and conduit unless noted otherwise: 20 psf

B. UNIFORM LIVE LOADS:

Elevated grating floors:	100 psf
Columns:	No column live load reduction allowed

Stairs and landings:	100 psf
Equipment platforms, walkways/catwalks (other than exitways):	100 psf
Utility bridges:	75 psf per level minimum

C. WIND LOADS:

Code:	FBC 2014 & ASCE 7-10
Ultimate Wind Speed (3-second gust):	160mph
Exposure:	C
Topographic Factor (K_{zt})	1.0

All exterior non-structural components and non-building structures, unless located in a pit or basin, shall be designed to withstand the design wind loads without consideration of shielding effects by other structures.

D. IMPACT LOADS:

Impact loads shall be considered in the design of support systems.

The following impact load factors shall be used unless recommendations of the equipment manufacturer will cause a more severe load case.

Rotating machinery: 20% of moving load

Reciprocating machinery: 50% of moving load

Monorail Hoists:
- Vertical: 25% of lifted load
- Longitudinal: 10% of lifted load

Hangers supporting floors and platforms: 33% of live and dead load

E. TEMPERATURE:

The effects of temperature shall be included in design where nonstructural components and non-building structures are exposed to differential climatic conditions. See Section 1.07 for temperature extremes.

1.06 LOAD COMBINATIONS

All nonstructural components and non-building structures shall be designed to withstand the load combinations as specified in the governing building code. Where the exclusion of live load or impact load would cause a more severe load condition for the member under investigation, then the load shall be ignored when evaluating that member.

1.07 DESIGN CONSIDERATIONS

All nonstructural components and non-building structures shall be designed for the following conditions:

A. CLIMATIC CONDITIONS:

Maximum design temperature:	100	degrees Fahrenheit
Minimum design temperature:	15	degrees Fahrenheit

B. FOUNDATIONS:

Foundations supporting nonstructural components and non-building structures shall extend below grade a minimum of 12".

Consult project geotechnical report for allowable soil bearing recommendations at location of structure.

1.08 COLUMN BASE FIXITY

Column bases shall be designed as pinned connections. No moments shall be assumed to be transferred to the foundations.

Where significant shear loads (greater than 5,000 lb. per anchor bolt) are transferred at column base plates, the equipment vendor shall provide a shear key.

1.09 DEFLECTIONS

Maximum beam deflections as a fraction of span for walkways and platforms shall be L/240 for total load and L/360 for live load. Maximum total load deflection for equipment supports shall be L/450.

PART 2 – PRODUCTS

2.01 GENERAL

Materials shall be in conformance with information shown on the drawings and in other technical specification sections. See individual component and equipment specifications for additional requirements.

PART 3 – EXECUTION

3.01 GENERAL

A. Attachments and braces shall be made in such a manner that the component force is transferred to the lateral force-resisting system of the structure. Attachment requirements and size and number of braces shall be based on the calculations submitted by the Contractor.

B. All anchorage of equipment is specified to be made by cast-in anchor bolts in concrete elements unless specifically noted otherwise on the drawings or other specification Sections. Contractor shall be responsible for any remedial work or strengthening of concrete elements because of superimposed loading if anchor bolts are improperly installed or omitted due to lack of submittal review or improper placement for any reason, at no additional cost to the County.

C. Anchor bolts shall be provided and installed by the Contractor in accordance with Section 05501. Size of anchor bolts and embedment of anchor bolts shall be based on the calculations submitted by the Contractor.

D. Details of and calculations for all anchorages shall be submitted and accepted in accordance with paragraph 1.03 prior to placement of concrete or erection of other structural supporting members. Submittals received after structural supports are in place will be rejected if proposed anchorage method would create an overstressed condition of the supporting member. The Contractor shall be responsible for revisions to the anchorages and/or strengthening of the structural support so that there is no overstressed condition at no additional cost to the County.

END OF SECTION

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SECTION 01999

REFERENCE FORMS

The forms listed below and included in this section are referenced from other sections of the project manual:

Form No.	Title
01040-A	Maintenance of Plant Operations (MOPO) Form
01300-A	Submittal Transmittal Form
01660-A	Equipment Test Report Form
01730-A	Operation and Maintenance Transmittal Form
01730-B	Equipment Record Form
01730-C	Equipment Record Form
09900-A	Coating System Inspection Checklist
11000-A	Manufacturer's Installation Certification Form
11000-B	Manufacturer's Instruction Certification Form
11000-C	Unit Responsibility Certification Form
11002-A	Rigid Equipment Mount Installation Inspection Checklist
11060-A	Motor Data Form
15000-A	Lubrication Record
15000-B	Alignment Record
15000-C	Inspection Report Fan/Blower
15000-D	Mechanical Equipment Data Record
15000-E	Final Tank and Vessel Inspection
15000-F	Piping Inspection Report
15000-G	Pressure Test Report
15000-H	Heat Trace Record
15000-I	System Flush Record
16000-A	Wire and Cable Resistance Test Data Form
16000-B	Installed Motor Test Data Form
16000-C	Dry Transformer Test Data Form
16000-D	Motor Control Center Test Form
16000-E	Medium Voltage Motor Starter Test Form
16000-F	Medium Voltage Switchgear Test Form
16000-G	Protective Relay Test Form
16000-H	Low Voltage Switchgear Test Form
16000-I	Medium Voltage Load Interrupter Switch Test Form
16000-J	Liquid-Filled Transformer Test Form
16000-K	Automatic Transfer Switch Test Form
16000-L	Neutral Grounding Resistor Test

Form No.	Title
17000-A	Loop Wiring and Insulation Resistance Test Data Form
17000-B	Control Circuit Piping Leak Test Form
17000-C	Controller Calibration Test Data Form
17000-D	Panel Indicator Calibration Test Data Form
17000-E	Recorder Calibration Test Data Form
17000-F	Signal Trip Calibration Test Data Form
17000-G	Field Switch Calibration Test Data Form
17000-H	Transmitter Calibration Test Data Form
17000-I	Miscellaneous Instrument Calibration Test Data Form
17000-J	Individual Loop Test Data Form
17000-K	Loop Commissioning Test Data Form

01040 – A – MAINTENANCE OF PLANT OPERATIONS

MOPO Title: _____

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN

01040 – A – MAINTENANCE OF PLANT OPERATIONS – COMPLETED SAMPLE

MOPO Title: CENTRATE PUMP STATION

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.01	Construct New 30" DAF Pipe, 4" SPD Pipe, and 2" HPA Pipe Demolish unused 18" WAS pipe from WAS splitter box	- WAS Splitter Box - DAFT 5, DAFT 6, DAFT 7, and/or DAFT 8 - Secondary Sedimentation Basins - Thickener Effluent Wet Well	- WAS Splitter Box - DAFT 5 and/or DAFT 6 - Secondary Sedimentation Basins - Thickener Effluent Wet Well	- DAFT 7 and DAFT 8	- None	CITY shall: - Take DAFT 7 and DAFT 8 out of service - Shut down sump pumps at DAFT 7 and DAFT 8 CONTRACTOR shall: - Dewater 4" SPD and 30" DAF pipe from DAFT 7 and DAFT 8 to Thickener Effluent Wet Well - Construct new 30" DAF, 4" SPD, and 2" HPA pipes as shown on drawings - Tie-in new 30" DAF pipe to existing 30" DAF pipe - Install temporary plugs in each end of 30" DAF pipe during tie-in. Remove before tie-in is completed.	Reference sheets: **G42**: Index areas F/G/H-3 **G43**: Index areas F/G/H-11 **G64**: F/G/H-3 **G65**: F/G/H-11 Contractor shall be responsible for maintaining proper working conditions and safety personnel during the MOPO as identified in specifications Contractor shall provide spill mitigation during tie-in of 30" DAF pipe 2" AR pipe shall be out of service for no more than 30 minutes	48 hours

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.01 cont'd						- Tie-in new 4" SPD to existing 4" SPD - Tie-in new 2" HPA to existing 2" HPA - Cut, drain, and cap unused 18" WAS pipe from WAS splitter box as shown on drawings. <u>CITY shall:</u> - Return DAFT 7 and DAFT 8 to service		

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.02	Centrate Pump Station Chemical Resistant Coating Application	- DAFT 5 - DAFT 6 - DAFT 7 - DAFT 8 - WAS Splitter Box	- DAFT 5 - DAFT 6 - WAS Splitter Box	- DAFT 7 - DAFT 8 - <u>On a limited basis:</u> WAS Splitter Box, DAFT 5 and DAFT 6	- None	<u>CITY shall:</u> - Shut off plant wasting pumps - Pump down Centrate Pump Station level as much as possible until level stops increasing - Shut off Centrate Pump Station Pumps 1, 2, and 3 - Close butterfly valves at discharges of Centrate Pump Station Pumps 1, 2, and 3 - Shut off storm water pump east of Digester Cleaning Bed 99 - Verify butterfly valve on spare tee on Centrate Pump Station discharge header is closed <u>CONTRACTOR shall:</u> - Install temporary pumps in DAFT 5 and DAFT 6 effluent wet well south of Centrate Pump Station	Reference sheets: M501, M502 Contractor is cautioned that the existing valves may not provide a liquid-tight shutoff Contractor will be responsible for maintaining proper working conditions and safety personnel during the MOPO as identified in specifications Contractor is advised that storm water diversion may be completed prior to start of MOPO	8 days – 24 hours/day including holidays and weekends (if necessary)

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.02 cont'd						- Remove blind flange from the spare tee in the Centrate Pump Station discharge header - Install temporary piping from the temporary pumps to the spare tee in the Centrate Pump Station discharge header - Install blind flanges in discharges of Centrate Pump Station Pumps 1, 2, and 3 - Complete dewatering of pump station with portable pump(s). - Install a tee, valves, and temporary piping in the storm water pump discharge line to divert flow to Digester Cleaning Bed 99 <u>CITY will:</u> - Open butterfly valve between temporary piping and spare tee - Return plant wasting pumps to normal operation	Contractor will be responsible for routing the discharge from the storm water pump to one of the drainage gates on the West side of Digester Cleaning Bed 99 in the event it is not possible or recommended to pump the storm water directly into Digester Cleaning Bed 99 Contractor shall schedule shutdown during April to September to take advantage of lower effluent flows	

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.02 cont'd						- Start temporary pumps at DAFT 5 and DAFT 6 effluent wet well - Return storm water pump to normal operation <u>CONTRACTOR shall:</u> - Install temporary plugs in both ends of 24" pipe between DAFT 5 and 6 effluent wet well and Centrate Pump Station - Modify Centrate Pump Station discharge piping as indicated in drawings and specifications - Apply chemical resistant coating to Centrate Pump Station as indicated in drawings and specifications <u>CITY will:</u> - Shut off plant wasting pumps - Shut off temporary pumps		

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.02 cont'd						- Close butterfly valve between temporary piping and spare tee - Shut off storm water pump CONTRACTOR shall: - Remove blind flanges from discharges of Centrate Pump Station pumps 1, 2, and 3 - Remove temporary pumps - Remove temporary plugs - Remove temporary piping - Reinstall blind flange on spare tee - Remove temporary piping from storm water pump discharge to Digester Cleaning Bed 99		

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.02 cont'd						CITY shall: - Open butterfly valves at discharges of Centrate Pump Station pumps 1, 2, and 3. - Return Centrate Pump Station pumps to normal operation - Return storm water pump to normal operation - Return plant wasting pumps to normal operation		

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.03	Demolition of DAF Piping and Installation of Centrate Flow Meter and CEN Piping at Tunnel 2.	- DAFT 5, DAFT 6, DAFT 7 and/or DAFT 8 - Thickener Effluent Wet Well - Decant Pump Station - Headworks Centrate/DAF Splitter Structure	- DAFT 5, DAFT 6, DAFT 7 and/or DAFT 8 - Thickener Effluent Wet Well	- Decant Pump Station - Headworks Centrate/DAF Splitter Structure	- None	CITY will: - Shut down Decant Pump Station pumps - Close two 8" CEN plug valves east of Grit Basin No. 4 - Open 20" butterfly valve and close 30" butterfly valve to divert Thickener Effluent Wet Well flow from Headworks to Plant 1A Aeration Basin No. 1 CONTRACTOR shall: - Dewater Headworks Centrate/DAF Splitter Structure as needed - Install temporary plugs in twelve 30" DAF inlets to Headworks Centrate/DAF Splitter Structure. CITY will: - Open two 8" CEN plug valves east of Grit Basin No. 4 - Start Decant Pump Station pumps CONTRACTOR shall: - Cut and drain existing	Reference sheets: G41, G61, M103 Contractor shall be responsible for maintaining proper working conditions and safety personnel during the MOPO as identified in specifications Contractor shall provide spill mitigation during cutting and draining of existing DAF piping at Tunnel 2 MOPO may require that feed to SHF centrifuges be temporarily stopped to prevent Decant Pump Station level from increasing	Duration of each Decant Pump Station shut down to install/remove plugs – 2 hours

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.03 cont'd						DAF piping - Demolish DAF piping in and adjacent to Tunnel 2 as shown on drawings. - Install CEN piping and flow meter as shown on drawings. - Clean, disinfect and test piping in accordance with specifications <u>CITY will:</u> Shut down Decant Pump Station pumps - Close two 8" CEN plug valves east of Grit Basin No. 4 <u>CONTRACTOR shall:</u> - Dewater Headworks Centrate/DAF Splitter Structure as required - Remove 12 temporary plugs from 30" DAF inlets to Headworks Centrate/DAF Splitter Structure <u>CITY will:</u> Open two 8" CEN plug valves east of Grit Basin No. 4 - Start Decant Pump		

ITEM NO.	ITEM DESCRIPTION	PROCESS UNITS OPERATING PRIOR TO SHUTDOWN	PROCESS UNITS OPERATING DURING SHUTDOWN	PROCESS UNITS OUT-OF-SERVICE DURING SHUTDOWN	IMPACT ON OTHER PROCESS UNITS	PROCEDURE	CONSTRAINTS AND REMARKS	DURATION OF SHUTDOWN
5.03 cont'd						Station pumps - Open 30" butterfly valve and close 20" butterfly valve to divert Thickener Effluent Wet Well flow to Headworks		

SUBMITTAL TRANSMITTAL

Submittal Description: _____ Submittal No:[1] _____

Spec Section: _____

	Routing	Sent	Received
CITY:	Contractor/CM		
PROJECT:	CM/Engineer		
	Engineer/CM		
CONTRACTOR:	CM/Contractor		

We are sending you ☐ Attached ☐ Under separate cover via _____
☐ Submittals for review and comment ☐ Product data for information only

Remarks: _____

Item	Copies	Date	Section No.	Description	Review action[a]	Reviewer initials	Review comments attached

[a]**Note: NET = No exceptions taken; MCN = Make corrections noted; A&R = Amend and resubmit; R = Rejected** Attach additional sheets if necessary.

Contractor

Certify either A or B:

☐ A. We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, specified (no exceptions).

☐ B. We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

No.	Deviation

Certified by: _____
Contractor's Signature

[1]See paragraph 01300-4.0 A, Transmittal Procedure.

01660-A. EQUIPMENT TEST REPORT FORM

NOTE: This example equipment test report is provided for the benefit of the Contractor and is not specific to any piece of equipment to be installed as a part of this project. The example is furnished as a means of illustrating the level of detail required for the preparation of equipment test report forms for this project.

CITY OF SAMPLE

EXAMPLE WATER TREATMENT PLANT
STAGE IV EXPANSION PROJECT

ABC Construction Company, Inc., General Contractor
XYZ Engineering, Inc., Engineer

EQUIPMENT TEST REPORT

Equipment Name: Sludge Feed Pump 2
Equipment Number: P25202
Specification Ref: 11390
Location: East Sedimentation Basin Gallery

	Contractor		Engineer	
	Verified	Date	Verified	Date
PREOPERATIONAL CHECKLIST				
Mechanical				
Lubrication				
Alignment				
Anchor bolts				
Seal water system operational				
Equipment rotates freely				
Safety guards				
Valves operational				
Hopper purge systems operational				
Sedimentation tank/hopper clean				
O&M manual information complete				
Manufacturer's installation certificate complete				
Electrical (circuit ring-out and high-pot tests)				
Circuits:				
Power to MCC 5				
Control to HOA				

	Contractor		Engineer	
	Verified	Date	Verified	Date
Indicators at MCC:				
Red (running)				
Green (power)				
Amber (auto)				
Indicators at local control panel				
Wiring labels complete				
Nameplates:				
MCC				
Control station				
Control panel				
Equipment bumped for rotation				
Piping Systems				
Cleaned and flushed:				
Suction				
Discharge				
Pressure tests				
Temporary piping screens in place				
Instrumentation and Controls				
Flowmeter FE2502F calibration				
Calibration Report No.				
Flow recorder FR2502G calibrated against transmitter				
VFD speed indicator calibrated against independent reference				
Discharge overpressure shutdown switch calibration				
Simulate discharge overpressure Shutdown				
FUNCTIONAL TESTS				
Mechanical				
Motor operation temperature satisfactory				
Pump operating temperature satisfactory				
Unusual noise, etc.?				
Pump operation: 75 gpm/50 psig				
Measurement:				
Flow:				
Pressure:		Test gage number:		
Alignment hot				
Dowelled in				
Remarks:				

	Contractor		Engineer	
	Verified	Date	Verified	Date
Electrical				
Local switch function:				
Runs in *HAND*				
No control power in *OFF*				
Timer control in *AUTO*				
Overpressure protection switch PS2502C functional in both *HAND* and *AUTO*				
Overpressure protection switch PS2502C set at 75 psig				
PLC 2500 set at 24-hour cycle, 25 min *ON*				
OPERATIONAL TEST				
48-hour continuous test. Pump cycles as specified, indicators functional, controls functional, pump maintains capacity, overpressure protection remains functional, hour meter functional				

RECOMMENDED FOR BENEFICIAL OCCUPANCY

_____ _____

Engineer _____ Date _____

ACCEPTED FOR BENEFICIAL OCCUPANCY

_____ _____

City's Representative_____ Date _____

01730-A. OPERATION AND MAINTENANCE TRANSMITTAL FORM

Date: _____ Submittal No:[2] _____

To: _____ Contract No: _____

_____ Spec. Section: _____

_____ Submittal Description: _____

_____ From: _____

Attention: _____ _____

Checklist	Contractor		Engineer	
	Satisfactory	N/A	Accept	Deficient
1. Table of contents				
2. Equipment record forms				
3. Manufacturer information				
4. Vendor information				
5. Safety precautions				
6. Operator prestart				
7. Start-up, shutdown, and post shutdown procedures				
8. Normal operations				
9. Emergency operations				
10. Operator service requirements				
11. Environmental conditions				
12. Lubrication data				
13. Preventive maintenance plan and schedule				
14. Troubleshooting guides and diagnostic techniques				
15. Wiring diagrams and control diagrams				
16. Maintenance and repair procedures				
17. Removal and replacement instructions				
18. Spare parts and supply list				
19. Corrective maintenance man-hours				
20. Parts identification				
21. Warranty information				
22. Personnel training requirements				
23. Testing equipment and special tool information				

Remarks: _____

_____
Contractor's Signature

[2]See paragraph 01300-4.0 A, Transmittal Procedure.

01730-B. EQUIPMENT RECORD FORM

EQUIP DESCRIP		EQUIP LOC	
EQUIP NO.	SHOP DWG NO.	DATE INST	COST
MFGR		MFGR CONTACT	
MFGR ADDRESS			PHONE
VENDOR		VENDOR CONTACT	
VENDOR ADDRESS			PHONE

MAINTENANCE REQUIREMENTS	D	W	M	Q	S	A	Hours
LUBRICANTS: RECOMMENDED:							
ALTERNATIVE:							
MISC. NOTES:							

RECOMMENDED SPARE PARTS			
PART NO	QUAN	PART NAME	COST

ELECTRICAL NAMEPLATE DATA			
EQUIP			
MAKE			
SERIAL NO.		ID NO.	
MODEL NO.		FRAME NO.	
HP	V	AMP	HZ
PH	RPM	SF	DUTY
CODE	INSL. CL	DES	TYPE
NEMA DES	C AMB	TEMP RISE	RATING
MISC.			
MECHANICAL NAMEPLATE DATA			
EQUIP			
MAKE			
SERIAL NO.		ID NO.	
MODEL NO.		FRAME NO.	
HP	RPM	CAP	SIZE
TDH	IMP SZ	BELT NO.	CFM
PSI	ASSY NO.	CASE NO.	
MISC			

01730-C. EQUIPMENT RECORD FORM

EQUIP DESCRIP		EQUIP LOC	
EQUIP NO.	SHOP DWG NO.	DATE INST	COST
MFGR		MFGR CONTACT	
MFGR ADDRESS			PHONE
VENDOR		VENDOR CONTACT	
VENDOR ADDRESS			PHONE

MAINTENANCE REQUIREMENTS	D	W	M	Q	S	A	Hours

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09900-A COATING SYSTEM INSPECTION CHECKLIST

09900-A Coating System Inspection Checklist			
Project Name			
City		Coating System Manufacturer (CSM)	
General Contractor (GC)		Coating System Applicator (CSA)	
Area or Structure		Location within Structure	
Coating System (e.g. E-1)		Coating Type (e.g. Epoxy, etc.)	

Step	Description		Name	Signature	Date
1	Completion of cleaning and substrate decontamination prior to abrasive blast cleaning.	GC QC			
		CSM QC			
		CSA QC			
2	Installation of protective enclosure of structure or area and protection of adjacent surfaces or structures that are not to be coated.	GC QC			
		CSM QC			
		CSA QC			
3	Completion of ambient condition control in structure or building area and acceptance of ventilation methods in structure or Area.	GC QC			
		CSM QC			
		CSA QC			
4	Completion of Surface Preparation for Substrates to Be Coated.	GC QC			
		CSM QC			
		CSA QC			
5	Completion of Primer Application.	GC QC			
		CSM QC			
		CSA QC			
6	Completion of Concrete Repairs If Required and Related Surface Preparation Rework Prior to Coating System Application.	GC QC			
		CSM QC			
		CSA QC			

Step	Description		Name	Signature	Date
7	Completion of Concrete Filler/ Surface Application to Concrete.	GC QC			
		CSM QC			
		CSA QC			
8	Completion of First Finish Coat Application and of Detail Treatment at Transitions or Terminations.	GC QC			
		CSM QC			
		CSA QC			
9	Completion of Second Finish Coat Application and of Detail Treatment at Transitions and Terminations.	GC QC			
		CSM QC			
		CSA QC			
10	Completion of Full and Proper Cure of Coating System.	GC QC			
		CSM QC			
		CSA QC			
11	Completion of Testing of Cured Coating System including Adhesion, Holiday (Continuity) Testing and Dry Film Thickness.	GC QC			
		CSM QC			
		CSA QC			
12	Completion of Localized Repairs to Coating System Following Testing.	GC QC			
		CSM QC			
		CSA QC			
13	Final Acceptance of Coating System Installation Including Final Clean-Up Complying with Specification Requirements and the CSM's Quality Requirements.	GC QC			
		CSM QC			
		CSA QC			

11000-A. MANUFACTURER'S INSTALLATION CERTIFICATION FORM

Contract No: _____ Specification section: _____

Equipment name: _____

Contractor: _____

Manufacturer of equipment item: _____

The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations, and that the trial operation of the equipment item has been satisfactory.

Comments: _____

_____

_____

_____

_____

_____ _____

Date Manufacturer

_____

Signature of Authorized Representative

_____ _____

Date Contractor

_____

Signature of Authorized Representative

11000-B. MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No: _____ Specification section: _____

Equipment name: _____

Contractor: _____

Manufacturer of equipment item: _____

The undersigned manufacturer certifies that a service engineer has instructed the wastewater treatment plant operating personnel in the proper maintenance and operation of the equipment designated herein.

Operations Check List (check appropriate spaces)	
Start-up procedure reviewed	
Shutdown procedure reviewed	
Normal operation procedure reviewed	
Others:	
Maintenance Check List (check appropriate spaces)	
Described normal oil changes (frequency)	
Described special tools required	
Described normal items to be reviewed for wear	
Described preventive maintenance instructions	
Described greasing frequency	
Others:	

_____ _____
Date Manufacturer

_____
Signature of Authorized Representative

_____ _____
Date Signature of City's Representative

_____ _____
Date Signature of Contractor's Representative

(Project Title)

CERTIFICATE OF UNIT RESPONSIBILITY
for Specification Section _____

_____
(Section title)

In accordance with paragraph 11000-1.02 C of the contract documents, the undersigned manufacturer of driven equipment ("manufacturer") accepts unit responsibility for all components of equipment furnished to the Project under specification Section_____ , and for related equipment manufactured under Sections___ ____, _____, and _____ .

We have reviewed the requirements for Sections 11000 (and 11050 where applicable) and all sections referencing this (these) section(s), including but not limited to drivers, supports for driving and driven equipment and all other specified appurtenances to be furnished to the Project by manufacturer. And, we have further reviewed, and modified as necessary, the requirements for associated variable speed drives and motor control centers. We hereby certify that all specified components are compatible and comprise a functional unit suitable for the specified performance and design requirements whether or not the equipment was furnished by us. We will make no claim nor establish any condition that problems in operation for the product provided under this specification Section _____ are due to incompatibility of any components covered by this Certificate of Unit Responsibility. Nor will we condition or void any warranty for the performance of the product of this specification Section _____ due to incompatibility of any components covered under this Certificate of Unit Responsibility.

Our signature on this Certificate of Unit Responsibility does not obligate us to take responsibility for, nor to warrant the workmanship, quality, or performance of related equipment provided by others under specification Sections _____, _____, and _____. Our obligation to warranty all equipment provided by us shall remain unaffected.

_____
Notary Public

_____
Commission expiration date

Seal:

_____
Name of Corporation

_____
Address

By: _____
Duly Authorized Official

_____
Legal Title of Official

Date: _____

11002-A. RIGID EQUIPMENT MOUNT INSTALLATION CHECKLIST

(CLIENT, PROJECT NAME)

Equipment Tag No.: _____ Date: _____

Grout Product Name and Type: _____

Grouting System Manufacturer: _____

Grouting Application Contractor: _____

General Contractor: _____

Step 1: Verify Equipment Anchor Installation Conformance to Equipment Pad Details

Name: _____ Date___/___/___
Contractor Rep.

Name: _____ Name: _____
Engineer Millwright

Step 2: Completion of Cleaning and Concrete Substrate Preparation Prior to Grouting

Name: _____ Date___/___/___
Contractor Rep.

Name: _____ Name: _____
Engineer Grouting Contractor Rep.

Name: _____
Grout Manufacturer's Technical Rep.

Step 3: Equipment Leveling

Name: _____ Date___/___/___
Contractor Rep.

Name: _____ Name: _____
Engineer Millwright

Step 4: Installation of Protection of Adjacent Surfaces or Structures NOT TO BE GROUTED

Name: _____ Date___/___/___
Contractor Rep.

Name: _____ Name: _____
Engineer Grouting Contractor Rep.

Name: _____
Grout Manufacturer's Technical Rep.

Step 5: Preparation and Construction of Forms and Epoxy Grout Filling Standpipes

Name: _____ Date___/___/___
Contractor Rep.

Name: _____ Name: _____
Engineer Grouting Contractor Rep.

Name: _____
Grout Manufacturer's Technical Rep.

Step 6: Completion of Ambient Condition Control in Structure or Building Area and Acceptance of Ambient Conditions as They Apply to Application and Curing Requirements for the Grouting System

Name: _____ Date___/___/___
Contractor Rep.

Name: _____ Date___/___/___
Grouting Contractor Rep.

Name: _____ Date___/___/___
Grout Manufacturer's Technical Rep.

Name: _____ Date___/___/___
Engineer

Step 7: Epoxy Grout Installation

Name: _____ Date___/___/___
Contractor Rep.

Name: _____ Name: _____
Engineer Grouting Contractor Rep.

Name: _____
Grout Manufacturer's Technical Rep.

Step 8: Completion of Full and Proper Cure of Epoxy Grout

Name: _____ Date___/___/___
Contractor Rep.

Name: _____ Date___/___/___
Grouting Contractor Rep.

Name: _____ Date___/___/___
Grout Manufacturer's Technical Rep.

Name: _____ Date___/___/___
Engineer

Step 9: Completion of Localized Repair of Grout Voids

Name: _____ Date___/___/___
Contractor Rep.

Name: _____ Date___/___/___
Grouting Contractor Rep.

Name: _____ Date___/___/___
Grout Manufacturer's Technical Rep.

Name: _____ Date___/___/___
Engineer

Step 10: Final Acceptance of Grouting System Installation Including Final Clean-Up of the Work Site Complying with All Specification Requirements and the GSM's Quality Requirements

Name: _____ Date___/___/___
Contractor Rep.

Name: _____ Date___/___/___
Grouting Contractor Rep.

Name: _____ Date___/___/___
Grout Manufacturer's Technical Rep.

Name: _____ Date___/___/___
Engineer

11060-A. MOTOR DATA FORM

Equipment Name: _____ Equipment No(s): _____

Project Site Location: _____

Nameplate Markings

Mfr:		Mfr Model:		Frame:		Horsepower:	
Volts:		Phase:		RPM:		Service Factor:	
FLA:		LRA:		Frequency:		Amb Temp Rating:	ºC
Time rating:				Design Letter:			
	(NEMA MG1-10.35)				(NEMA MG-1.16)		
KVA Code Letter:				Insulation Class:			

The following information is required for explosion-proof motors only:

A. Approved by UL for installation in Class _____, Div _____, Group _____

B. UL frame temperature code ____ (NEC Tables 500-8B)

The following information is required for all motors 1/2 horsepower and larger:

A. Guaranteed minimum efficiency _____
(Paragraph 11060-2.04 G)

B. Nameplate or nominal efficiency _____

Data Not Necessarily Marked on Nameplate

Type of Enclosure:				Enclosure Material:		
Temp Rise:	ºC (NEMA MG1-12.41,42)					
Space Heater included?	☐ Yes	☐ No	If Yes:	Watts	Volts	
Type of motor winding over-temperature protection, if specified:						

Provide information on other motor features specified:

_____

15000-A. LUBRICATION RECORD

Description:		TAG:	
System:		P&ID:	
	Driven Equipment	**_____Coupling _____Chain**	**Driver Equipment**
Grease Manufacturer			
Grease Type			
Oil Manufacturer			
Factory Lubed (Inspected)			
Date Lubricated			
Tag Installed			
Lube Quantity			

Additional Checks and Remarks as Required
(Inspection frequencies and items which require special maintenance)

Approved by: _____ Dept: _____ Date: _____

Performed by: _____ Dept: _____ Date: _____

15000-B. ALIGNMENT RECORD

Description: TAG:

System: P&ID:

Equipment Data	Driven	Driver
Manufacturer		
Serial Number		
Tag Number		
Sheave Alignment (Belt or chain driven)		
Pipe Strain Values (If applicable)		

FACE **OUTSIDE DIAMETER**

Viewed from Driver End

Manufacturer's Tolerance:

FACE: _____ CD: _____ GAP: _____

Remarks:

Performed by: _____ Dept: _____ Date: _____

Approved by: _____ Dept: _____ Date: _____

15000-C. INSPECTION REPORT FAN/BLOWER

Description:	TAG:
System:	P&ID:
Manufacturer	S/N
Type	Model
Size	Capacity
RPM	

Equipment Test Data

Bearing Temperatures: Measured RPM

Inboard: _____ Outboard: _____

Rotation Viewed from Motor End Motor AMPS (At Test Condition) CW

CCW

Vibration Data (Draw arrows where taken)

Points	A	B	C	D	E
Horiz.					
Vert.					
Axial					

Units of Measure: _____ **Sketch of Equipment**

Fan Data:

MFG.	Fan Size	Blade Pitch Angle
S/N	Fan Type	Motor HP
M/N		

Completeness Checklist:

Alignment	Date:	Initials:
Drive Guard	Date:	Initials:
Shaft Free to Rotate	Date:	Initials:
Blower Lobe Clearance	Date:	Initials:
Balance	Date:	Initials:

Remarks:

Approved by: _____ Dept: _____ Date: _____

Performed by: _____ Dept: _____ Date: _____

15000-D. MECHANICAL EQUIPMENT DATA RECORD

Description:	TAG:
System:	P&ID:

Name Plate Data: (Driven equipment)
see motor acceptance for motor information.

Manufacturer	S/N
Type	Model
Size	Capacity
RPM	

Equipment Test Data

Suction Pressure	Suction Temperature
Discharge Pressure	Discharge Temperature
Bearing Temperatures: Inboard: _____ Outboard: _____	Measured RPM
Rotation Viewed from Motor End CW CCW	Motor AMPS (At Test Condition)

Vibration Data (Draw arrows where taken)

Points	A	B	C	D	E
Horiz.					
Vert.					
Axial					

Units of Measure: _____ **Sketch of Equipment**

Remarks:

Performed by: _____ **Date** _____

Approved by: _____ **Date** _____

15000-E. FINAL TANK AND VESSEL INSPECTION

Description:		TAG:
System:		P&ID:
Tank Name Plate Data		
Manufacturer		
Type		
Size/Capacity		
Design Pressure		
Inspection Items	**Verified By**	**Date**
Clean		
Dry		
Grounding		
Coating		
Pipe Connections		
Cathodic Protection		
Heater Checkout		
Equipment Number		
Heater Coil Resistance	OHMS	
Thermostat Setting	Degrees	
Amperage in Service	Amps	
Remarks:		
Performed by: _____ Dept: _____ Date: _____		
Approved by: _____ Dept: _____ Date: _____		

15000-F. PIPING INSPECTION REPORT

Description: Tag:

System: P&ID:

READY FOR FINAL INSPECTION

Approved by: _____ Dept: _____ Date: _____

Verify the following as meeting the drawings and applicable piping specification.

(Verification to be 100% unless otherwise noted)

[R] = Random (Approx. 10% of installed quantities)

	Item	Initials	Remarks
[R]	Material check (pipe and fittings)		
[R]	Studs / Bolts (material and type) 1-1 1/2 thread minimum protrusion from both nuts		
[R]	Gaskets (type & rating)		
[R]	Valves / in line components (Tag & Rating)		
	Welding visual		
	Nondestructive testing		
	Post weld heat treatment		
	Supports (attach verification sheets)		

Note: 100% verification required for studs, gaskets, and valves for HPS and HP feedwater systems.

Comments / Exceptions:

Released for pressure test or system turnover:

Performed by: _____ Dept: _____ Date: _____

Approved by: _____ Dept: _____ Date: _____

15000-G. PRESSURE TEST REPORT

Description:			Tag:
System:			P&ID:
Applicable Code/Section			
Above Ground			
Design Pressure:			
Test Method:	Hydrostatic	Pneumatic	In Service
Required Test Pressure:			
Inspection Test Pressure:			
Required Time Pressure Test Held:			
Time Test Started:		Time Test Completed:	
Remarks:			
Calibration Data Gauge No: _____ Calibration Date: _____			
Performed by: _____ Dept.: _____ Date: _____			
Approved by: _____ Dept.: _____ Date: _____			

15000-H. HEAT TRACE RECORD

System:

Heat Trace Circuit No.	Power Supply Panel No.	Ring Out	Hook Up	Amps	Thermostat Setpoint	Post Insul. Megger Readings	In-Service Initials/Date

Performed by: _____ Dept.: _____ Date: _____

Approved by: _____ Dept.: _____ Date: _____

15000-I. SYSTEM FLUSH REPORT

System:	P&ID:
Flushing Fluid:	
Description of Flush:	
Note: Verify that all critical piping not flushed is acceptably clear.	
Performed by: _____ Dept.: _____ Date: _____	
Approved by: _____ Dept.: _____ Date: _____	

16000-A. WIRE AND CABLE RESISTANCE TEST DATA FORM

Wire or Cable No.:_____ Temperature, °F: _____

Location of Test	Insulation resistance, megohms
1.	
2.	
3.	
4.	
5.	
6.	
7	

.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

16000-B. INSTALLED MOTOR TEST FORM

Motor Equipment Number: _____ Date of test: _____

Equipment Driven: _____

MCC Location: _____

				Ambient temp	°F
Resistance:					
Insulation resistance phase-to-ground megohms:					
Phase A		Phase B		Phase C	
Current at Full Load:					
Phase		Current, amps			
Phase		Current, amps			
Phase		Current, amps			
Thermal Overload Device:	Manufacturer/catalog #		Amperes		
Circuit breaker (MCP) setting:					

Motor Nameplate Markings:

Mfr		Mfr Model		Frame		HP	
Volts		Phase		RPM		Service factor**	
Amps		Freq		Ambient temp rating		°C	
Time rating			Design letter**				
	(NEMA 1-10.35)			(NEMA MG-1.16)			
Code letter			Insulation class				

**Required for 3-phase squirrel cage induction motors only.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

16000-C. DRY TRANSFORMER TEST DATA FORM

(Note: Use Data Form for dry type transformers with voltage rating of 600 Vac or less and sizes to 167 kVA single phase and 500 kVA three phase. Use NETA Test Forms and Test Procedures for higher voltages and larger transformers.)

Equipment Tag No.: _____ Temperature Rating: _____

Description/Location: _____ Feeder size/Source: _____

Primary Voltage: _____ Secondary Voltage: _____ Winding Connection: _____

A. VISUAL INSPECTION

Transformer Inspection	Pass	Fail	Note
1. Nameplate data as specified			
2. Mechanical condition			
a. Free of dents and scratches			
b. Anchored properly			
c. Shipping brackets removed			
d. Spacing from wall per nameplate			
3. Grounding *			
a. Equipment grounding			
b. System grounding			

B. INSULATION-RESISTANCE TESTS:

Perform tests with calibrated megohmeter. Apply 1000 Vdc test voltage for 60 seconds and record readings in megohms at 30-seconds and 60-seconds intervals.

Test Group	Resistance between		30-second reading	60-second reading	Absorption Ratio Index 60-sec. / 30-sec.
Primary Winding to ground	A	GRD			
	B	GRD			
	C	GRD			
Secondary Winding to ground with * N-G Bond removed	a	GRD			
	b	GRD			
	c	GRD			
Primary Winding to Secondary Winding	A	a			
	B	b			
	C	c			

Submit resistance readings to the Engineer immediately after the tests that are less than the manufacturer's recommended value or less than 10-megohms. Record the Absorption Ratio Index values for future reference. Ratio must be 1.0 or greater, with infinity (∞) equal to 1.0.

Contractor Representative Certified: _____ Date _____

City Representative Witnessed: _____ Date _____

16000-D. MOTOR CONTROL CENTER TEST FORM

Equipment No.: _____ Ambient room temperature: _____

Location: _____

A. MECHANICAL CHECK:

All bolted connections either bus to bus or cable to bus shall be torqued to the manufacturer's recommendations.

B. ELECTRICAL TESTS:

1. Measure insulation resistance of each bus section phase to phase and phase to ground for 1 minute using a megohmmeter at 1000 volts.

Test results (megohms)			
Phase		Phase	
A-GRD		A-B	
B-GRD		B-C	
C-GRD		C-A	

2. Set the circuit breaker in the starter unit to comply with the requirements of NEC, Article 430-52 and Table 430-152.

3. Motor overload heater elements shall be sized and installed based on the actual nameplate full load amperes of the motor connected to the starter.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

16000-E. MEDIUM VOLTAGE MOTOR STARTER TEST FORM

Equipment No.: _____

Location: _____

Room Temperature: _____

The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms)

Phase:	A		B		C	

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A		B		C		
Pole to ground							megohms
Across open pole							megohms
Pole to pole	AB		BC		CA		megohms

3. Perform minimum pickup voltage tests on trip and close coils.

4. Motor RTDs shall be tested by using a hot oil bath. The temperature at which the sensor trips shall be recorded for each RTD.

5. The Contactor shall be tripped by operation of each protective device.

16000-F. MEDIUM VOLTAGE SWITCHGEAR TEST FORM

Equipment No.: _____

Location: _____

Room Temperature: _____

The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms).

Phase:	A		B		C	

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A		B		C		
Pole to ground							megohms
Across open pole							megohms
Pole to pole	AB		BC		CA		megohms

3. Perform minimum pickup voltage tests on trip and close coils.

4. Verify the instrument transformer ratios. Check the transformer's polarity electrically.

5. The Contactor shall be tripped by operation of each protective device.

16000-G. PROTECTIVE RELAY TEST FORM

Location: _____

Switchgear Breaker No.: _____

Protective Relay Description: _____

The protective relays shall be tested in the following manner:

1. Each protective relay circuit shall have its insulation resistance tested to ground.

2. Perform the following tests on the specified relay setting:

   a. Pickup parameters on each operating element.

   b Timing test shall be performed at three points on the time dial curve.

   c. Pickup target and seal-in units.

The results shall be recorded and signed. A copy shall be given to the Engineer in accordance with paragraph 16000-1.05 B.

16000-H. LOW VOLTAGE SWITCHGEAR TEST FORM

Equipment No.: _____

Location: _____

Room Temperature: _____

The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms).

Phase:	A		B		C	

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A		B		C		
Pole to ground							megohms
Across open pole							megohms
Pole to pole	AB		BC		CA		megohms

3. Minimum pickup current shall be determined by primary current injection.

4. Long time delay shall be determined by primary injection at three hundred percent (300%) pickup current.

5. Short time pickup and time delay shall be determined by primary injection of current.

6. Instantaneous pickup current shall be determined by primary injection.

7. Trip unit reset characteristics shall be verified.

8. Auxiliary protective devices, such as ground fault or under voltage relays, shall be activated to ensure operation of shunt trip devices.

16000-I. MEDIUM VOLTAGE LOAD INTERRUPTER SWITCH TEST FORM

Equipment Number: _____

Location: _____

Date: _____

1. Measure switch blade resistance (micro-ohms).

Phase:	A		B		C	

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A		B		C		
Pole to ground							megohms
Across open pole							megohms
Pole to pole	AB		BC		CA		megohms

The results shall be recorded and signed. A copy shall be given to the Engineer in accordance with paragraph 16000-2.06 B.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

16000-J. LIQUID-FILLED TRANSFORMER TEST FORM

Equipment Number: _____

Location: _____

Date/Weather Conditions: _____

A. Perform the "Insulation-Resistance Test" and "Dielectric Absorption Test" using Form 16000-C, Dry Transformer Test Data Form.

B. Perform an applied voltage (low frequency dielectric) test in accordance with ANSI C57.12.90, paragraph 10.5, Applied Voltage Test. Applied voltage levels shall be 75 percent of recommended factory test levels or recommended test levels of ANSI C57.12.00, Table 5.

C. Insulating oil shall be sampled and shall be laboratory tested for the following:

1. Dielectric strength.

2. Acid neutralization.

3. Interfacial tension.

4. Color.

5. Power factor.

D. Perform a turns ratio test between the windings for all tap positions.

E. The temperature and pressure switches shall be tested using a hot oil bath and air pump.

F. The results shall be recorded and signed by the Contractor and Engineer. A copy shall be given to the Engineer in accordance with paragraph 16000-2.06 D. Any readings which are abnormal to ANSI industry standards shall be reported to the Engineer.

16000-K. AUTOMATIC TRANSFER SWITCH TEST FORM

Equipment Number: _____

Location: _____

Date: _____

1. Perform an insulation resistance test (1000 volts DC for 1 minute):

Phase	A		B		C		
Pole to ground							megohms
Pole to pole	AB		BC		CA		megohms

2. Perform the following operations and initial:

   a. Manual transfer _____

   b. Loss of normal power; _____sec delay

   c. Return to normal power; _____sec delay

The results shall be recorded and signed. A copy shall be given to the Engineer in accordance with paragraph 16000-2.06 B.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

16000-L. NEUTRAL GROUNDING RESISTOR TEST

Equipment No.: _____

Location: _____

The pickup and time delay setting on the ground fault relay shall be set in accordance with Section 16431.

1. The transformer neutral insulation resistance shall be measured with and without the grounding resistor connected to insure no parallel ground paths exist.

2. The protective relay pickup current shall be determined by injecting test current into the current sensor. The pickup current should be within 10 percent of the dial setting. Record the dial setting and actual pickup tie.

3. The relay timing shall be tested by injecting 150 and 300 percent of pickup current into the current sensor. The relay timing shall be in accordance with the manufacturer's published time-current characteristic curves. Record the relay timing at 150 and 300 percent of pickup current.

4. The circuit interrupting device shall be operated by operating the relay.

The results shall be recorded and signed by the Contractor and Engineer. A copy shall be given to the Engineer in accordance with paragraph 16000-2.06 B.

17000-A. LOOP WIRING AND INSULATION RESISTANCE TEST DATA FORM

Loop No.: _____

List all wiring associated with a loop in table below. Make applicable measurements as indicated after disconnecting wiring.

Wire No.	Panel Tie	Field TB	Continuity Resistance[a]		Insulation Resistance[b]			
			Cond./ Cond.	Cond./ Shield	Shield/ Gnd.	Shield/ Cond.	Cond./ Gnd.	Shield/ Shield
A			--	(A/SH)				
B			(A/B)	--				
C			(A/C)	--				
D			(A/D)	--				
etc.								

NOTES:

a. Continuity Test. Connect ohmmeter leads between wires A and B and jumper opposite ends together. Record resistance in table. Repeat procedure between A and C, A and D, etc. Any deviation of ±2 ohms between any reading and the average of a particular run indicates a poor conductor, and corrective action shall be taken before continuing with the loop test.

b. Insulation Test. Connect one end of a 500 volt megger to the panel ground bus and the other sequentially to each completely disconnected wire and shield. Test the insulation resistance and record each reading.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

17000-B. CONTROL CIRCUIT PIPING LEAK TEST FORM

Loop No.:_____

List tubing associated with loop in table below. Make applicable measurements after isolating any air consuming pilots from circuit.

Tube No.	Tubing Equivalent Length of 1/4-Inch Copper[a]	Test Period (seconds)	Permitted Pressure Drop (psi)[b]	Measured Pressure Drop (psi)
A				
B				
C				
D				
etc.				

NOTES:

a. Convert actual tubing and air motor volume to equivalent 1/4-inch copper tubing.

b. Pressure drop shall not exceed 1 psi per hundred feet 1/4-inch tubing per 5 seconds.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

17000-C. CONTROLLER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____ Process Variable (PV) Scale: _____

Output: _____ Output Scale: _____

PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
			% Deviation Allowed:	

Connect output to PV for following tests:

Set Point (SP) Indicator Accuracy			Output Meter Accuracy			Controller Accuracy		
SP	PV Reading	Expected % Dev.	Actual Reading	Expected Reading	Actual % Dev.	Output	Output	% Dev.
(0%)								
(50%)								
(100%)								
% Deviation Allowed:			% Deviation Allowed:			% Deviation Allowed:		

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

17000-D. PANEL INDICATOR CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____

Scale: _____ Range: _____

PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
			% Deviation Allowed:	

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

17000-E. RECORDER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____ Chart: _____

Scale: _____ Range: _____

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
			% Deviation Allowed:	

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

17000-F. SIGNAL TRIP CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____

Scale: _____ Range: _____

Set Point(s): _____

After setting set point(s), run signal input through entire range and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

17000-G. FIELD SWITCH CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No: _____

Input: _____

Range: _____

Set Point(s): _____

Simulate process variable (flow, pressure, temperature, etc.) and set desired set point(s). Run through entire range of switch and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

17000-H. TRANSMITTER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____

Output: _____

Range: _____ Scale: _____

Simulate process variable (flow, pressure, temperature, etc.) and measure output with appropriate meter.

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
			% Deviation Allowed:	

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

17000-I. MISCELLANEOUS INSTRUMENT CALIBRATION TEST DATA FORM

(For instruments not covered by any of the preceding test forms, the Contractor shall create a form containing all necessary information and calibration procedures.)

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

17000-J. INDIVIDUAL LOOP TEST DATA FORM

Loop No.: _____

Description: (Give complete description of loop's function using tag numbers where appropriate.)

P&ID No.: (Attach copy of P&ID.)

a. Wiring tested:
(Attach test form 17000-A)

b. Instrumentation tubing/piping tested:
(Attach test form 17000-B)

c. Instruments calibrated:
(Attach test forms 17000-C through I)

d. List step-by-step procedures for testing loop parameters. Test loop with instruments, including transmitters and control valves, connected and functioning. If it is not possible to produce a real process variable, then a simulated signal may be used with the Engineer's approval.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

17000-K. LOOP COMMISSIONING TEST DATA FORM

Loop No.: _____

a. Loop tested:
(Attach test form 17000-J)

b. Controlled or connected equipment tests confirmed:

c. Give complete description of loop's interface with process.

d. With associated equipment and process in operation, provide annotated chart trace of loop response to changes in set points for verification of performance. This chart should demonstrate 1/4-amplitude damping as output adjusts to set point change. Show set points, starting and finishing times on chart, as well as any other pertinent data.

Connect 2-pen recorder to process variable (PV) and to controller output. Use 1 inch/second chart speed.

Pen 1 - PV - Connections:

Pen 2 - Output - Connections:

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

END OF SECTION

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SECTION 02050

DEMOLITION

PART 1 – GENERAL

1.01 SUMMARY

A. SCOPE

This section specifies all labor, materials, equipment, and incidentals, as shown, specified, and required for demolitions, removal and disposal work. Included, but not limited to, are demolitions and removals of existing materials, equipment, or work necessary to install the work for this Contract as shown and specified and to connect same with existing work in an approved manner. Demolition includes structural concrete, foundations, walls, doors, windows, structural steel, metals, masonry, attachments, appurtenances, piping, electrical and mechanical equipment, paving, curbs, walks, fencing, and similar existing facilities. Contractor shall pay for all landfill disposal fees. Contractor shall conduct site visit to determine extent of work and the problems anticipated to perform the work.

The Engineer did not perform a survey of asbestos containing materials or lead based paints during the design efforts. However, the Contractor shall include in their scope a limited survey to determine if asbestos containing materials or lead based paint is present. This survey shall be performed between the period of the Notice to Proceed and the Notice to Commence. The results of this survey shall be provided to the County and shall be performed by a competent and certified specialist in this type of work. The Contractor will be required to use this information to show Manatee County the presence or the lack of asbestos containing materials and lead based paints in the demolition to be performed.

1.02 SUBMITTALS

Submittals shall be made in accordance with Section 01300. In addition, the following specific information shall be provided:

A. Contractor shall develop and submit demolition plan within 14 days of the Notice to Proceed which includes a demolition schedule and detail methods to use on each item to be demolished. The demolition plan shall take into consideration any appurtenances that is to remain in service until the proposed replacement is in installed, accepted, and operational.

B. Qualifications of firm contracted by the Contractor to perform the survey for asbestos containing materials and lead based paint.

C. Results of the survey for asbestos containing materials and lead based paint.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. All materials and equipment removed from existing site work shall become the property of Contractor, except for those items that the County chooses to salvage. All materials and equipment that the County identifies to be salvaged shall be carefully removed by Contractor so as not to be damaged and shall be cleaned and stored on or adjacent to the site in a protected place specified by the County.

B. Contractor shall dispose of all demolition materials, equipment, debris, and all other items not marked by the County to salvage, off site and in conformance with all existing applicable laws and regulations.

C. Demolished items shall not be used in backfill.

D. Use water sprinkling, temporary enclosures, and other suitable methods to limit amount of dust and dirt rising and scattering to the lowest practical level. Comply with governing regulations pertaining to environmental protection.

3.02 DEMOLITION AND REMOVAL

A. STRUCTURES

Demolition and removal of structures consist of removal of abandoned superstructures, foundation walls, footings, slabs and any other structures. Excavations caused by existing foundations shall be cleared of waste, debris and loose soil, and refilled as specified.

Remove structures to the lines and grades shown, unless otherwise directed by the Engineer. Where no limits are shown the limits shall be 4 inches outside the item to be installed. The removal of masonry beyond these limits shall be at the Contractor's expense and these excess removals shall be reconstructed to the satisfaction of the Engineer with no additional compensation to Contractor.

Where depth of removal is not shown, remove structures to 12-inches below existing footing elevation and backfill to the original grade.

B. PAVEMENT

All pavement demolition shall terminate at cut edges, and all edges shall be neat linear neat line and have a vertical cut face, or saw cut at right angles to curb face.

When portions of pavements are to be removed and later construction is to be connected, Contractor shall preserve, intact, the existing reinforcing steel that would/will project into the new concrete one lap length into the new concrete. Where preserving existing reinforcing steel to a proper length is not possible, Contractor shall splice new reinforcing steel by welding to existing bars. Welds shall be of such size and length as to develop the full strength of the existing bars, and shall conform to AWS D12.1, Reinforcing Steel Welding Code.

C. MECHANICAL and YARD PIPING

Mechanical and yard piping removals shall comply with applicable mechanical and civil Drawings and Specifications.

When existing underground piping is to be altered or removed, the remaining piping shall be properly capped. Abandoned underground piping shall be drained (water inside the demolished pipe shall be collected and not spilled onto the ground) and removed. Contractor shall coordinate with the County for proper disposal of the drained water at the facility.

D. ELECTRICAL

Electrical removals shall comply with applicable electrical Drawings and Specifications.

3.03 SALVAGE

The Contractor may salvage for their use any equipment or material scheduled for demolition that the County does not request to be salvaged. The County shall identify items that the County wants salvaged five (5) days prior to any salvage or demolition work. During the course of the Work, the Engineer may determine that certain piping and valving which is scheduled for demolition may be re-used. The Contractor shall propose to the Engineer to salvage portions of the Work scheduled for demolition that in the opinion of the Contractor is reusable and good condition. The Contractor shall retain from the contract value 10% of the cost of the material salvaged as if it were purchased new; and the County shall receive a credit in the amount of 90% of the cost of the new item which did not need to be purchased. The Engineer shall have the final decision on whether a piece of equipment, valving or piping may be re-used. In the instance of re-use, the Contractor shall coat to new in accordance with Section 09900. Valving, piping and equipment submittals and purchases shall be preceded by an evaluation by the Contractor and the Engineer of the equipment, piping and valving scheduled for demolition.

3.04 ALTERATIONS AND CLOSURES

Alterations shall conform to all Contract Documents and the directions and approvals of the Engineer.

Alterations resulting in openings in existing concrete slabs, ceilings, masonry walls shall be closed and sealed, as shown or otherwise directed by Engineer. The work shall be keyed into the existing work in a manner approved by Engineer. In general, use the same or matching materials as the existing adjacent surface. The finished closure shall be a smooth, tight, sealed, permanent closure acceptable by Engineer.

3.05 CLEAN-UP

Contractor shall remove from the site all debris resulting from the demolition operations as it accumulates. Upon completion of the work, all materials, equipment, waste, and all debris shall be removed, and premises shall be left clean, neat and orderly.

END OF SECTION

SECTION 02064

MODIFICATIONS TO EXISTING STRUCTURES, PIPING AND EQUIPMENT

PART 1 – GENERAL

1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required to modify, alter and/or convert existing structures as shown or specified and as required for the installation of piping, mechanical equipment and appurtenances. Existing piping and equipment shall be removed and dismantled as necessary for the performance of facility alterations in accordance with the requirements herein specified.

PART 2 – PRODUCTS

2.01 GENERAL

A. Epoxy mortar shall be fiberglass fiber mixed with an epoxy filler.

B. Non-shrink grout shall be a sand-cement, non-metallic formulation, having a 28-day strength of 4,000 psi and 0.0 percent shrinkage per ASTM C1090.

C. Liners to be installed in existing manholes and wetwells shall be spray-applied, monolithic, reinforced urethane resin. Urethane resin-based manhole liner material shall be resistant to hydrogen sulfide gas, and other common contents found in a sanitary sewer environment.

D. Approved manhole and wet well liner products are Raven 405, SprayWall, Green Monster, or SpectraShield.

PART 3 – EXECUTION

3.01 GENERAL

A. Cut, repair, reuse, excavate, demolish or otherwise remove parts of the existing structures or appurtenances, as indicated on the construction drawings, or as necessary to complete the work as required. Dispose of surplus materials resulting from the above work in an approved manner. The work shall include all necessary cutting and bending of reinforcing steel, structural steel, or miscellaneous metal work found embedded in the existing structures.

B. Dismantle and remove all existing equipment, piping, and other appurtenances required for the completion of the work. Where called for or required, cut existing pipelines for the purpose of making connections thereto.

C. Anchor bolts for equipment and structural steel to be removed shall be cut off one inch below the concrete surface. Surfaces shall then be refinished using non-shrink grout or epoxy mortar or as indicated on the construction drawings. Repairs to the interior surfaces of existing concrete structures in sanitary sewers shall be made with epoxy mortar. Repairs to be made on other existing concrete surfaces using non-shrink grout shall be made using a bonding agent such as Acrylbond by Concrete Producers Solutions or an equal approved by the County. Remove all dirt, curing compounds, sealers, paint, rust or other foreign material, and etch with muriatic acid solution. Flush with clean water and while still damp, apply a coating of the bonding agent. Place the new grout patch onto the treated area immediately.

D. At the time that a new connection is made to an existing pipeline, additional new piping, extending to and including a new valve, shall be installed. Pipe restraint devices, if required, shall also be installed as required. At the time when a new potable or reclaimed water service is installed, a pipe locator tracer wire shall be installed and connected to the tracer wire at the main.

E. No existing structure, equipment, or appurtenance shall be shifted, cut, removed, or otherwise altered except with the express approval of and only to the extent approved by the County. All existing valve boxes, fire hydrants, air release valve cabinets, and manholes shall be relocated to meet the new finished grade elevations after construction.

F. When removing materials or portions of existing utility pipelines or structures or when making openings in walls and partitions, take all precautions and use all necessary barriers and other protective devices so as not to damage the structures beyond the limits necessary for the new work, and not to damage the structures or contents by falling or flying debris. Unless otherwise approved by the County, saw-cutting, rotary core-boring, or line drilling will be required in removing material from existing concrete structures or pipes.

G. Materials and equipment removed in the course of making alterations and additions shall remain the property of the County, except that items not salvageable, as determined by the County, shall be disposed of off the work site.

H. All alterations to existing utility pipes and structures shall be done at such time and in such a manner as to comply with the approved time schedule. Before any part of the work is started, all tools, equipment, and materials shall be assembled and made ready so that the work can be completed without delays.

I. All cutting of existing concrete or other material to provide suitable bonding to new work shall be done in a manner to meet the requirements of the respective section

of these Standards covering the new work. When not covered, the work shall be carried on in the manner and to the extent directed by the County or per the construction drawings.

J. Surfaces of seals visible in the completed work shall be made to match as nearly as possible the adjacent surfaces.

K. Non-shrink cementatious grout shall be used for setting wall castings, sleeves, leveling pump bases, doweling anchors into existing concrete and elsewhere as shown on the construction drawings. The surface to which grout is to be applied shall be wetted to facilitate good bonding.

L. Where necessary or required for the purpose of making connections; cut existing pipelines in a manner to provide an approved joint. Where required, use flanges, couplings, or adapters, all as required.

M. Provide flumes, hoses, piping, pumps and well points, and other related items to divert or provide suitable plugs, bulkheads, or other means to hold back the flow of water or other liquids, all as required in the performance of the work.

N. Care shall be taken not to damage any part of existing buildings or foundations or outside structures.

O. Prior to entering confined spaces in sanitary sewer structures, conduct an evaluation of the atmosphere within, in accordance with local, state, and federal regulations. Provide ventilation equipment and other equipment as required to assure safe working conditions.

3.02 CONNECTING TO EXISTING PIPING AND EQUIPMENT

The Contractor shall verify exact location, material, alignment, joint, etc. of existing piping and equipment prior to making the connections called out in the Drawings. The verifications shall be performed with adequate time to correct any potential alignment or other problems prior to the actual time of connection. A County Inspector must be present for all tie-ins for a visual inspection.

3.03 REMOVAL AND ABANDONMENT OF ASBESTOS CEMENT PIPE AND APPURTENANCES

A. All work associated with the removal or abandonment of existing asbestos cement pipe and appurtenances shall be performed by a licensed asbestos removal Contractor registered in the State of Florida.

B. The asbestos Contractor shall contact the appropriate regulatory agencies prior to removal or abandonment of any asbestos material and shall obtain all required permits and licenses and issue all required notices. The cost for all fees associated

with permits, licenses and notices to the governing regulatory agencies shall be borne by the asbestos Contractor.

C. All work associated with removal or abandonment of asbestos cement pipe and appurtenances shall be performed in accordance with the standards listed below and all other applicable local, State, or Federal standards.

1. Florida Administrative Code, Chapter 62-257, ASBESTOS PROGRAM
2. Title 40 CFR, Part 61, Subpart M, NATIONAL EMISSION STANDARD FOR ASBESTOS
3. Occupational Safety and Health Act, Title 29 CFR
4. Title 40 CFR, Part 763, ASBESTOS
5. Florida Statute Title XXXII, Chapter 469, ASBESTOS ABATEMENT

D. All asbestos cement pipe sections indicated on the construction drawings to be removed, and all related tees, valves, fittings and appurtenances shall be removed in their entirety and disposed of by the asbestos Contractor in accordance with this Section. Asbestos cement nipples between tees and valves shall be replaced. After removal of the pipelines, all excavations shall be backfilled in accordance with the applicable provisions of the Trenching and Excavation Section of these Standards. The cost of disposing of the removed materials shall be borne by the asbestos Contractor.

E. The cutting of existing asbestos-cement (A/C, a.k.a. "Transite") pipe shall be by hand tools only. No powered machine cutting is allowed. Removal of all fragments of pipe shall be double bagged prior to shipment. Longer sections of pipe removed may be shipped without double bagging. An asbestos manifest form must accompany each shipment of such pipe or pipe material waste to the Manatee County Lena Road Landfill. Prior to each shipment, a minimum of 24 hours notice to the Landfill field office (telephone (941) 748-5543) is required.

3.04 IN-PLACE GROUTING OF EXISTING PIPE

A. Where water and wastewater utility pipes are to be abandoned in place, they shall be filled with a nonshrinking sand-cement grout. When such pipes are made of asbestos-cement materials, the abandonment activities shall be performed by a licensed asbestos Contractor. It is completely the Contractor’s responsibility to obtain all regulatory clearances and provide documentation in cases where they have determined that an asbestos-cement pipe abandonment activity by in-place grouting does not require a licensed asbestos Contractor.

B. The ends of the pipe sections to be grout-filled shall be capped or plugged with suitable pipe fittings. The grout material shall be of suitable properties and the pumping pressure shall be such that the pipe sections are filled completely with grout. All above ground features shall be removed: hydrants, meters, valve & meter

boxes, pads, vaults, etc. Existing tees, crosses, and valves left in service shall be plugged and restrained.

C. The County shall be given timely notice so that the County's representative may be present to monitor all pipe grouting operations. Provide standpipes and/or additional means of visual inspection as required to determine if adequate grout material has filled the entire pipe sections.

D. All tees, crosses, and valves left in service shall be plugged and restrained.

3.05 SPRAY-APPLIED LINERS

A. Use a high-pressure water spray to remove all foreign material from the walls and bench of the structure. Loose or protruding masonry materials shall be removed using a hammer and chisel. Fill any voids, holes or cracks using a hand trowel with epoxy mortar to form a uniform surface. Place covers over all pipe openings to prevent extraneous material from entering the pipes. Block or divert sewer flow from entering the structure. Any infiltration leaks shall be stopped by using such methods as approved by the County.

B. The liner material shall be sprayed onto the invert, bench and wall areas. The sprayed-on material shall be applied such that the entire structure is lined with a structurally enhanced monolithic liner. The thickness of the wall liner material shall be such that it will withstand the hydraulic load generated by the surrounding groundwater table, using a factor of safety of two, and using the assumption that the groundwater table is at the level of the top of the structure. The invert and bench liner material shall be the same thickness as that required for the base of the wall.

C. Special care shall be used to provide a smooth transition between the intersecting pipelines and the manhole inverts such that flow is not impaired. Remove concrete material from the existing manhole base channel in depth to the required thickness of the new liner material.

D. No active sewer flow shall be allowed in the newly lined structure, nor shall any vacuum tests be performed, until the liner material has had adequate time to cure, as recommended by the liner material manufacturer.

E. Install the coating systems per manufacturer's recommendation and completely protect the structure from corrosion. The liner or coating systems must extend and seal onto manhole ring, onto and around pipe openings and any other protrusions, and completely cover the bench and flow invert. Provide a five (5)-year unlimited warranty on all workmanship and products. The work includes the surface preparation and application of the coating or liner system, and shall protect the structure for at least five (5) years from all leaks and from failure due to corrosion from exposure to corrosive gases such as hydrogen sulfide.

3.06 CONNECTION TO EXSTING MANHOLE

A. Where required or as indicated on the construction drawings, make connection of new pipelines to existing manhole structures. If pipe stub-outs of the correct size and position are not available, make connections by removing a portion of the manhole wall by mechanical rotary core boring. The connection between pipe and concrete manhole shall be complete with resilient seals meeting the requirements of ASTM C923.

B. A new channel shall be formed in the manhole base by removing and reforming or by providing new concrete to convey the new flow into the existing channel in accordance with the standard requirements for new sewer manhole structures. Flow direction shall not change by more than 90 degrees within the manhole base.

C. Repair internal coating of existing manholes cored during connection of new sewers by applying approved coating material as listed above in accordance with the manufacturer's recommendations. If existing manhole has an internal coating other than that listed above, sandblast the interior of the existing manhole and apply an approved coating in accordance with the manufacturer's recommendations.

D. When connecting a force main to an existing manhole, the force main termination manhole and the next two manholes downstream shall be rehabilitated and lined with a currently approved liner. If the existing manholes are lined with a non-conforming liner according to Part 2.D above, the existing liner shall be removed and replaced, unless otherwise noted on the plans or with written approval by the County.

END OF SECTION

SECTION 02100

SITE PREPARATION

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. This Section covers clearing, grubbing and stripping of the project site and/or along the pipeline route.

B. The Contractor shall clear and grub all of the area within the limits of construction or as required, which includes, but is not limited to utility easements. The width of the area to be cleared shall be reviewed by the County prior to the beginning of any clearing.

C. The Contractor's attention is directed to any Soil Erosion and Sediment Control Ordinances in force in Manatee County. The Contractor shall comply with all applicable sections of these ordinances.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 CLEARING

The surface of the ground, for the area to be cleared and grubbed shall be completely cleared of all timber, brush, stumps, roots, grass, weeds, rubbish and all other objectionable obstructions resting on or protruding through the surface of the ground. However, trees shall be preserved as hereinafter specified unless otherwise designated by the County. Clearing operations shall be conducted so as to prevent damage to existing structures and installations and to those under construction, so as to provide for the safety of employees and others. Soil erosion control devices such as hay bales and silt fences shall be installed to satisfy all Federal, State and County requirements.

3.02 GRUBBING

Grubbing shall consist of the complete removal of all stumps, roots larger than 1-1/2 inches in diameter, matted roots, brush, timber, logs and any other organic or metallic debris not suitable for foundation purposes, resting on, under or protruding through the surface of the ground to a depth of 18 inches below the subgrade. All depressions excavated below the original ground surface for or by the removal of such objects, shall be refilled with suitable materials and compacted to a density conforming to the surrounding ground surface.

3.03 STRIPPING

In areas so designated, topsoil shall be stockpiled. Topsoil so stockpiled shall be protected until it is placed as specified. The County shall have the option to receive all excess topsoil materials. The Contractor shall pay all equipment and labor cost to deliver excess top soil material to a remote site chosen by the County within a five mile radius of the construction site. Should County not choose to receive any or all excess topsoil materials, the Contractor shall dispose of said material at no additional cost to County.

3.04 DISPOSAL OF CLEARED AND GRUBBED MATERIAL

The Contractor shall dispose of all material and debris from the clearing and grubbing operation by hauling such material and debris off site. The cost of disposal (including hauling) of cleared and grubbed material and debris shall be considered a subsidiary obligation of the Contractor; the cost of which shall be included in the prices bid for the various classes of work.

3.05 PRESERVATION OF TREES

Those trees which are not designated for removal by the County shall be carefully protected from damage. The Contractor shall erect such barricades, guards and enclosures as may be considered necessary by him for the protection of the trees during all construction operation.

3.06 PRESERVATION OF DEVELOPED PRIVATE PROPERTY

A. The Contractor shall exercise extreme care to avoid unnecessary disturbance of developed private property adjacent to proposed project site. Trees, shrubbery, gardens, lawns and other landscaping, which are not designated by the County to be removed, shall be replaced and replanted to restore the construction easement to the condition existing prior to construction.

B. All soil preservation procedures and replanting operations shall be under the supervision of a nursery representative experienced in such operations.

C. Improvements to the land such as fences, walls, outbuildings and other structures which of necessity must be removed, shall be replaced with equal quality materials and workmanship.

D. The Contractor shall clean up the construction site across developed private property directly after construction is completed upon approval of the County.

3.07 PRESERVATION OF PUBLIC PROPERTY

The appropriate paragraphs of these Specifications shall apply to the preservation and restoration of public lands, parks, rights-of-way, easements and all other damaged areas. This includes, but is not limited to the trimming of trees damaged by contractor's equipment.

END OF SECTION

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SECTION 02220

EXCAVATION, BACKFILL, FILL AND GRADING FOR STRUCTURES

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. Structural excavation shall consist of the removal of material for the construction of foundations for structures and other excavation designated on the drawings or in these specifications.

B. Structural excavation and backfill shall consist of furnishing material, if necessary and placing and compacting backfill material around structures to the lines and grades designated on the drawings, as specified or directed by the County.

C. Structural excavation and backfill shall include the furnishing of all materials, equipment and other facilities which may be necessary to perform the excavations, place and compact the backfill, install sheeting and bracing, and carry out any necessary dewatering. It shall also include the wasting or disposal of surplus excavated material in a manner and in locations approved by the County.

D. The Contractor is responsible for the protection of every tree which is scheduled to remain in the project area. This includes trees which may or may not be shown on the plans. Every tree shall be adequately protected in place at no additional cost to the County. This includes, but is not limited to, protecting the root systems and adjusting grades as necessary for tree/root protection.

1.02 QUALITY ASSURANCE

A. Testing Agency:

1. In place soil compaction tests shall be performed by a qualified testing laboratory.

2. Compaction tests shall be taken every 500 feet, except in the road crossings or road shoulders. Tests are to be taken according to current FDOT Standards.

B. Reference Standards:

1. American Society for Testing and Materials (ASTM):

a. ASTM D1557, Moisture-Density Relations of Soils Using 10-lb. (4.5-kg) Rammer and 18-in. (457-mm) Drop.

1.03 JOB CONDITIONS

A. The Contractor shall provide, operate and maintain all necessary pumps, discharge lines, well points, etc., in sufficient number and capacity to keep all excavation, bases, pits, etc., free from seepage, standing or running water at all times throughout the period of construction.

B. The Contractor shall assume all responsibility for the security of the excavation required, employing bracing, lining or other accepted means necessary to accomplish same.

C. Excavated areas shall be cleared of all debris, water, slush, muck, clay and soft or loose earth and shall be conditioned to the entire satisfaction of the County.

D. All excavated material unsuitable for use or which will not be used shall be disposed of in a manner consistent with State and County regulation.

E. All unsuitable organic materials, roots, logs, etc., found during excavation shall be removed by the Contractor and the trench shall be refilled with suitable material.

PART 2 – PRODUCTS

2.01 MATERIAL FOR CONTROLLED FILL

A. Composition: Only approved material free from organic matter and lumps of clay, shall be used for backfill. Excavated earth free from debris or organic material may be used for backfilling foundations or fill.

B. Crushed stone and shell shall meet or exceed current FDOT Standards.

2.02 UNSUITABLE MATERIAL

Unsuitable material shall be defined as highly organic soil per ASTM D2487 Group PT. This includes, but is not limited to, such items as topsoil, roots, vegetable matter, trash, debris, and clays that cannot be dried sufficiently to obtain specified compaction.

PART 3 – EXECUTION

3.01 INSPECTION

A. The Contractor shall verify that work preceding the affected work of this Section has been satisfactorily completed.

B. Conditions adversely affecting the work of this Section shall be corrected to the satisfaction of the County.

3.02 REMOVAL OF UNSUITABLE MATERIALS

A. The Contractor shall remove unsuitable material from within the limits of the Work.

B. Materials meeting requirements for controlled fill shall be stockpiled as necessary and in such a manner satisfactory to the County.

C. All material excavated shall be placed so as to minimize interference with public travel and to permit proper access for inspection of the work.

3.03 EXCAVATION

A. When concrete or shell subbase footing is to rest on an excavated surface, care shall be taken not to disturb the natural soil. Final removal and replacement of the foundation material and subbase compaction to grade shall not be made until just before the concrete or masonry is placed.

B. When any structural excavation is completed, the Contractor shall notify the County who will make an inspection of the excavation. No concrete or masonry shall be placed until the excavation has been approved by the County.

C. The elevations of the footing bottom and the base slab as shown on the Drawings, shall be considered as approximate and the County may order in writing, such changes in dimensions or elevations of the footings and slab base as necessary to secure satisfactory foundations.

D. All excavation shall be made within an area bounded by lines five feet outside and parallel to the exterior walls of the structure to allow for correct forming, shoring and inspection of foundation work. Pouring of concrete against earth side walls shall not be permitted.

E. If the ground is excavated below the grade called for by the Drawings or becomes unstable due to the Contractor's carelessness or operations, the ground shall be excavated to undisturbed native soil before continuing concreting operations.

F. If in the opinion of the County, the material at or below the normal grade of the bottom of the trench is unsuitable for pipe or structure foundation, it shall be removed to the depth directed by the County and if so directed, replaced by crushed stone or washed shell.

3.04 STRUCTURAL BACKFILL

A. Structural backfill shall not be placed until the footings or other portions of the structure or facility have been inspected by the County and approved for backfilling.

B. A minimum of 1-1/2" layer of lean concrete shall be placed as a working mat for the concrete base slabs and footings if required by the County.

C. Fill shall be placed in uniform layers not more than 12" thick and compacted to a minimum of 98 percent of the maximum density determined by ASTM D1557, Method A or C, or as directed by the County. The Contractor shall securely tamp the backfill with pneumatic rammer around all wall foundations. The method of compaction shall be satisfactory to the County.

D. Compaction of structural backfill by ponding and jetting may be permitted when, as determined by the County: the backfill material is of such character that it will be self-draining when compacted; foundation materials will not soften or be otherwise damaged by the applied water; no damage from hydrostatic pressure will result to the structure. Ponding and jetting within two feet below finished subgrade shall not be permitted in roadway areas. At the discretion of the County, ponding and jetting may be permitted with compaction layers not to exceed four feet.

E. Surplus material not used on-site shall be removed and disposed of off-site by the Contractor. In no case shall surplus material be deposited on adjacent lands. Fill used for grading shall be placed in layers not to exceed 12 inches in thickness and shall be compacted to a density equal or greater to that of the surrounding natural ground.

3.05 BACKFILLING AROUND STRUCTURES

A. Common fill and structural fill are specified for use as backfill against the exterior walls of the structures. Fill shall be placed in layers having a maximum thickness of eight (8) inches in loose state and shall be compacted sufficiently to prevent settlement. If compaction is by rolling or ramming, material shall be wetted down as required. Where material can be suitably compacted by jetting or puddling, the Contractor may use one of these methods. No boulders shall be allowed to roll down the slopes and hit the walls.

B. Backfilling shall be carried up evenly on all walls of an individual structure simultaneously. A variation of two (2) feet in elevation will be the maximum allowable. No backfill shall be allowed against walls until the walls and their supporting slabs, if applicable, have attained sufficient strength. Backfilling shall be subjected to approval by the County.

C. In locations where pipes pass through building walls, the Contractor shall take the following precautions to consolidate the refill up to an elevation of at least one foot above the bottom of the pipes:

1. Place structural fill in such areas for a distance of not less than three feet either side of the center line of the pipe in level layers not exceeding 6-inches in depth.
2. Wet each layer to the extent directed and thoroughly compact each layer with a power tamper to the satisfaction of the County.
3. Structural fill shall be of the quality specified under Part 2 of this Section.

D. The surface of filled areas shall be graded to smooth true lines, strictly conforming to grades indicated on the grading plan. No soft spots or uncompacted areas shall be allowed in the work.

E. Temporary bracing shall be provided as required during construction of all structures to protect partially completed structures against all construction loads, hydraulic pressure and earth pressure. The bracing shall be capable of resisting all loads applied to the walls as a result of backfilling.

3.06 FIELD QUALITY CONTROL

A. The density of soil in place shall be a minimum of 95 percent in accordance with ASTM test 1557-70T, Method A or C.

END OF SECTION

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SECTION 02221

TRENCHING, BEDDING AND BACKFILL FOR PIPE

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment and incidentals necessary to perform all dewatering, excavation, backfill, fill, grading, trench protection or other related work required to complete the piping work shown on the Drawings and specified herein. The work shall include, but not be limited to: vaults; duct conduit; pipe; roadways and paving; backfilling; required fill or borrow operations; grading; disposal of surplus and unsuitable materials; and all related work such as sheeting, bracing and dewatering.

B. Prior to commencing work, the Contractor shall examine the site and review test borings if available, or undertake his own subsurface investigations and take into consideration all conditions that may affect his work.

C. The Contractor is responsible for the protection of every tree which is scheduled to remain in the project area. This includes trees which may or may not be shown on the plans. Every tree shall be adequately protected in place at no additional cost to the County. This includes, but is not limited to protecting the root systems and adjusting grades as necessary for tree/root protection.

1.02 PROTECTION

A. Sheeting and Bracing in Excavations:

1. In connection with construction of underground structures, the Contractor shall properly construct and maintain cofferdams. These shall consist of: sheeting and bracing as required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction and to protect adjacent structures, existing yard pipe and/or foundation material from disturbance, undermining, or other damage. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.

2. Trench sheeting for pipes: no sheeting is to be withdrawn if driven below, mid-diameter of any pipe and no wood sheeting shall be cut off at a level lower than one foot above the top of any pipe unless otherwise directed by the County. During the progress of the work, the County may direct the

Contractor in writing to leave additional wood sheeting in place. If steel sheeting is used for trench sheeting, removal shall be as specified above, unless written approval is given for an alternate method of removal.

3. All sheeting and bracing not left in place shall be carefully removed in such a manner as not to endanger the construction or other structures, utilities, existing piping, or property. Unless otherwise approved or indicated on the Drawings or in the Specification, all sheeting and bracing shall be removed after completion of the piping or structure, care being taken not to disturb or otherwise injure the pipeline or finished masonry. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools specifically made for that purpose, by watering, or as may otherwise be directed.

4. The Contractor shall construct, to the extent he deems it desirable for his method of operation, the cofferdams and sheeting outside the neat lines of the pipeline trench or foundation unless otherwise indicated on the Drawings or directed by the County. Sheeting shall be plumb and securely braced and tied in position. Sheeting, bracing and cofferdams shall be adequate to withstand all pressures to which the pipeline or structure will be subjected. Pumping, bracing and other work within the cofferdam shall be done in a manner to avoid disturbing any construction of the pipeline or the enclosed masonry. Any movement or bulging which may occur shall be corrected by the Contractor at his own expense so as to provide the necessary clearances and dimensions.

5. Drawings of the cofferdams and design computations shall be submitted to the County and approved prior to any construction. However, approval of these drawings shall not relieve the Contractor of the responsibility for the cofferdams. The drawings and computations shall be prepared and stamped by a Registered Professional Engineer in the State of Florida and shall be in sufficient detail to disclose the method of operation for each of the various stages of construction, if required, for the completion of the pipeline and substructures.

B. Dewatering, Drainage and Flotation

1. The Contractor shall construct and place all pipelines, concrete work, structural fill, bedding rock and limerock base course, in-the-dry. In addition, the Contractor shall make the final 24" of excavation for this work in-the-dry and not until the water level is a minimum of 18 below proposed bottom of excavation.

2. The Contractor shall, at all times during construction, provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavation and keep such excavations dry so as to obtain

a satisfactory undisturbed subgrade foundation condition until the fill, structure, or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations. At all times during the construction operations, the groundwater levels shall be maintained at an elevation 18 inches below the lowest level where structures are being installed.

3. Dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.

4. Wellpoints may be required for dewatering the soil prior to final excavation for deeper in-ground structures or piping and for maintaining the lowered groundwater level until construction has been completed to avoid the structure, pipeline, or fill from becoming floated or otherwise damaged. Wellpoints shall be surrounded by suitable filter sand and no fines shall be removed by pumping. Pumping from wellpoints shall be continuous and standby pumps shall be provided.

5. The Contractor shall furnish all materials and equipment to perform all work required to install and maintain the proposed drainage systems for handling groundwater and surface water encountered during construction of structures, pipelines and compacted fills.

6. Where required, the Contractor shall provide a minimum of two operating groundwater observation wells at each structure to determine the water level during construction of the pipeline or structure. Locations of the observation wells shall be at structures and along pipelines as approved by the County prior to their installation. The observation wells shall be extended to 6 inches above finished grade, capped with screw-on caps protected by 24" x 24" wide concrete base and left in place at the completion of this Project.

7. Prior to excavation, the Contractor shall submit his proposed method of dewatering and maintaining dry conditions to the County for approval. Such approval shall not relieve the Contractor of the responsibility for the satisfactory performance of the system. The Contractor shall be responsible for correcting any disturbance of natural bearing soils for damage to pipeline or structures caused by an inadequate dewatering system or by interruption of the continuous operation of the system as specified.

8. As part of his request for approval of a dewatering system, the Contractor shall demonstrate the adequacy of the proposed system and wellpoint filter sand by means of a test installation. Discharge water shall be clear, with no visible soil particles in a one quart sample. Discharge water shall not flow

directly into wetlands or Waters of the State as defined by FDEP and SWFWMD.

9. During backfilling and construction, water levels shall be measured in observation wells located as directed by the County.

10. Continuous pumping will be required as long as water levels are required to be below natural levels.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General

1. Materials for use as fill and backfill shall be described below and shall be from an FDOT certified pit. For each material, the Contractor shall notify the County of the source of the material and shall furnish the County, for approval, a representative sample weighing approximately 50 pounds, at least ten calendar days prior to the date of anticipated use of such material.

2. Additional materials shall be furnished as required from off-site sources and hauled to the site.

B. Bedding - shall conform to FDOT Standard Specifications for Road and Bridge Construction, Section 901 Coarse Aggregate, and shall be either coarse aggregate of Size No. 57 or coarse sand of Size No. 9. Washed shell size No.57 may be used as an alternate bedding material.

C. Structural Fill

1. Structural fill in trenches shall be used below spread footing foundations, slab-on-grade floors and other structures as backfill within three feet of the below grade portions of structures.

2. Shall be either soil classification A-1, A-2 or A-3, per AASHTO M-145, and shall be free of organic matter, lumps of clay or marl, muck, compressible materials, and rock exceeding 2.5 inches in diameter. Broken concrete, masonry, rubble or other similar materials shall not be used as backfill. Minimum acceptable density shall be 98 percent of the maximum density as determined by AASHTO T-180.

D. Selected Common Fill - shall have the same material classification and requirements as Structural Fill, as described above.

E. Common Fill

1. Shall be either soil classification A-1, A-2, A-3, A-4, A-5 or A-6, per AASHTO M-145, and shall be free of organic matter, lumps of clay or marl, muck, compressible materials and rock exceeding 2.5 inches in diameter. Broken concrete, masonry, rubble or other similar materials shall not be used as backfill.

2. Material falling within the above specification, encountered during the excavation, may be stored in segregated stockpiles for reuse. All material which, in the opinion of the County, is not suitable for reuse shall be spoiled as specified herein for disposal of unsuitable materials by the Contractor.

E. Unsuitable Material - soil classification A-7 and A-8, per AASHTO M-145, shall not be used as backfill material.

PART 3 – EXECUTION

3.01 EXCAVATION

A. Excavate trenches and pits for structures to the elevations indicated on the construction drawings. Take special care to avoid over-excavating or disturbing the bottom of the trench or pit, so that the soil at the bottom of the hole remains in a naturally compacted condition. Excavate to widths sufficient to provide adequate working room to install the required structures. Do not excavate the final layer of soil to the designed grade until just before placing the bedding, foundation, pipe, structure, or masonry work required. Remove boulders, rocks, logs or any unforeseen obstacles encountered.

B. In case the foundation soil found at the bottom of the trench or pit is soft, plastic or mucky, or does not conform to the soils classification specified as suitable foundation material, over-excavation to a greater depth will be required. Soils not meeting the classification required for foundation material shall be removed to a depth at least four inches below the bottom of the pipe, bedding or structure bottom elevation. Rock, boulders or other hard or lumpy material shall be removed to a depth 12 inches below the bottom of the pipe, bedding or structure bottom elevation. Remove muck, clay or other soft material to a depth as needed to establish a firm foundation.

C. Where possible, the sides of trenches should be vertical up to at least the spring line of the installed pipe.

D. Trench excavation shall be performed in accordance with Florida Statute Title XXXIII, Chapter 553, Part III, Trench Safety Act.

3.02 BACKFILLING

A. Backfill materials shall be placed on solid, firm, naturally compacted or compacted to 98 percent of the maximum dry density of the material as determined by AASHTO T-180, dry or dewatered in place soil foundations.

B. Where over-excavation is required due to nonconforming soil classification or rocky, unstable, or otherwise undesirable soil conditions, place Structural Fill or Selected Common Fill in the over-excavated zone up to the base of the bedding material layer. Compact the over-excavated zone to 98 percent of the maximum dry density of the material as determined by AASHTO T-180.

C. When backfilling in an over-excavated zone where moist or watery conditions exist, backfill shall be coarse No. 9 sand or a mixture of No. 57 coarse aggregate with either No. 9 coarse sand, A-1, or A-3 material.

D. After compaction, backfill material in the over-excavation zone shall form a solid and firm foundation on which to build up successive layers of backfill and structures.

E. Bedding materials shall be placed on solid, firm soil foundations and shall be compacted to 98 percent of the maximum dry density of the material as determined by AASHTO T-180.

F. Concrete and masonry structures shall be backfilled using Structural Fill. Backfilling and compaction shall be underneath the structure and carried up evenly on all walls of an individual structure simultaneously. The maximum allowable difference in backfill elevations shall be two feet. No backfilling shall be allowed against concrete or masonry walls until the walls and their supporting slabs have been in place at least seven days or until the specified 28-day strength has been attained. Compaction of Structural Fill underneath the base and along the walls shall be 98 percent of the maximum dry density of the material as determined by AASHTO T-180. The Structural Fill shall be either dried or shall have water added so that the moisture content of the material is within a range that will allow the required density to be achieved.

G. Trenching backfill for pipe installation shall be Selected Common Fill for the pipe bedding zone. The pipe bedding envelope shall begin at the level four inches, six inches, or nine inches, depending on pipe diameter, below the bottom of the pipe, and shall extend vertically up to a level 12 inches above the top of the pipe. Where the in-place soil material within the four inch, six inch, or nine inch pipe bedding zone beneath the bottom of the pipe meets the soil classification for Selected Common Fill, undercutting of the trench below the bottom of the pipe will not be required. In this case, loosen the soil in the bottom of the trench immediately below the middle third of the pipe diameter, and place the pipe upon it. Where the in-place soil material within the pipe bedding zone does not meet the soil classification for Selected Common Fill, undercutting shall be required, and the bedding zone shall be backfilled with Selected Common Fill. In this case, place the pipe bedding

material and leave it in a moderately firm uncompacted condition under the middle third of the pipe diameter, and compact the outer portions of the trench bottom to 98 percent of the maximum dry density. Soils that were over-excavated due to rocky, soft or otherwise unsuitable soil foundation conditions shall also be replaced with Selected Common Fill. Compaction of Selected Common Fill shall be 98 percent of the maximum dry density as determined by AASHTO T-180. Such backfill material shall have an optimized moisture content that will allow the required density to be achieved.

H. Pipe sections for gravity flow systems shall be laid with spigots downstream and bells upstream. Excavate for pipe bells before laying pipe. Lay pipe true to the lines and grades indicated on the construction plans. Place backfill material on both sides of the pipe and compact to 98 percent of the maximum dry density of the material as determined by AASHTO T-180. Take special care to effectively fill and compact the material in the haunch areas under the sides of the pipe.

I. For pipes that are not installed under roadways or driveways, trenching backfill for pipe installation shall be Common Fill above the pipe envelope zone, and shall be compacted to 95 percent of the maximum dry density of the material as determined by AASHTO T-180, and shall have moisture content optimized to allow the required density. For pipes that are installed under roadways or driveways, trenching backfill for pipe installation shall be Selected Common Fill above the pipe envelope zone, and shall be compacted to 98 percent of the maximum dry density of the material as determined by AASHTO T-180, and shall have moisture content optimized to allow the required density. Selected Common Backfill shall be placed in layers not to exceed 6 inches. Common Backfill shall be placed in layers not to exceed 12 inches.

J. Backfill compaction tests shall be performed every 500 feet in pipe line trenches and for every utility structure. Test reports shall be presented to the County Inspector.

3.03 GRADING AND CLEAN UP

A. Surplus and unsuitable soil materials not used on-site shall be removed and disposed of off-site in a manner that is consistent with state and local regulations. In no case shall surplus or unsuitable material be deposited on-site or on adjacent lands.

B. The surface of backfilled areas shall be graded smooth and true to the lines and grades indicated on the construction plans. No soft spots or uncompacted areas shall be allowed in the work.

C. Upon completion of the work, leave the work areas and all adjacent areas in a neat and presentable condition, clear of all temporary structures, rubbish and surplus

materials. Pile any salvageable materials that have been removed in neat piles for pickup by County crews, unless otherwise directed.

END OF SECTION

SECTION 02223

EXCAVATION BELOW GRADE AND CRUSHED STONE OR SHELL REFILL

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. If in the opinion of the County, the material at or below the normal grade of the bottom of the trench is unsuitable for pipe or structure foundation, it shall be removed to the depth directed by the County and replaced by crushed stone or washed shell.

PART 2 – PRODUCTS (NOT USED)

PART 3 – MATERIALS

3.01 EXCAVATION AND DRAINAGE

A. Whatever the nature of unstable material encountered or the groundwater conditions, trench stabilization shall be complete and effective.

B. Should the Contractor excavate below the grade shown on the Contract drawings because of negligence or for his own convenience; due to failure in properly dewatering the trench; disturbs the subgrade before dewatering is sufficiently complete; he shall be directed by the County to excavate below grade. The work of excavating below grade and furnishing and placing the approved refill material shall be performed at the Contractor's expense.

3.02 REFILL

A. Soils not meeting the classification required for foundation material shall be removed to a depth at least four inches below the bottom of the pipe, bedding or structure bottom elevation. Rock, boulders or other hard or lumpy material shall be removed to a depth 12 inches below the bottom of the pipe, bedding or structure bottom elevation. Remove muck, clay or other soft material to a depth as needed to establish a firm foundation.

END OF SECTION

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SECTION 02260

FINISH GRADING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The Contractor shall finish grade sub-soil.

B. The Contractor shall cut out areas to receive stabilizing base course materials for paving and sidewalks.

C. The Contractor shall place, finish grade and compact top soil.

1.02 PROTECTION

The Contractor shall prevent damage to existing fencing, trees, landscaping, natural features, bench marks, pavement and utility lines. Damage shall be corrected at no cost to the County.

PART 2 – PRODUCTS

2.01 TOPSOIL

The top soil shall be friable loam free from subsoil, roots, grass, excessive amount of weeds or other organics, stones, and foreign matter; acidity range (pH) of 5.5 to 7.5; containing a minimum of 4 percent and a maximum of 25 percent organic matter. The Contractor may use topsoil stockpiles on site if they conform to these requirements.

PART 3 – EXECUTION

3.01 SUB-SOIL PREPARATION

A. The Contractor shall rough grade sub-soil systematically to allow for a maximum amount of natural settlement and compaction. Uneven areas and low spots shall be eliminated. Debris, roots, branches or other organics, stones, and sub-soil shall be removed by the Contractor and disposed of in a manner consistent with the latest Manatee County Standards as well as any affected regulatory agency. Should contaminated soil be found, the Contractor shall notify the County.

B. The Contractor shall cut out areas to sub-grade elevation to stabilize base material for paving and sidewalks and shall be compacted to 98 percent of the maximum dry

density of the material as determined by AASHTO T-180, and shall have moisture content optimized to allow the required density.

C. The Contractor shall bring sub-soil to required profiles and contour graces gradually; and blend slopes into level areas.

D. The Contractor shall slope the structure grade a minimum of two (2) inches in ten (10) feet unless indicated otherwise on the Drawings.

E. The Contractor shall cultivate sub-grade to a depth of 3 inches where the topsoil is to be placed. He shall repeat cultivation in areas where equipment use has compacted sub-soil.

F. The Contractor shall not make grade changes which causes water to flow onto adjacent lands.

3.02 PLACING TOPSOIL

A. The Contractor shall place topsoil in areas where seeding, sodding and planting is to be performed. He shall place from the following minimum depths, up to finished grade elevations:

1. 6 inches for seeded areas
2. 4-1/2 inches for sodded areas
3. 24 inches for shrub beds
4. 18 inches for flower beds

B. The Contractor shall use topsoil in a dry state as determined by the County. He shall place the material during dry weather.

C. The Contractor shall use fine grade topsoil eliminating rough and low areas to ensure positive drainage. He shall maintain levels, profiles and contours of the sub-grades.

D. The Contractor shall remove stone, roots, grass, weeds, debris, and other organics or foreign material while spreading the material.

E. The Contractor shall manually spread topsoil around trees, plants and structures to prevent damage which may be caused by grading equipment.

F. The Contractor shall lightly compact and place the topsoil.

3.03 SURPLUS MATERIAL

A. The Contractor shall remove surplus sub-soil and topsoil from site at his expense.

B. The Contractor shall leave stockpile areas and entire job site clean and raked, ready for landscaping operations.

END OF SECTION

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SECTION 02270

EROSION, SEDIMENTATION, AND DUST CONTROL

PART 1 – GENERAL

1.01 DESCRIPTION

A. WORK INCLUDED

Provide all material, equipment and labor necessary to install erosion and sediment control elements in accordance with this Specification. All costs for permit application shall be borne by the Contractor. Any permits required by the Contractor shall be available at the site at all times.

The specification sections listed below may be related to the project work.

1. SECTION 02050 - Demolition

2. SECTION 02100 – Site Preparation

B. Provide erosion control measures so as to prevent pollution of water, detrimental effects to public or private property adjacent to the project, and damage to work on the project. Construct and maintain temporary erosion control features or, where practical, construct and maintain permanent erosion control features as shown in the Plans or as may be directed by the Engineer.

C. Coordinate the installation of temporary erosion control features with the construction of the permanent erosion control features to the extent necessary to ensure economical, effective, and continuous control of erosion and water pollution throughout the life of the Contract.

D. Do not disturb lands or waters outside the limits of construction.

PART 2 – PRODUCTS

2.1 SUBMITTALS

Prior to commencing work, the Contractor shall submit to the Engineer for approval the Contractor's plans for Erosion, Sedimentation and Dust Control. The Erosion Sedimentation and Dust Control Plan shall be in conformance with the overall construction plan and in accordance with Section 01300.

2.2 SOD

The sod type shall be Bahia sod. All sod and mulch shall be free of noxious weeds and exotic pest plants, plant parts or seed listed in the current Category I "List of Invasive Species" from the Florida Exotic Pest Plant Council (FLEPPC). It shall be well matted with roots. The sod shall be taken up in commercial-size rectangles or rolls preferably 12 inches by 24 inches or larger, except where 6-inch strip sodding is called for, or as rolled sod at least 12 inches in width and length consistent with the equipment and methods used to handle the rolls and place the sod. Sod shall be a minimum of 1-1/4 inches thick including a 3/4-inch-thick layer of roots and topsoil.

The sod shall be sufficiently thick to secure a dense stand of live turf. The sod shall be live, fresh and uninjured, at the time of planting. It shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. It shall be planted within 48 hours after being cut and kept moist from the time it is cut until it is planted.

2.3 FERTILIZERS

Fertilizers shall comply with the State fertilizer laws. Fertilizers shall meet the requirements of the FDOT Standard Specifications for Road and Bridge Construction SECTION 982.

2.4 SILT FENCING

A. Geotextiles shall be woven or nonwoven fabrics that will allow the passage of water. Geotextiles shall be packaged in a protective covering sufficient to protect it from sunlight, dirt, and other debris during shipment and storage, upon which the manufacturer's name, product name, style number, roll dimensions and LOT numbers are clearly labeled.

B. Posts: Posts for silt fences shall as shown in the drawings and be either wooden stakes or metal stakes with a minimum length of 3 feet. Steel posts shall have projections for fastening wire to them.

C. Silt Fence shall be a pervious sheet of propylene, nylon, polyester or ethylene yarn and shall be certified by manufacturer or supplier as conforming to the following requirements:

Physical Property	Test Requirements
Permittivity	ASTM-D-4491 .05 SEC^{-1}
Grab tensile	ASTM-D-4632 90 lbs. (min. warp)
Grab Sewn Strength	ASTM-D-4884 2.1 lb/in (min)
Trapezoidal Tear	ASTM-D-4533 35 lbs. (min)

UV Resistance	ASTM-D-4355	80% (500 hrs)
Filtration Efficiency	ASTM-D-5141	75% (min)
Flow Rate	ASTM-D-5141	.3 gal (min)

The base plastic shall contain stabilizers and/or inhibitors to make the filaments resistant to deterioration due to ultraviolet light, heat exposure and potential chemically damaging environment. The fabric shall be free of any treatment which may significantly alter its physical properties. The edges of the fabric shall be selvaged or otherwise finished to prevent the outer yarn from pulling away from the fabric.

D. Other materials: Select all other materials not specifically described but required for compliance with the erosion and sediment control plan, subject to approval by the Engineer.

2.5 FILTER FABRIC

Filter Fabric for inlet protection shall be Type D-3 per FDOT Index 199.

2.6 AGGREGATES

Aggregate for Truck Wash Out area shall be as described in Section 901 excluding 901-2.3 of the FDOT Standard Specifications for Road and Bridge Construction. Aggregates shall be FDOT size No 1. If this size is not available, the next available smaller size aggregate may be substituted with the approval of the Engineer. Sizes containing small aggregate will track off the project and are unsuitable.

PART 3 – EXECUTION

3.1 GENERAL

A. Contractor shall familiarize himself with all the stipulations and requirements of the erosion and sediment control plan. Contractor shall be held responsible for strict adherence to the FDEP generic permit. Contractor shall be deemed liable for any negligence or infringement, which results in non-compliance with this permit.

B. The location of all sediment and erosion control measures shall be left to the Contractor's discretion unless otherwise shown on the Drawings or required by the permit. Should there be no requirement of an erosion control plan, then Contractor shall be required to provide such measures necessary to prevent the formation of gullies or the spread of mud and debris across roads, into waterways or other areas where it may be considered a nuisance.

3.2 PLANNING OF CONSTRUCTION

A. Planning and coordination of the construction is needed to minimize sediment pollution. Clearing shall be kept to shortest distance possible ahead of construction. Cleared areas shall be kept to minimum required to facilitate construction.

B. Restoration work shall be performed as the Project progresses and not be left until the end of the Project. No areas shall be left unprotected for longer than 10 days without some form of temporary seeding or, if during a non-growing season, some other form of stabilization, such as mulch.

3.3 EXCAVATION AND BACKFILL

Excavation shall be closely controlled. The material removed from the excavation shall be selectively stockpiled in areas where a minimum of sediment will be generated and where other damage will not result from piled earth. Drainage swales and ponds shall be protected at all times and the piling of soil in drainageways shall not be allowed. Repaving shall be placed promptly following completion of backfilling and compaction in improved areas.

3.4 STOCKPILES

A. Stockpile areas shall be selected and maintained by on-site personnel. Site selection and stockpile design shall incorporate sediment and erosion control considerations to prevent the potential direct production and delivery of sediment to waterways, and damage to vegetation. Temporary stabilization of stockpiles shall be promptly instituted. The existence of critical slopes on stockpiles shall be avoided. Stockpiling in or immediately adjacent to diversion channels shall not be allowed. If a stockpile is to remain for over sixty (60) days, it shall be stabilized by soil stabilizing chemicals, temporary vegetation, interim structures or other approved practices.

B. Temporary vegetative measures planned for implementation on stockpiles shall be established immediately after stockpile completion. Proper mulching and soil stabilization in conjunction with these seeding operations shall also be carried out.

3.5 SILT FENCES

Place silt fences in a continuous row, parallel to the slope, waterway, roadway or other area being protected. Anchor the silt fence fabric to posts set at a minimum of 10 ft. apart. Embed the bottom of the fabric a minimum of 4" deep and backfill and compact soil over the embedded portion. Replace or repair any sections of fence, which collapse or are washed out during the construction period as soon as reasonably possible.

Inspect all silt fences immediately after each rainfall and at least daily during prolonged rainfall. Immediately correct any deficiencies. In addition, make a daily review of the location of silt fences in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist, install additional silt fences as directed by the Engineer.

Remove sediment deposits when the deposit reaches approximately 1/2 of the volume capacity of the silt fence or as directed by the Engineer. Dress any sediment deposits remaining in place after the silt fence is no longer required to conform to the finished grade and prepare and sod them in accordance with the requirements of this section.

3.6 SODDING

Place the sod on the prepared surface, with edges in close contact. Do not use sod which has been cut for more than 48 hours. Monitor placed sod for growth of pest plants and noxious weeds. If pest plants and/or noxious weeds manifest themselves within 30 days of placement of the sod during the months April through October, within 60 days of placement of the sod during the months of November through March treat affected areas by means acceptable to the City at no expense to the City. If pest plants and/or noxious weeds manifest themselves after the time frames described above from date of placement of sod, the Engineer, at his sole option, will determine if treatment is required and whether or not the Contractor will be compensated for such treatment.

3.7 DUST CONTROL

It shall the Contractor's responsibility to control dust by watering and sweeping at the end of each and every workday or as directed by the Engineer.

3.8 INLET PROTECTION

The Contractor shall protect from sediment and debris any existing catch basin with filter fabric while work is in progress. Filter fabric shall be removed after completion of work or sod has established. Filter fabric must be cleaned periodically to avoid excessive accumulation of sediment and debris. Extreme care shall be taken when removing filter fabric to avoid sediments and debris entering catch basin. Any sediments falling inside the drainage system shall be removed.

4.0 CLEAN UP

A. A spill kit must be provided during the entire duration of the project. The spill kit is to be used in the immediate response and clean-up of spills, leaks or other discharges of hazardous wastes or other hazardous materials (chemical spills). Spill kits shall be maintained in close proximity to areas where chemicals are managed or stored to enable prompt response and clean-up of spills. The contents of a spill kit shall be tailored to the types and quantities of chemicals that can

potentially spill. As a minimum granular absorbent or oil-specific absorbent pads shall be kept on site.

B. Upon project completion, remove all temporary erosion and sediment control devices. Remove from job site all excess materials, debris, surplus tools and equipment. Leave site in a neat and orderly condition acceptable to the Engineer.

C. Upon removal of temporary erosion and sediment control devices, perform all required finish grading, seeding, and mulching as specified under Section 02200.

END OF SECTION

SECTION 02444

FENCING

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, material, equipment and incidentals necessary for complete installation of vinyl coated chain link fence system with privacy decorative slatting. The fencing shall be installed according to manufacturer's specifications unless otherwise directed or authorized by the County.

B. The Contractor's security fencing is at his expense and option and is not covered in this Section.

1.02 QUALITY ASSURANCE

A. Standards of Manufacture shall comply with the standards of the Chain Link Fence Manufacturer's Institute for "Galvanized Steel Chain Link Fence Fabric" and as herein specified.

B. Provide each type of steel fence and gates as a complete unit produced by a single manufacturer, including, but not limited to accessories, fittings, fasteners and appurtenances complete and ready for use.

C. Acceptable Manufacturers: Anchor, Cyclone, or approved equal

D. Erector Qualifications: The Contractor or approved subcontractor, must have a minimum of two years experience in similar fence installation.

1.03 SUBMITTALS

A. Product Data:

For Steel Fences and Gates, the Contractor shall submit for review and approval to the County, five (5) copies of the manufacturer's technical data, details of fabrication, installation instructions and procedures for steel fences and gates. The Contractor shall be responsible for a copy of each instruction to be given to the Installer.

B. Samples:

The Contractor shall submit two samples approximate size 6-inches long, or 6-inches square of fabric material, framework members and typical accessories to the County for review and approval.

C. Certificates:

The Contractor shall provide manufacturer's certification that materials meet or exceed the Contract Document requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. The pipe sizes indicated are commercial pipe sizes.

B. The tube sizes indicated are nominal outside dimension.

C. Framework and appurtenances shall be finished with not less than minimum weight of zinc per sq. ft. and shall comply with the following:

1. Pipe: ASTM A53 (1.8 oz. zinc psf)
2. Square tubing: ASTM A 123 (2.0 oz. zinc psf)
3. Hardware and Accessories: ASTM A 153 (zinc weight per Table I).

D. All fence components shall be galvanically compatible.

E. Vinyl coatings for fabric, posts, rails, gates, and all other fittings and components shall be thermally fused polyvinyl chloride; heavy mil coating per ASTM F 668.

2.02 FABRIC

Fabric shall be 0.148 inch (9 gage) steel wire, 2-inch diamond mesh and both top and bottom salvages shall be twisted and barbed for fabric over 60-inches high. Finish shall be hot dipped galvanized, ASTM A 392, Class II.

2.03 POSTS, RAILS AND BRACES

A. End, Corner and Pull Posts:

The Contractor shall furnish end, corner and pull posts of the minimum size of 3” (2-1/2-inch min. OD) pipe weighing 3.65 pounds min. per linear ft.

B. Line Post:

The Contractor shall furnish line posts of the minimum size of 2.5” Post (2-3/8-inch min. OD) pipe weighing 2.72 pounds min. per linear foot. Post shall be spaced 8 foot o.c. maximum, unless otherwise indicated:

C. Gate Posts:

The Contractor shall furnish 4" (3-1/2-inch min. OD) gate posts for supporting a 6 feet wide, single gate leaf, or one leaf of a double gate installation, for nominal gate width; weighing 5.79 pounds min. per linear foot.

D. Top Rails:

The Contractor shall furnish 1-5/8-inch min. Sch 40 vinyl coated top rail pipe weighing 2.27 pounds min. per linear, unless otherwise indicated.

E. Post Brace Assembly:

The Contractor shall furnish bracing assemblies at the end, gate, at both sides of corner and pull posts, with the horizontal brace located at mid-height of the fabric. Use 1-5/8-inch min. OD pipe weighing 2.27 pounds min. per linear foot for horizontal brace and 3/8-inch diameter rod with turnbuckles for diagonal truss.

F. Tension Wire:

The Contractor shall furnish tension wire consisting of galvanized 0.177 inch (7 gage) coiled spring wire as per ASTM A824 at the bottom of the fabric only.

G. Barbed Wire Supporting Arms (only when specified):

The Contractor shall furnish pressed steel, wrought iron, or malleable iron barbed wire supporting arms, complete with provisions for anchorage to posts and attaching three rows of barbed wire to each arm. Supporting arms may be attached either to posts or integral with post top weather cap. The Contractor shall provide a single 45 degree arm for each post where indicated.

H. Barbed Wire (only when specified):

The Contractor shall furnish barbed wire. It shall be 2 strand, 12-1/2 gauge wire with 14 gauge, 4-point barbs spaced 5-inch o.c., galvanized, complying with ASTM A121, Class 3.

I. Post Tops:

The Contractor shall furnish post tops. Tops shall be pressed steel, wrought iron, or malleable iron of ASTM F626 designed as a weathertight closure cap (for tubular posts). The Contractor shall furnish one cap for each post unless equal protection is afforded by a combination of post top cap and barbed wire supporting arm. The Contractor shall furnish caps with openings to permit through passage of the top rail.

J. Stretcher Bars:

The Contractor shall furnish stretcher bars. Bars shall be one piece lengths equal to the full height of the fabric, with a minimum cross-section of 3/16-inch x 3/4-inch. The Contractor shall provide one stretcher bar for each gate and end post and two bars for each corner and pull post, except where fabric is integrally woven into the post.

K. Stretcher Bar Bands:

The Contractor shall furnish stretcher bar bands. Bands shall be steel, wrought iron, or malleable iron, a maximum space of 15-inch o.c. to secure stretcher bars to end, corner, pull and gate posts.

2.04 GATES

A. The Contractor shall provide a 6 feet high, 6 feet wide fabricated gate perimeter frames of 1-5/8-inch min. OD pipe tubular members weighting 2.27 pounds min. per linear foot. Additional horizontal and vertical members shall ensure proper gate operation and attachment of fabric, hardware and accessories. The maximum space of the frame members shall not be more than 8-inches apart.

B. The Contractor shall assemble gate frames by welding or with special malleable or pressed steel fittings and rivets for rigid connections. He shall use the same fabric width as for the fence, unless otherwise indicated in the Contract Documents or authorized by the County. He shall install the fabric with stretcher bars at vertical edges. The bars may also be used at the top and bottom edges. The contractor shall attach stretchers to the gate frame at a maximum spacing of 15-inch o.c. He shall attach the hardware with rivets or by other means which will prevent removal or breakage.

C. The Contractor shall install diagonal cross-bracing consisting of 3/8-inch diameter adjustable length truss rods on gates as necessary to ensure frame rigidity without sag or twist.

D. The Contractor shall install barbed wire above the gates, (only when specified). He shall extend the end members of gate frames 12-inches above the top member which will be prepared for three strands of wire. The Contractor shall provide necessary clips for securing wire to extensions.

E. Gate Hardware:

1. The Contractor shall furnish the following hardware and accessories for each gate.

   a. Hinges: Pressed or forged steel or malleable iron to suit gate size, non-lift-off type, offset to permit 180 degrees gate opening. Provide 1-1/2 pair of hinges for each leaf over six feet nominal height.

b. Latch: Forked type of plunger-bar type to permit operation from either side of gate with padlock eye as integral part of latch.

c. Keeper: Provide keeper for all vehicle gates, which automatically engages the gate leaf and holds it in the open position until manually released.

d. Double Gates: Provide gate stops for double gates, consisting of mushroom type of flush plate with anchors. Set in concrete to engage the center drip drop rod or plunger bar. Include locking device and padlock eyes as an integral part of the latch, using one padlock for locking both gate leaves.

e. Where gates are between masonry piers, provide "J" with 4-inch square anchor plate to masonry contractor for building in.

2.05 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Wire Ties: The Contractor shall tie fabric to line posts. He shall use 9 gauge wire ties spaced 12-inches o.c. For tying fabric to rails and braces, he shall use 9 gauge wire ties spaced 24-inches o.c. For tying fabric to tension wire, he shall use 11 gauge hog rings spaced 24-inches o.c. The finish of ties shall match the fabric finish.

B. Concrete: The Contractor shall provide portland cement concrete in compliance with ASTM C-150 and the Contract Documents. Aggregates shall comply with ASTM C-33. The Contractor shall mix the materials to obtain a minimum 28-day compressive strength of 3,000 psi, using a minimum of 4 sacks of cement per cubic yard, a maximum size aggregate of 1-inch, a maximum 3-inch slump and air entrainment of 2 percent to 4 percent.

C. Privacy Decorative Slatting (PDS) shall be PVC, bottom locking, non-fin type, sized to match the fabric height and color in both the fence and gates.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The Contractor shall not start the fence installation prior to the final grade completion, and the finish elevations established, unless otherwise authorized by the County.

B. The Contractor shall repair damaged coatings in the shop or in the field by recoating utilizing manufacturers recommended repair compounds and as applied per manufacturer's recommendations.

C. Excavation:

1. For post footings, the Contractor shall drill holes in firm, undisturbed or compacted soil of the diameters and spacings shown or called out in the Contract Documents.

    a. For holes not shown or called out on the Contract Documents, the Contractor shall excavate minimum diameters recommended by the fence manufacturer.

    b. Post holes shall be in true alignment and of sufficient size to provide a permanent concrete foundation. Concrete shall be poured against undisturbed earth sides and bottom. All holes shall be 48-inches deep with posts and corner posts placed in the concrete to a depth of 36-inches. The gate posts shall be set in the concrete to a depth of 42-inches below the surface in firm, undisturbed soil. Holes shall be well centered on the posts. A minimum diameter of 12-inches shall be required for all corner and line post holes; 18-inches min. shall be required for all gate post holes.

    c. Excavated soil shall be removed from the County's property.

    d. If solid rock is encountered near the surface, the Contractor shall drill into rock at least 12-inches for line posts and at least 18-inches for end, pull, corner or gate posts. Hole shall be drilled to at least 1-inch greater diameter than the largest dimension of the post to be place.

    e. If the Contractor encounters solid rock below solid overburden, he shall drill to the full depth required; however, rock penetration need not exceed the minimum depths specified.

D. Setting Posts:

1. The Contractor shall remove loose and foreign materials from the sides and bottoms of holes, and moisten soil prior to placing concrete.

    a. Center and align posts in holes above bottom of excavation.

    b. Place concrete around posts in a continuous pour and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold in position during placement and finishing operations. The top of concrete shall extend 2-inches above finish grade.

    c. Trowel finish tops of footings and slope or dome to direct water away from posts. Extend footings for gate posts to the underside of bottom hinge. Set keeps, stops, sleeves and other accessories into concrete as required.

    d. Keep exposed concrete surfaces moist for at least 7 days after placement, or cure with membrane curing materials, or other acceptable curing method.

    e. Grout-in posts set into sleeved holes, concrete constructions, or rock

excavations with non-shrink portland cement grout, or other acceptable grouting material.

E. Concrete Strength:

The Contractor shall allow the concrete to attain at least 75% of its minimum 28-day compressive strength no sooner than 7 days after placement, before rails, tension wires, barbed wire, or fabric is installed. The Contractor shall not stretch and tension fabric or wires and shall not hang gates until the concrete has attained its full design strength.

F. Top Rails:

The Contractor shall run the rail continuously through post caps or extension arms and bend to radius for curved runs. He shall provide expansion coupling as recommended by fencing manufacturer.

G. Brace Assemblies:

The Contractor shall install braces so that posts are plumb when diagonal rod is under proper tension.

H. Tension Wire:

The Contractor shall install tension wires by weaving through the fabric and tying to each post with not less than 0.177 inch (7 gage) galvanized wire, or by securing the wire to the fabric.

I. Fabric:

The Contractor shall leave approximately 3-inches between finish grade and bottom salvage, except where the bottom of the fabric extends into the concrete. He shall pull the fabric taut and tie it to posts, rails and tension wires. He shall install fabric on the security side of the fence and anchor it to the framework so that the fabric remains in tension after the pulling force is released.

J. Stretcher Bars:

The Contractor shall thread through or clamp the bars to the fabric 4-inches o.c. and secure them to posts with metal bands spaced 15-inches o.c.

K. Barbed Wire (only when spedified):

The Contractor shall install 3 parallel wires on each extension arm on the security side of fence, unless otherwise indicated. He shall pull the wire taut and fasten securely to each extension arm.

L. Gate:

The Contractor shall install gates plumb, level and secure for full opening without interference. He shall install ground-set items in concrete for anchorage, as recommended by the fence manufacturer. He shall adjust hardware for smooth operation and lubricate where necessary.

M. Tie Wires:

The Contractor shall use U-shaped wire, conforming to the diameter of the attached pipe, and shall clasp the pipe and fabric firmly with twisted ends of at least 2 full turns. He shall bend the end of the wire to minimize hazard to persons or clothing.

N. Fasteners:

The Contractor shall install nuts for tension band and hardware bolts on the side of fence opposite the fabric side. Pen ends of bolts or score threads to prevent removal of nuts.

3.02 INSTALLATION

Fence shall be constructed such that each run of fence between corner posts or gate posts has equal spacing between the line posts. Spacing shall not exceed 8 feet.

END OF SECTION

SECTION 02480

LANDSCAPING

PART 1 – GENERAL

1.10 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals required to install trees, ground cover, and shrubs, to place accessory planting materials, to maintain and guarantee all planted areas. All work shall be in strict accordance with sound nursery practice and shall include maintenance and watering of all of the work of this Contract until final completion and acceptance by the County.

B. The landscaping shall be performed by a contractor or subcontractor who specializes in landscaping and who is fully familiar and experienced in projects of this type and scope. The landscaping contractor or subcontractor shall be subject to the approval of the County.

C. The Contractor shall provide all landscaping complete and ready for use as specified in the Contract Documents and as shown on the Drawings.

1.02 SUBMITTALS

A. The Contractor shall submit to the County for review and approval, shop drawings and complete written maintenance instructions for each type of plant furnished under this Contract.

B. The Contractor shall submit representative samples of any or all of required accessory planting materials as requested by the County.

1.03 OBSTRUCTIONS BELOW GROUND

A. The County may change the location of plant material if underground construction, utilities or obstructions are encountered in excavation of planting areas or pits.

B. The Contractor shall make such changes without additional compensation from the County.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Plant species and size shall conform to those indicated in the Plant List and in plan locations shown on the Drawings. Nomenclature shall conform to the Florida

Department of Agriculture: "Grades and Standards for Nursery Plants". The designated authority for identification of plants shall be in conformance with FDOT Standard Specification Section 580-2.1.1 Plants.

B. Plants shall be sound, healthy, vigorous, free from plant diseases, insects, pests, or their eggs and shall have healthy normal root systems. Plants shall be nursery grown stock, freshly dug. No heeled in, cold storage, or collected stock shall be accepted.

C. Shape and Form

1. Plant material shall be symmetrical, typical for the variety and species, and shall conform to the measurements specified in the Plant List.
2. Plants used where symmetry is required shall be matched as nearly as possible.
3. Plants shall not be pruned prior to delivery except as authorized by the County.
4. All plants shall have been transplanted or root pruned at least once in the past three years.
5. Unless otherwise noted, street trees shall be free of branches up to six feet, with the single leader well branched, and with straight trunks.
6. Shrubs shall have been transplanted twice, have fully developed root systems, be heavily canned with foliage to base, fulfill dimensions required, and be typical of species.
7. Ground covers shall have sturdy fibrous root systems and shall be heavily leafed.

D. Measurement: The height and/or width of trees shall be measured from the ground or across the normal spread of branches with the plants in their normal position. This measurement shall not include the immediate terminal growth.

E. Substitutions in plant species or size shall be made only with the written approval of the County.

F Ground cover plants shall be planted in beds of four inches of approved topsoil. The beds shall be thoroughly disked into the soil. The compacted and settled finished surface shall be set to the required grade. Plants shall be spaced as described in the Contract Documents or shown on the Contract Drawings, or otherwise directed by the County in accordance with the best practices of the trade.

G. Planting Soil

1. Soil for backfilling around plants and planting beds shall be a good grade of garden loam as approved by the County. Soil shall be free of heavy clay, coarse sand, stones, lumps, sticks, or other foreign material. The soil shall not be delivered or used in a muddy condition.

2. The soil shall be taken from ground that has never been stripped. There shall be a slight acid reaction to the soil with no excess of calcium or carbonate. The soil shall be free from excess weeds or other objectionable material.
3. Soil for trees and shrubs shall be delivered in a loose, friable condition. All trees shall average approximately one cubic yard per tree, except Sabal Palmetto, which shall be planted with clean sand. There shall be a minimum of 4-inches of planting soil in ground cover areas and 1/8 cubic yard per shrub or vine.
4. No marl shall be allowed in ground cover planting beds.

H. Before plants are backfilled with planting soil, fertilizer tablets, Agriform 20-10-5 or equal, shall be placed in each pit. The Contractor shall provide three tablets for each tree and one for each shrub or vine.

I. Tree Staking: All tree staking and bracing shall be included herein in accordance with sound nursery practice and shall be in accordance with the Contract Documents. The Contractor shall furnish all materials required for staking and bracing as approved.

J. Landscaping stones shall be inert and nonleaching. The Contractor shall provide physical samples for approval prior to installation. Crushed limerock shall not be acceptable.

PART 3 – EXECUTION

3.01 PLANTING PROCEDURES

A. Plant Locations: All plants shall be located as shown on the Drawings, to dimensions if shown, to scale if not dimensioned. Large areas or beds shall be scaled and the plants spaced evenly. Approval by the County is required before any plants may be installed.

B. Tree Pits: Pits for trees shall be at least two feet greater in diameter than the specified diameter of the ball. Pits shall be of sufficient depth to allow a 12-inch layer of planting soil under the ball when it is set to grade. Bottom of pit shall be loosened prior to backfilling.

C. Digging and Handling

1. Plants shall be handled at all times so that roots or balls are adequately protected from sun or drying winds. Tops or roots of plant allowed to dry out will be rejected.
2. Balled and burlapped plants shall be moved with firm, natural balls of soil, not less than one foot diameter of ball to every one inch caliper of trunk, and a depth of not less than 2/3 of ball diameter. No plant shall be accepted when the ball of earth surrounding its roots has been cracked or broken. All trees,

except palms, shall be dug with ball and burlapped. Root pruning shall have been done at minimum of four weeks before planting at the job.

3. Bare root plants shall be dug with spread of root and of sufficient depth to insure full recovery of plant.

D. Cabbage Palms (Sable Palmetto):

1. Cabbage Palms shall be taken from moist black sand areas. Only a minimum of fronds shall be removed from the crown to facilitate moving and handling. Clear trunk or overall height shall be as specified after the minimum of fronds have been removed.
2. Cabbage Palms buds shall be tied to a suitable support with a burlap strip, to be left in place until the tree is well established in its new location.
3. Cabbage Palms shall be planted in sand, thoroughly washed in during planting operations, and with a dished or saucer depression left at the soil line for future waterings. Palms with marred or burned trunks will be accepted at the discretion of the County only.
4. Trees moved by winch or crane shall be thoroughly protected from chain marks, girdling or bark slippage by means of burlap, wood battens, or other approved method.

E. When balled or burlapped plants are set, planting soil shall be carefully tamped under and around the base of the balls to prevent voids. All burlap, rope, wires, etc., shall be removed from the sides and tops of balls, but no burlap shall be pulled from underneath. Roots of bare rooted plants shall be properly spread out and planting soil carefully worked in among them.

F. All plants shall be set straight or plumb, in locations shown on the Drawings. Except as otherwise specified, plants shall be planted in pits which shall be set at such level that, after settlement, they bear the same relation to the finished grade or the surrounding ground as they bore to the grade of the soil from which they are taken.

G. Pruning shall be carefully done by experienced plantsmen. Prune immediately upon acceptance by the County, including any broken branches, thinning small branches and tipping back main branches (except main leaders).

H. Excess soil and debris shall be disposed of off the project site unless ordered stockpiled by the County.

3.02 NORMAL MAINTENANCE OF PLANT MATERIALS

A. Plant material maintenance shall begin when planting operations start and shall extend until final acceptance of work.

B. Maintain all plant materials under this Contract to the satisfaction of the County.

Maintenance shall include necessary watering, cultivation, weeding, pruning, spraying, tightening and repair to guy wires, removal of dead material, resetting, and other work required to conform with referenced standards and accepted nursery standards as approved.

C. Plant materials which are in a tilted or in a leaning position shall be properly righted.

D. After final acceptance by the County and until one calendar year after acceptance of all plantings, the landscaping contractor or subcontractor shall make monthly inspections of materials and report in writing to the County the conditions of the plants and the necessary requirements to keep the plants in a healthy growing condition.

3.03 TREE AND PLANT PROTECTION

A. The Contractor shall remove all trees (if any) within the limit of landscaping shown on the detail sheet except those designated to be salvaged (if any). Prior to removal of said trees, the Contractor shall obtain a tree removal permit, if required. All other trees in the vicinity of the work shall be protected against damage by the Contractor until all work under the Contract has been completed.

B. Consult with the County, and remove agreed-on roots and branches which interfere with construction. Employ qualified tree surgeon to remove, and to treat cuts.

C. Provide temporary barriers to a height of six feet around each group of trees and plants.

D. Protect root zones of trees and plants

1. Do not allow vehicular traffic or parking.
2. Do not store materials or products.
3. Prevent dumping or refuse or chemically injurious materials or liquids.
4. Prevent puddling or continuous running water.

E. Carefully supervise excavating, grading, and filling, and subsequent construction operations, to prevent damage.

F. In case of inadvertent damage to any tree or plant by the Contractor or any of his subcontractors or employees, the Contractor shall provide replacement of each such damaged tree or plant with a new one of acceptable type, size and quality.

G. Completely remove barricades, including foundations, when construction has progressed to the point that they are no longer needed, and when approved by the County.

H. Clean and repair damage caused by installation, fill and grade the areas of the site

to required elevations and slopes, and clean the area.

3.04 GUARANTEE

The life and satisfactory condition of all plant material planted shall be guaranteed by the Contractor for a minimum of one calendar year. Guarantee shall include complete replacement with material of the same kind and size as in the original work if not in a healthy condition, as determined by the County, at the end of the guarantee period.

3.05 REPLACEMENT

A. At the end of the guarantee period, any plant required under this Contract that is dead or not in satisfactory growth as determined by the County, shall be removed. Plants replaced shall be guaranteed for 90 days after date of replacement.

B. Replacement of plants necessary during guarantee period shall be the responsibility of the Contractor, except for possible replacements of plants resulting from removal, vandalism, acts of neglect on the part of others, or acts of God.

C. All replacements shall be plants of the same kind and size as specified in the Drawings. They shall be furnished and planted as herein specified. The cost shall be the responsibility of the Contractor.

END OF SECTION

SECTION 02485

SEEDING AND SODDING

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials and equipment necessary to satisfactorily return all construction areas to their original conditions or better.

B. Work shall include furnishing and placing seed or sod, fertilizing, planting, watering and maintenance until acceptance by County.

1.02 RELATED WORK NOT INCLUDED

Excavation, filling and grading required to establish elevation shown on the Drawings are included under other sections of these Specifications.

1.03 QUALITY ASSURANCE

A. It is the intent of this Specification that the Contractor is obliged to deliver a satisfactory stand of grass as specified. If necessary, the Contractor shall repeat any or all of the work, including grading, fertilizing, watering and seeding or sodding at no additional cost to the County until a satisfactory stand is obtained. For purposes of grassing, a satisfactory stand of grass is herein defined as a full lawn cover over areas to be sodded or seeded, with grass free of weeds, alive and growing, leaving no bare spots larger than 3/4 square yard within a radius of 8 feet.

B. All previously grassed areas where pipelines are laid shall be sodded. All sodding and grassing shall be installed in accordance with these Specifications or as directed by the County.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Fertilizer: The fertilizer shall be of the slow-release type meeting the following minimum requirements: 12 percent nitrogen, 8 percent phosphorus, 8 percent potassium; 40 percent other available materials derived from organic sources. At least 50 percent of the phosphoric acid shall be from normal super phosphate or an equivalent source which will provide a minimum of two units of sulfur. The amount of sulfur shall be indicated on the quantitative analysis card attached to each bag or other container. Fertilizer shall be uniform in composition, dry and free

flowing delivered to sites in original unopened containers bearing manufacturer's statement or guarantee.

B. Seeding/Grassing: The Contractor shall grass all unpaved areas disturbed during construction which do not require sod. All grassing shall be completed in conformance with FDOT Specifications, Sections 570 and 981. The grassed areas shall be mulched and fertilized in accordance with FDOT Specifications, except that no additional payment will be made for mulching, fertilizing and/or watering.

C. Sodding: Sod shall be provided as required on the construction drawings or at locations as directed by the County in accordance with Florida Department of Transportation, Specifications Section 575 and 981. The Contractor shall furnish bahia grass sod or match existing sod. Placement and watering requirements shall be in accordance with FDOT Specifications Section 575, except that no additional payment will be made for placement and/or watering. This cost shall be included in the Contract price bid for sodding.

D. Topsoil: Topsoil stockpiled during excavation may be used as necessary. If additional topsoil is required to replace topsoil removed during construction, it shall be obtained off site at no additional cost to the County. Topsoil shall be fertile, natural surface soil, capable of producing all trees, plants and grassing specified herein.

E. Water: It is the Contractor's responsibility to supply all water to the site, as required during seeding and sodding operations and through the maintenance period and until the work is accepted. The Contractor shall make whatever arrangements that may be necessary to ensure an adequate supply of water to meet the needs for his work. He shall also furnish all necessary hose, equipment, attachments and accessories for the adequate irrigation of lawns and planted areas as may be required. Water shall be suitable for irrigation and free from ingredients harmful to plant life.

PART 3 – EXECUTION

3.01 INSTALLATION

A. When the trench backfill has stabilized sufficiently, the Contractor shall commence work on lawns and grassed areas, including fine grading as necessary and as directed by the County.

B. Finish Grading: Areas to be seeded or sodded shall be finish graded, raked, and debris removed. Soft spots and uneven grades shall be eliminated. The County shall approve the finish grade of all areas to be seeded or sodded prior to seed or sod application.

C. Areas to be sodded shall be excavated or cut-down to accept the approximate 2" thick sod, so finish grade matches existing. Sod shall not be thrown over top of existing sod or debris.

D. Protection: Seeded and sodded areas shall be protected against traffic or other use by placing warning signs or erecting barricades as necessary. Any areas damaged prior to acceptance by the County shall be repaired by the Contractor as directed by the County.

3.02 CLEANUP

Soil or similar materials spilled onto paved areas shall be removed promptly, keeping those areas as clean as possible at all times. Upon completion of seeding and sodding operations, all excess soil, stones and debris remaining shall be removed from the construction areas.

3.03 LANDSCAPE MAINTENANCE

A. Any existing landscape items damaged or altered during construction by the Contractor shall be restored or replaced as directed by the County.

B. Maintain landscape work for a period of 90 days immediately following complete installation of work or until County accepts project. Watering, weeding, cultivating, restoration of grade, mowing and trimming, protection from insects and diseases, fertilizing and similar operations as needed to ensure normal growth and good health for live plant material shall be included at no additional cost to the County.

3.04 REPAIRS TO LAWN AREAS DISTURBED BY CONTRACTOR'S OPERATORS

Lawn areas planted under this Contract and all lawn areas damaged by the Contractor's operation shall be repaired at once by proper soil preparation, fertilizing and sodding, in accordance with these Specifications.

END OF SECTION

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SECTION 02513

ASPHALT CONCRETE PAVING

PART 1 – GENERAL

1.01 SCOPE OF WORK

The Contractor shall furnish all labor, materials and equipment necessary to complete all milling asphalt pavement and asphalt concrete paving (including restoration of driveways) as called out on the Contract Documents or as shown on the Drawings.

1.02 QUALITY ASSURANCE

A. Qualifications of Asphalt Concrete Producer: The only materials permitted shall be furnished by a bulk asphalt concrete producer exclusively engaged in the production of hot-mix, hot-laid asphalt concrete.

B. Qualification of Testing Agency: The County may employ a commercial testing laboratory to conduct tests and evaluations of asphalt concrete materials and design. The Contractor shall:

1. Provide asphalt concrete testing and inspection service acceptable to County.
2. Include sampling and testing asphalt concrete materials proposed, and tests and calculations for asphalt concrete mixtures.
3. Provide field testing facilities for quality control testing during paving operations.

C. Requirements of Regulatory Agencies: The Contractor shall comply with the applicable requirements of:

1. Manatee County Utility Operations Department
2. Manatee County Transportation Department
3. State of Florida Dept. of Transportation

1.03 PAVING QUALITY REQUIREMENTS

A. General: In addition to other specified conditions, the Contractor shall comply with the following minimum requirements:

1. In-place asphalt concrete course shall be tested for compliance with requirements for density, thickness and surface smoothness.
2. Final surface shall be provided of uniform texture, conforming to required grades and cross sections.

3. A minimum of four inch diameter pavement specimens for each completed course shall be taken from locations as directed by the County.
4. Holes from test specimens shall be repaved as specified for patching defective work.

B. Density:

1. When subjected to 50 blows of standard Marshall hammer on each side of an in place material specimen, densities shall be comparable to a laboratory specimen of same asphalt concrete mixture.
2. The minimum acceptable density of in-place course material shall be 98% of the recorded laboratory specimen density.

C. Thickness: In-place compacted thicknesses shall not be acceptable if less than the minimum thicknesses shown on the Drawings.

D. Surface Smoothness:

1. Finished surface of each asphalt concrete course shall be tested for smoothness, using a 10 ft. straightedge applied parallel to and at right angles to centerline of paved areas.
2. Surface areas shall be checked at intervals directed by County.
3. Surfaces shall not be acceptable if they exceed the following:
   a. Base Course: 1/4 in. in 10 ft.
   b. Surface Course: 3/16 in. in 10 ft.
   c. Crowned Surfaces:
   1) Test crowned surfaces with a crown template, centered and at right angles to the crown.
   2) Surfaces will not be acceptable if varying more than 1/4 in. from the template.

1.04 SUBMITTALS

A. Samples: The Contractor may be required to provide samples of materials for laboratory testing and job-mix design.

B. Test Reports: The Contractor shall submit laboratory reports for following materials tests:

1. Coarse and fine aggregates from each material source and each required grading:
   a. Sieve Analysis: ASTM C 136 (AASHO T 27).
   b. Unit Weight of Slag: ASTM C29 (AASHO T 19).
   c. Soundness: ASTM C 88 (AASHO T 104) for surface course aggregates only.
   d. Sand Equivalent: ASTM D 2419 (AASHO T 176).

e. Abrasion of Coarse Aggregate: ASTM C131 (AASHO T 96),for surface course aggregates only.

2. Asphalt cement for each penetration grade:
   a. Penetration: ASTM D5 (AASHO T49).
   b. Viscosity (Kinematic): ASTM D2170 (AASHO T 201).
   c. Flash Point: ASTM D92 (AASHO T 48).
   d. Ductility: ASTM D 113 (AASHO T 51).
   e. Solubility: ASTM D 4 (AASHO T 44).
   f. Specific Gravity: ASTM D 70 (AASHO T 43).
3. Job-mix design mixtures for each material or grade:
   a. Bulk Specific Gravity for Coarse Aggregate: ASTM C 117(AASHO T 85).
   b. Bulk Specific Gravity for Fine Aggregate: ASTM C 128(AASHO T 84).
4. Uncompacted asphalt concrete mix: Maximum Specific Gravity: ASTM D 2041 (AASHO T 209).
5. Compacted asphalt concrete mix:
   a. Bulk Density: ASTM D 1188 (AASHO T 166).
   b. Marshall Stability and Flow: ASTM D 1559.
6. Density and voids analysis:
   a. Provide each series of asphalt concrete mixture text specimens, in accordance with A.I. MS-2 "Mix Design Methods for Asphalt Concrete".
   b. Use Marshall method of mix design unless otherwise directed or acceptable to the County.
   c. Report the quantity of absorbed asphalt cement in pounds of dry aggregate, percent air voids, and percent voids in mineral aggregate.
7. Sampling and testing of asphalt concrete mixtures for quality control during paving operations:
   a. Uncompacted asphalt concrete mix.
      1) Asphalt Cement Content: ASTM D 2172 (AASHO T 164).
      2) Penetration of Recovered Asphalt Cement: ASTM D 5(AASHO T 49).
      3) Ductibility of Recovered Asphalt Cement: ASTM D 113(AASHO T 51).
   b. Compacted asphalt concrete mix:
      1) Bulk Density: ASTM D 1188 (AASHO T 166).
      2) Marshall Stability and Flow: ASTM D1559).
   c. Perform at least one test for each day's paving.
8. Asphalt plant inspection: ASTM D 290.
9. Additional testing:
   a. Retesting shall be required if previous tests indicate insufficient values, or if directed by the County.
   b. Testing shall continue until specified values have been attained.
10. Asphalt concrete materials which do not comply with specified requirements shall not be permitted in the work.

1.05 JOB CONDITIONS

A. Weather Limitations:

1. Apply bituminous prime and tack coats only when the ambient temperature in the shade is 50 degrees F. and when the temperature has not been below 35 degrees F. for 12 hours immediately prior to application.
2. Do not apply when the base surface is wet or contains an excess of moisture which would prevent uniform distribution and the required penetration.
3. Construct asphalt concrete surface course only when atmospheric temperature is above 40 degrees F., when the underlying base is dry, and when weather is not rainy.
4. Base course may be placed when air temperature is not below 30 degrees F. and rising, when acceptable to the County.

B. Grade Control: Establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.

C. Traffic Control: Maintain vehicular and pedestrian traffic during paving operations, as required for other construction activities.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Soil Cement or Shell Base Course: as specified in FDOT Section 270, "Material for Base and Stabilized Base", and as called for in the Contract Documents.

B. Aggregate for Asphalt Concrete, General:

1. Sound, angular crushed stone, crushed gravel, or crushed slag: ASTM D 692.
2. Sand, stone, or slag screening: ASTM D 1073.
3. Provide aggregate in gradations for various courses to comply with local highway standards.

C. Surface Course Aggregates:

1. Provide natural sand, unless sand prepared from stone, slag, or gravel or combinations are required to suit local conditions.

D. Asphalt Cement: Comply with ASTM D 946 for 85-100 penetration grade.

E. Prime Coat:

1. Cut-back liquid asphalt.
2. Medium-Curing type: ASTM D 2027, Grade MC-70.

2.02 ASPHALT-AGGREGATE MIXTURES

A. Job-mix criteria:

1. Provide job-mix formulas for each required asphalt-aggregate mixture.
2. Establish a single percentage of aggregate passing each required sieve size, a single percentage of asphalt cement to be added to aggregate, and a single temperature at which asphalt concrete is to be produced.
3. Comply with the mix requirements of local governing highway standards.
4. Maintain material quantities within allowable tolerances of the governing standards.

2.03 TRAFFIC AND PARKING MARKING MATERIALS

A. Traffic lane marking paint with chlorinated rubber base.

B. Factory mixed, quick drying and non bleeding, FS TT-P-115C, Type III.

C. Color: Driving Lane Dividers - White
No Parking Zone - Yellow
Parking Dividers - White

PART 3 – EXECUTION

3.01 SURFACE PREPARATION

A. Subbase Preparation:

1. The Contractor shall remove from the area all organic substance encountered to a depth of six or eight inches (6" or 8"), or to such depth and width as directed by the County. The entire area shall be plowed and dragged prior to placing a stabilizing additive, if required to meet minimum bearing value.
2. Subbase shall be compacted to a minimum density of 98 percent of the maximum as determined by the Modified Proctor Density AASHTO T180, and shall have a minimum bearing value of 40 pounds per square inch as determined by the Florida Bearing Test.

B. Base Course:

1. Check subgrade for conformity with elevations and section immediately before placing base material.

2. Place base material in compacted layers not more than 6 inches thick, unless continuing tests indicate the required results are being obtained with thicker layers.
3. In no case will more than 8-inches of compacted base be placed in one lift.
4. Spread, shape, and compact all base material deposited on the subgrade during the same day.
5. Compact base course material to be not less than 98% of maximum density: ASTM D 1557, Method D (98 percent maximum density: AASHTO T-180).
6. Test density of compacted base course: ASTM D 2167.
7 Conduct one test for each 250 sq. yds. of in-place material, but in no case not less than one daily for each layer.

C. Loose and Foreign Material:

1. Remove loose and foreign material from compacted subbase surface immediately before application of paving.
2. Use power brooms or blowers, and brooming as required.
3. Do not displace subbase material.

D. Prime Coat:

1. Uniformly apply at rate of 0.20 to 0.5 gal. per sq. yd. over compacted and cleaned subbase surface.
2. Apply enough material to penetrate and seal, but not flood the surface.
3. Allow to cure and dry as long as required to attain penetration and evaporation of volatile, and in no case less than 24 hours unless otherwise acceptable to the County.
4. Blot excess asphalt with just enough sand to prevent pick-up under traffic.
5. Remove loose sand before paving.

E. Tack Coat:

1. Dilute material with equal parts of water and apply to contact surfaces of previously constructed asphalt concrete or portland cement concrete and similar surfaces.
2. Apply at rate of 0.05 to 0.15 gal. per sq. yd. of surface.
3. Apply tack coat by brush to contact surfaces of structures projecting into or abutting asphalt concrete pavement.
4. Allow surfaces to dry until material is at condition of tackiness to receive pavement.

3.02 MANHOLE FRAME / VALVE BOX ADJUSTMENTS (IF APPLICABLE)

A. Placing Manhole frames:

1. Surround manhole frames set to elevation with a ring of compacted asphalt concrete base prior to paving.
2. Place asphalt concrete mixture up to 1 in. below top of frame, slope to grade, and compact by hand tamping.

B. Adjust manhole frames to proper position to meet paving.

C. If permanent covers are not in place, provide temporary covers over openings until completion of rolling operations.

D. Set cover manhole frames to grade, flush with surface of adjacent pavement.

3.03 PREPARING THE MIXTURE

A. Comply with ASTM D 995 for material storage, control, and mixing, and for plant equipment and operation.

B. Stockpiles:

1. Keep each component of the various-sized combined aggregates in separate stockpiles.
2. Maintain stockpiles so that separate aggregate sizes shall not be intermixed.

C. Heating:

1. Heat the asphalt cement at the mixing plant to viscosity at which it can be uniformly distributed throughout mixture
2. Use lowest possible temperature to suit temperature-viscosity characteristics of asphalt.
3. Do not exceed 350 degrees F. (176.6 degrees C.).

D. Aggregate:

1. Heat-dry aggregates to reduce moisture content to not more than 2.0%.
2. Deliver dry aggregate to mixer at recommended temperature to suit penetration grade and viscosity characteristics of asphalt cement, ambient temperature, and workability of mixture.
3. Accurately weigh or measure dry aggregates and weigh or meter asphalt cement to comply with job-mix formula requirements.

E. Mix aggregate and asphalt cement to achieve 90-95% of coated particles for base mixtures and 85-90% of coated particles for surface mixture, when tested in accordance with ASTM D 2489.

F. Transporting:

1. Transport asphalt concrete mixtures from mixing site in trucks having tight, clean compartments.
2. Coat hauling compartments with a lime-water mixture to prevent asphalt concrete mixture from sticking.
3. Elevate and drain compartment of excess solution before loading mix.
4. Provide covers over asphalt concrete mixture when transporting to protect from weather and to prevent loss of heat.
5. During periods of cold weather or for long-distance deliveries, provide insulation around entire truck bed surfaces.

3.04 EQUIPMENT

A. Provide size and quantity of equipment to complete the work specified within project time schedule.

B. Bituminous Pavers: Self-propelled that spread hot asphalt concrete mixtures without tearing, shoving or gouging surfaces, and control pavement edges to true lines without use of stationary forms.

C. Rolling Equipment:

1. Self-propelled, steel-wheeled and pneumatic-tired rollers that can reverse direction without backlash.
2. Other type rollers may be used if acceptable to the County.

D. Hand Tools: Provide rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters, and other miscellaneous small tools to complete the work specified.

3.05 PLACING THE MIX

A. Place asphalt concrete mixture on prepared surface, spread and strike-off using paving machine.

B. Spread mixture at a minimum temperature of 225 degrees F. (107.2 degrees C.).

C. Inaccessible and small areas may be placed by hand.

D. Place each course at thickness so that when compacted, it will conform to the indicated grade, cross-section, finish thickness, and density indicated.

E. Paver Placing:

1. Unless otherwise directed, begin placing along centerline of areas to be paved on crowned section, and at high side of sections on one-way slope, and in direction of traffic flow.

2. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips.
3. Complete base courses for a section before placing surface courses.
4. Place mixture in continuous operation as practicable.

F. Hand Placing:

1. Spread, tamp, and finish mixture using hand tools in areas where machine spreading is not possible, as acceptable to County.
2. Place mixture at a rate that will insure handling and compaction before mixture becomes cooler than acceptable working temperature.

G. Joints:

1. Carefully make joints between old and new pavements, or between successive days' work, to ensure a continuous bond between adjoining work.
2. Construct joints to have same texture, density and smoothness as adjacent sections of asphalt concrete course.
3. Clean contact surfaces free of sand, dirt, or other objectionable material and apply tack coat.
4. Offset transverse joints in succeeding courses not less than 24 inches.
5. Cut back edge of previously placed course to expose an even, vertical surface for full course thickness.
6. Offset longitudinal joints in succeeding courses not less than 6 inches.
7. When the edges of longitudinal joints are irregular, honeycombed, or inadequately compacted, cut back unsatisfactory sections to expose an even, vertical surface for full course thickness.

3.06 COMPACTING THE MIX

A. Provide sufficient rollers to obtain the required pavement density.

B. Begin rolling operations as soon after placing when the mixture will bear weight of roller without excessive displacement.

C. Do not permit heavy equipment, including rollers to stand on finished surface before it has thoroughly cooled or set.

D. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

E. Start rolling longitudinally at extreme lower side of sections and proceed toward center of pavement. Roll to slightly different lengths on alternate roller runs.

F. Do not roll centers of sections first under any circumstances.

G. Breakdown Rolling:

1. Accomplish breakdown or initial rolling immediately following rolling of transverse and longitudinal joints and outside edge.
2. Operate rollers as close as possible to paver without causing pavement displacement.
3. Check crown, grade, and smoothness after breakdown rolling.
4. Repair displaced areas by loosening at once with lutes or rakes and filling, if required, with hot loose material before continuing rolling.

H. Second Rolling:

1. Follow breakdown rolling as soon as possible, while mixture is hot and in condition for compaction.
2. Continue second rolling until mixture has been thoroughly compacted.

I. Finish Rolling:

1. Perform finish rolling while mixture is still warm enough for removal of roller marks.
2. Continue rolling until roller marks are eliminated and course has attained specified density.

J. Patching:

1. Remove and replace defective areas.
2. Cut-out and fill with fresh, hot asphalt concrete.
3. Compact by rolling to specified surface density and smoothness.
4. Remove deficient areas for full depth of course.
5. Cut sides perpendicular and parallel to direction of traffic with edges vertical.
6. Apply tack coat to exposed surfaces before placing new asphalt concrete mixture.

3.07 MARKING ASPHALT CONCRETE PAVEMENT

A. Cleaning:

1. Sweep surface with power broom supplemented by hand brooms to remove loose material and dirt.
2. Do not begin marking asphalt concrete pavement until acceptable to the County.

B. Apply paint with mechanical equipment.

1. Provide uniform straight edges.
2. Not less than two separate coats in accordance with manufacturer's recommended rates.

3.08 CLEANING AND PROTECTION

A. Cleaning: After completion of paving operations, clean surfaces of excess or spilled asphalt materials to the satisfaction of the County.

B. Protection:

1. After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened, and in no case sooner than 6 hours.
2. Provide barricades and warning devices as required to protect pavement.
3. Cover openings of structures in the area of paving until permanent coverings are placed (if applicable).

END OF SECTION

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SECTION 02575

PAVEMENT REPAIR AND RESTORATION

PART 1 – GENERAL

1.01 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment, obtain County or State right-of-way permits and incidentals required and remove and replace pavements over trenches excavated for installation of water or sewer lines and appurtenances as shown on the Contract Drawings.

1.02 GENERAL

A. The Contractor shall take before and after photographs.

B. The Contractor shall repair in a manner satisfactory to the County or State, all damage done to existing structures, pavement, driveways, paved areas, curbs and gutters, sidewalks, shrubbery, grass, trees, utility poles, utility pipe lines, conduits, drains, catch basin, flagstones, or stabilized areas or driveways and including all obstructions not specifically named herein, which results from this Project.

C. The Contractor shall keep the surface of the backfilled area of excavation in a safe traffic bearing condition and firm and level with the remaining pavement until the pavement is restored in the manner specified herein. All surface irregularities that are dangerous or obstructive to traffic are to be removed. The repair shall conform to applicable requirements of Manatee County Transportation Department requirements for pavement repair and as described herein, including all base, subbase and asphalt replacement.

D. All materials and workmanship shall meet or exceed the County requirements and as called for in the Contract Documents and nothing herein shall be construed as to relieve the Contractor from this responsibility.

E. All street, road and highway repair shall be made in accordance with the FDOT and County details indicated on the Drawings and in accordance with the applicable requirements and approval of affected County and State agencies.

PART 2 – PRODUCTS

2.01 PAVEMENT SECTION

A. Asphaltic concrete shall consist of asphalt cement, coarse aggregate, fine aggregate and mineral filler conforming to FDOT Type S-III Asphalt. Pavement

replacement thickness shall match that removed but in no case shall be less than 1-1/2" compacted thickness. All asphalt concrete pavement shall be furnished, installed and tested in accordance with FDOT Specifications for Road and Bridge Construction.

B. Asphalt or crushed concrete or approved equal base material shall be furnished and installed under all pavement sections restored under this Contract. Asphalt base shall have a minimum 6" compacted thickness, meet requirements for FDOT ABC III (Minimum Marshall Stability of 1000) and be furnished, installed and tested in accordance with the requirements of the FDOT Standards. Crushed concrete base shall be 10" minimum compacted thickness. Crushed concrete aggregate material shall have a minimum LBR of 140 compacted to 98% T-180 AASHTO density. Asphalt base and crushed concrete base are acceptable. Other bases shall be submitted for approval.

C. Prime and tack will be required and applied in accordance with Section 300 - FDOT Specifications: Prime and Tack Coat for Base Courses.

PART 3 – EXECUTION

3.01 CUTTING PAVEMENT

A. The Contractor shall saw cut in straight lines and remove pavement as necessary to install the new pipelines and appurtenances and for making connections to existing pipelines.

B. Prior to pavement removal, the Contractor shall mark the pavement for cuts nearly paralleling pipe lines and existing street lines. Asphalt pavement shall be cut along the markings with a rotary saw or other suitable tool. Concrete pavement shall be scored to a depth of approximately two (2) inches below the surface of the concrete along the marked cuts. Scoring shall be done by use of a rotary saw, after which the pavement may be broken below the scoring with a jackhammer or other suitable equipment.

C. The Contractor shall not machine pull the pavement until it is completely broken and separated along the marked cuts.

D. The pavement adjacent to pipe line trenches shall neither be disturbed nor damaged. If the adjacent pavement is disturbed or damaged, irrespective of cause, the Contractor shall remove and replace the pavement. In addition, the base and sub-base shall be restored in accordance with these Specifications, Florida Dept. of Transportation Standard Specifications and as directed by the County.

3.02 PAVEMENT REPAIR AND REPLACEMENT

A. The Contractor shall repair, to meet or exceed original surface material, all existing concrete or asphaltic pavement, driveways, or sidewalks cut or damaged by construction under this Contract. He shall match the original grade unless otherwise specified or shown on the Drawings. Materials and construction procedures for base course and pavement repair shall conform to those of the Florida Dept. of Transportation.

B. The Contractor's repair shall include the preparation of the subbase and base, place and maintain the roadway surface, any special requirements whether specifically called for or implied and all work necessary for a satisfactory completion of this work. Stabilized roads and drives shall be finished to match the existing grade. Dirt roads and drives shall have the required depth of backfill material as shown on the Contract Drawings.

C. The asphaltic concrete repairs shall be in accordance with the Manatee County Public Works Standards, Part I Utilities Standards Manual, Detail UG-12. The asphaltic concrete repairs shall extend the full width and length of the excavation or to the limits of any damaged section. The edge of the pavement to be left in place shall be cut to a true edge with a saw or other approved method so as to provide a clean edge to abut the repair. The line of the repair shall be reasonably uniform with no unnecessary irregularities. The existing asphalt beyond the excavation or damaged section shall be milled 25' back from the saw cut. Final overlay shall match existing with no discernable "bump" at joint.

3.03 MISCELLANEOUS RESTORATION

Sidewalks or driveways cut or damaged by construction shall be restored in full sections or blocks to a minimum thickness of four inches. Concrete curb or curb and gutter shall be restored to the existing height and cross section in full sections or lengths between joints. RCP pipe shall be repaired or installed in accordance with manufacturer's specifications. Grassed yards, shoulders and parkways shall be restored to match the existing sections with grass sod of a type matching the existing grass.

3.04 SPECIAL REQUIREMENTS

The restoration of all surfaces, as described herein, disturbed by the installation of pipelines shall be completed as soon as is reasonable and practical. The complete and final restoration of both paved and shell stabilized roads within a reasonable time frame is of paramount importance. To this end, the Contractor shall, as part of his work schedule, complete the restoration of any area of road within five weeks after removing the original surface. Successful leak testing shall be performed prior to restoring any area of road. All restoration and replacement or repairs are the responsibility of the Contractor.

3.05 CLEANUP

After all repair and restoration or paving has been completed, all excess asphalt, dirt and other debris shall be removed from the roadways. All existing storm sewers and inlets shall be checked and cleaned of any construction debris.

3.06 MAINTENANCE OR REPAIR

All wearing surfaces shall be maintained by the Contractor in good order suitable for traffic prior to completion and acceptance of the work.

END OF SECTION

SECTION 02614

STEEL PIPE AND FITTINGS

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and install, complete, ready for operation and field test all steel pipe as shown on the drawings and specified herein.

B. Steel pipe shall include black steel, galvanized steel, and stainless steel pipe and fittings.

C. Provide steel pipe only where specifically called out on the drawings.

1.02 DESCRIPTION OF SYSTEM

A. All of the equipment specified herein is intended to be standard steel pipe for use in transporting certain chemicals and liquids as shown on the drawings and specified herein.

1.03 QUALIFICATIONS

A. All steel pipe shall be furnished by a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the steel pipe to be furnished. The equipment shall be designed, constructed, installed in accordance with the best practices and methods and shall comply with all these specifications.

B. Steel pipe and fittings shall conform to all applicable standards of ASTM, ANSI and AWWA.

1.04 SUBMITTALS

A. Submit to the County for approval in accordance with the General Conditions and Section 01340, shop drawings to include dimensioning and technical specifications for all pipe to be furnished.

PART 2 – MATERIALS

2.01 STEEL PIPE AND FITTINGS FOR PIPING

A. Black Steel Pipe: All black steel pipe shall be seamless, Grade B and in conformance with ASTM Designation A-53 and ANSI B36.10.

B. Galvanized Steel Pipe:

1. Galvanized steel pipe for plant and potable water service shall be hot-dipped, zinc coated galvanized, Grade A, electric resistance welded, Schedule 40 conforming to ASTM Designation A120. All joints shall be threaded joints. Threaded joints shall be made up with a stiff mixture of graphite and mineral oil, or an approved, nontoxic, nonhardening, pipe joint compound applied to the male thread only. After having been set up, a joint shall not be backed off unless the joint is completely broken, the threads cleaned and new compound applied. All joints shall be airtight. A sufficient number of unions shall be provided to allow for convenient removal of piping. Fittings for galvanized steel pipe shall be galvanized malleable iron, 150 psi service rating.
2. Where flanged connections are indicated or otherwise required for connection to flanged valves, fittings, and appurtenances, they shall be made up using companion type flanges. Where flanged fittings are indicated or otherwise required, they shall be made up using thread galvanized steel nipples and steel companion type flanges. Companion flanges shall be steel, 150-psi ANSI Standard flat face flanges of the threaded type. Flanges shall be spot-faced on the back around each bolt hole.
3. All exposed threads, wrench marks, or other damage to the zinc coating, shall be protected by the application of two coats of a heavy consistency, bituminous paint, or with two wraps of an approved vinyl or polyvinyl pressure sensitive tape. Bituminous paint shall be equal to Koppers Bitumastic No. 50, brush applied. Tape shall be equal to 3M Company Scotchrap No. 50, 0.010-inch thick, installed as recommended by 3M Company over a primer.

C. Stainless Steel Pipe:

Stainless steel pipe shall be provided as shown on the drawings. Pipe shall be Schedule 40S, Type 316L, annealed, white pickle finish and shall be in accordance with ASTM Specification A312 and ANSI B36.19. Where indicated on the Drawings, holes shall be drilled in the pipe at the factory by the manufacture.

D. Steel Pipe Sleeves:

Sleeves for pipe that passes through floors and walls shall be galvanized Schedule 40 steel pipe conforming to ASTM Designation A120. Sleeve dimensions shall conform to the details shown on the drawings. Sleeve ends shall be cut and ground smooth. Sleeves shall be flush with walls and ceilings, but shall extend above the floor as shown on the drawings. Sleeves for use with mechanical type seals shall be sized in conformance with the seal manufacturer's requirements.

2.02 STEEL PIPE FOUR (4) INCHES AND LARGER

A. Except as modified or supplemented herein, all steel pipe, fittings and specials shall conform to the applicable requirements of the following standard specifications latest editions:

AWWA Standards

C200 Steel Water Pipe 6 Inches and Larger

C203 Coal-Tar Protecting Coatings and Linings for Steel Water Pipelines - Enamel and Tape-Hot-Applied.

C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 inches and larger - Shop Applied.

C206 Field Welding of Steel Water Pipe

C207 Steel Pipe Flanges for Waterworks Service - Sizes 4 inches through 144 inches, Class D.

C208 Dimensions for Steel Water Pipe Fittings

B. All steel pipe shall be manufactured and tested in accordance with the standards set forth in AWWA C200 latest edition for fabricated or mill type water pipe. The pipe shall be made from sheet or plate rolled into sections having longitudinal or spirally formed butt-welded seams. Girth seams shall be butt welded and shall be at least 8 feet apart except in specials and fittings. The steel shall conform to the standards established in Section 2 and Section 3 AWWA C200.

1. Minimum Physical Properties of Steel Plate or Sheet:

a. All steel pipe, specials and fittings shall be manufactured from steel plate or sheet having a specified minimum yield of 35,000 psi and specified minimum tensile of 60,000 psi. Test reports verifying the actual physical and chemical properties of the piping must be submitted to the County as soon as possible after manufacturing and fabrication. The test reports shall state the hydrotest pressure applied to all sections of straight pipe and to straight pipe used in fabrication of specials and fittings.

b. All steel pipe, specials and fittings shall be manufactured or fabricated to the diameter as shown on the drawings. The normal size shall be the outside diameter of 14 inches and larger. For sizes less than 14 inches, the pipe shall be the normal steel pipe dimensions as listed in ASTM A53 specification. All diameters of

steel pipe, specials and fittings shall have minimum nominal wall thicknesses as stated herein below:

Diameter	Minimum Wall Thickness
54"	.375
48"	.375
42"	.375
36"	.375
30"	.375
24" & smaller	.250

C. All fittings and specials shall be provided with ends as required for installation and shall be fabricated to the dimensions as shown on the drawings. All fittings shall be fabricated in accordance with the standards set forth in AWWA C208 latest edition. Fittings and specials shall be fabricated from hydrostatically tested pipe meeting AWWA C200 and will not require any further hydrostatic test in the shop. In reducing sections, the wall thickness will be governed by the largest end. Elimination of joints shown on the drawings must be approved by the County prior to the fabrication process.

D. Flanged and Coupling Standards:

1. All flanges, bolts, nuts and gaskets shall meet standards established in AWWA C207. Flanges shall be Class D suitable for pressure up to and including 150 psi with facing and drilling as stated in Section 3 of C207. Procedure for attachment of flanges shall be in accordance with Section 10 of AWWA C207. Blind flanges shall conform in diameter drilling and thickness to the flanges to which they attach and shall produce a watertight joint under the specified test pressure.
2. Mechanical couplings shall be Dresser Style 38, Rockwell Style 411 or equal. The middle ring of each coupling shall have a minimum thickness at least equal to that specified for the size of pipe on which the coupling is to be used and shall be 7 inches long for pipe 30 inches and smaller, 10 inches long for pipe 36 inches and larger. The pipe stop shall be omitted from the inner surface of the middle rings and the couplings shall be cleaned and shop primed with the manufacturer's standard rust inhibitive primer. The filter backwash header and where shown on the drawings shall the mechanically coupled joints be restrained with harness bolts and lugs. Joint harnesses, where applicable, shall conform to the details on the drawings. Lugs shall be attached to the pipe in the shop and coated as specified for the adjacent pipe. The dimensions shall be stated in AWWA M011 19.8.

E. Pipe supports, anchors, blocking and hangers shall be fabricated in accordance with the details shown on the drawings and shall be installed complete with all accessories required for proper operation of the system. Should it be necessary to

modify the details for proper installation, all such modifications shall be subject to approval by the County. Lugs required for anchorage of the piping system shall be attached in the shop and coated as the adjacent pipe.

F. All steel pipe, fittings, specials and appurtenances shall be prepared, primed, coated and lined as specified herein below:

1. Exterior surfaces of all steel pipe, fittings, specials, flanges, anchors and pipe supports exposed in above ground or interior locations shall be thoroughly cleaned in the shop by blasting with grit, shot or sand to SSPC SP6. One coat of primer shall be applied to the cleaned dry surface in a proper workmanship like manner and as recommended by the primer manufacturer. The primer shall be subject to approval of the County and compatible to the finish coat as specified in the paid section of the specifications. Field painting of the installed system shall be as specified in the painting section.
2. Interior surfaces of all steel pipe, fittings, and specials, which are to be installed exposed aboveground or in interior locations shall be thoroughly cleaned in the shop by blasting with grit, shot or sand to SSPC SP6. Two coats of paint shall be applied to the interior of the pipe at the shop. The paint coats shall be Koppers Bitumastic Super Tank Solution applied at a minimum of 8 mils D.F.T. per coat.
3. Exterior surfaces of all steel pipe, fittings and specials which are to be installed underground and in manholes which will not be encased in concrete shall be coated in the shop with coal tar enamel in accordance with the standards established in AWWA C203-78, except as modified or supplemented herein.
4. The exterior coating system for below ground steel pipe shall consist of coal tar enamel, fibrous glass mat, asbestos pipelines felt wrap and finally wrapped with kraft paper and shall be applied by the procedure described in AWWA C203. The coating shall be held back 12 inches from ends to be mechanically coupled with uncoated areas primed with coat tar primer. The coating system must be done in the shop by an established pipe coating applicator acceptable to the coating materials manufacture and the County. Repairs of the any damage to the coating system incurred during the shipment and the field coating of couplings and ends where coatings have held back for joints shall be done by experienced and qualified personnel approved by the County. Procedure for such field coating shall be as described in AWWA C203.
5. The interior surfaces of all steel pipe, fittings, and specials which are to be installed below ground shall be cleaned and lined with cement mortar conforming to the standards set forth in AWWA C205-80. All work performed in the lining process shall be done in a thorough and workmanship like manner by trained personnel under the supervision of experienced men skilled in the operations they supervise. The lining thickness shall be as follows:

Pipe Size (Inches)	Coating Thickness (Inches)	Tolerance (Inches)
4-10	1/4	-1/32 + 1/32
11-23	5/16	-1/16 + 1/8
24-36	3/8	-1/16 + 1/8
over 36	1/2	-1/16 + 1/8

Handling and transporting of cement mortar lined pipe shall be in accordance with Section 6 of AWWA C205 and Section 2.14 of AWWA C203.

6. The interior surface of all steel air piping shall be coated with a two part epoxy coating system equivalent to 7.0 mils DFT of Mobil Chemical 78-D-7 followed by 7.0 mils DFT of Mobil Chemical 78-W-3 or equal.

2.03 STEEL PIPE AND FITTING AND CHLORINE GAS PIPING

A. If steel pipes are used for chlorine gas lines, they shall be Schedule 80 seamless steel pipe conforming to ASTM A120. All joints shall be threaded. Threaded joints shall be made up with a cement prepared from litharge and glycerin, or teflon tape. The cement shall be applied to the male thread only. Fitting except unions, shall be carbon steel 2,000 pounds CWP. Unions shall be of the flanged, ammonia type, either two-bolt or four-bolt square.

PART 3 – EXECUTION

3.01 INSTALLATION AND TESTING

A. Steel pipe shall be installed true to alignment and rigidly supported anchors shall be provided where indicated.

After installation, the piping shall be tested by undergoing a four-hour pressure test at 20 percent above the designed operating pressure plant water supply lines. If any joint or pipe proves to be defective, it shall be repaired to the satisfaction of the County.

B. Screwed joints shall be made up with good quality thread compound and applied to the male thread only. After having been set up, a joint must not be backed off unless the joint is completely broken, the threads cleaned and new compound applied. All joints shall be air tight.

C. Stainless steel pipe shall have threaded joints or otherwise as required and shall be installed as shown on the Drawings.

D. Sleeves of the proper size shall be installed for pipes passing through floors and walls as indicated on the drawings. Sleeves shall be given a prime coat of rust inhibitive primer such as Koppers No. 621, or equal.

E. When cutting of pipe is required, the cutting shall be done by machine in a neat workmanlike manner without damage to the pipe. Cut ends shall be smooth and at right angles to the axis of the pipe.

F. All field welding shall be in accordance with the American Welding Society Standards. The strength of the field weld shall develop the strength of the pipe. Welds shall receive a field coating of paint as specified in Section 09900 and as approved by the County.

G. All galvanized steel pipe thread shall be clean, machine cut, and all pipe shall be reamed before erection. Each length of pipe as erected shall be up-ended and rapped to dislodge dirt and scale.

H. All galvanized steel piping shall have a sufficient number of unions to allow convenient removal of piping. Unions shall be compatible with pipe.

3.02 PAINTING

A. Pipe and fittings exposed to view, except stainless steel, shall receive a prime coating of rust inhibitive primer such as Koppers 621 or equal. Prior to prime coating, all surfaces shall be cleaned of all mill scale, rust, dirt, grease and other foreign matter.

B. All piping and fittings exposed to view except stainless steel pipe shall be painted as specified.

END OF SECTION

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SECTION 02615

DUCTILE IRON PIPE AND FITTINGS

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment and incidentals required to install ductile iron pipe and restrained joint ductile iron pipe and cast iron or ductile iron restrained joint fittings, complete, as shown on the Drawings and specified in these Standards.

B. Fittings are noted on the drawings for the Contractor's convenience and do not relieve him from laying and jointing different or additional items where required.

C. The Contractor shall furnish all labor, materials, equipment and incidentals required to install push-on joint or restrained joint ductile iron pipe, complete as shown on the Drawings and Specifications.

D. Newly installed pipe shall be kept clean and free of all foreign matter. All DI pipe installed underground shall be poly wrapped unless noted otherwise on the plans.

1.02 SUBMITTALS

A. The Contractor shall submit to the County, within ten days after receipt of Notice to Proceed, a list of materials to be furnished, the names of the suppliers and the appropriate shop drawings for all ductile iron pipe and fittings.

B. The Contractor shall submit the pipe manufacturer's certification of compliance with the applicable sections of the Specifications.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Ductile iron pipe shall conform to AWWA C150 and AWWA C151. Pipe shall be Pressure Class 350. All ductile iron pipe used in above ground applications shall be Special Thickness Class 53. All pipe materials used in potable water systems shall comply with NSF Standard 61.

B. Unrestrained joint pipe shall be supplied in lengths not to exceed 21 ft. and shall be either the rubber-ring compression-type push-on joint or standard mechanical joint pipe as manufactured by the American Cast Iron Pipe Company, U.S. Pipe and Foundry Company, or an approved equal.

C. All mechanical joint fittings shall be pressure rated for 350 psi for sizes 4-24 inches and 250 psi for sizes 30 inches and larger. All flanged fittings shall be pressure rated for 250 psi for all sizes. All fittings shall meet the requirements of AWWA C110 or AWWA C153.

D. Rubber gaskets shall conform to AWWA C111 for mechanical and push-on type joints and shall be Ethylene Propylene Diene Monomer (EPDM) rubber for potable water and reclaimed water pipelines. Standard gaskets shall be such as Fastite as manufactured by American Cast Iron Pipe Company, or an approved equal. Acrylonitrile butadiene (NBR) gaskets shall be used for potable water mains that are located in soil that is contaminated with low molecular-weight petroleum products or non-chlorinated organic solvents or non-aromatic organic solvents. Fluorocarbon (FKM) gaskets shall be used for potable water mains that are located in soil that is contaminated with aromatic hydrocarbons or chlorinated hydrocarbons. Fluorocarbon (FKM) gaskets shall be used where both classes of contaminates are found.

E. Water Main and Reclaimed Water Main Coatings: All ductile iron pipe used in water and reclaimed water systems shall have a standard thickness cement lining on the inside in accordance with AWWA C104 and a standard 1-mil asphaltic exterior coating per AWWA C151. All ductile iron or gray iron fittings used in water and reclaimed water systems shall have standard thickness cement linings on the inside per AWWA C104 and an asphaltic exterior coating or they shall have factory-applied fusion bonded epoxy coatings both inside and outside in accordance with AWWA C550.

F. Wastewater Main Coatings: All ductile iron pipe and fittings used in wastewater sewer systems shall have a factory applied dry film thickness 40-mil Protecto 401 or 40-mil Novocoat SP2000W amine cured novalac ceramic epoxy lining on the inside. The interior lining application is to be based on the manufacturer's recommendation for long-term exposure to raw sewage. To ensure a holiday-free lining, documentation must be provided, prior to shipment, showing each section of lined pipe has passed holiday testing at the time of production per ASTM G62. The lining shall have a minimum one year warranty covering failure of the lining and bond failure between liner and pipe.

Exterior coatings for ductile iron pipe and fittings used in wastewater systems shall be either an asphaltic coating per AWWA C151 or a factory-applied epoxy coating per AWWA C550.

G. Thrust restraint devices shall be provided at all horizontal and vertical bends and fittings, in casings under roads and railroads and at other locations specifically indicated on the construction drawings. Thrust restraint devices shall be either concrete thrust blocks or restraining glands as manufactured by Star Pipe Products, Stargrip 3000 and 3100, Allgrip 3600, or as manufactured by EBAA Iron Sales,

Megaflange, 2000 PV, or other approved equal restraining gland products. Restrained joints, where used, shall be installed at bend and fitting locations and at pipe joint locations both upstream and downstream from the bends or fittings at distances as required by these Standards. Restrained joint pipe fittings shall be designed and rated for the following pressures:

350 psi for pipe sizes up to and including 24" diameter
250 psi for pipe sizes 30" diameter and above

2.02 DETECTION

A. Pipe shall have a 3-inch wide warning tape of the proper color placed directly above the pipe 12 inches below finished grade or a 6-inch warning tape between 12 inches and 24 inches below finished grade.

B. Pipe shall have a solid, 10 gauge, high strength, copper clad steel wire with a polyethylene jacket of appropriate color installed along the pipe alignment as detailed in these standards. Tracer wire shall be manufactured by Copperhead Industries or Manatee County approved equal.

2.03 IDENTIFICATION

A. Each length of pipe and each fitting shall be marked with the name of the manufacturer, size and class, lining type, and shall be clearly identified as ductile iron pipe. All gaskets shall be marked with the name of the manufacturer, size and proper insertion direction.

B. All ductile iron pipe 12 inches and smaller shall be entirely polyethylene-wrapped blue for water mains, purple (Pantone 522 C) for reclaimed water mains and green for sewer mains, per AWWA C105.

C. All ductile iron pipe greater than 12 inches shall be spiral wrapped with color coded polyethylene at a six-inch minimum spacing, If soil testing, in accordance with AWWA C105, indicates that the soil at the site is corrosive, the ductile iron pipe shall be entirely polyethylene-wrapped with color coded polyethylene.

D. Poly-wrap shall be by V-BioTM Enhanced Polyethylene Encasement (or equivalent).

E. All above ground potable water mains and appurtenances shall be painted safety blue.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 02617

INSTALLATION AND TESTING OF PRESSURE PIPE

PART 1 – GENERAL

Reference Section 1.9, Installation of Pipelines in the Manatee County Public Works Utility Standards Part 1-Utility Standards Manual.

1.01 GENERAL

A. Furnish and install pipe, fittings, valves, fire hydrants, services, and all other appurtenances and incidentals complete and in-place as required by the construction drawings.

B. Where potable or reclaimed water mains are to be installed under pavement, in parking lots, etc., the main shall be DI or protected by a steel casing pipe.

C. All pipe crossing state or federal roads or local arterials & thoroughfares shall be installed in a casing pipe.

D. Services under any kind of pavement shall be Type "L" copper or Schedule 40 stainless steel.

E. Water mains 16-inches and larger shall be ductile iron. High density polyethylene or PVC (for 16" only). The use of HDPE pipe must be authorized by the County prior to ordering and installation.

F. Soil testing in accordance with AWWA C105 shall be performed during the design phase to determine if the soil is corrosive to ductile iron pipe. One (1) soil test shall be performed for pipe lengths under 500 lineal feet, with an additional soil test every 500 of additional ductile iron pipe to be installed. The soil testing shall be performed by a Florida licensed geotechnical engineering and signed and sealed report shall be supplied to the County for review prior to installation of the ductile iron pipe for evaluation. The soil testing results shall be used to determine if additional requirements for the installation of ductile iron pipe and/or the restrained joints is warranted.

G. Ductile iron pipe, with gasket materials as required in these Standards, shall be used in soil that is contaminated with low molecular-weight petroleum products, aromatic hydrocarbons, chlorinated hydrocarbons or organic solvents.

H. Trees shall not be planted or located within 10 feet of any potable water main, reclaimed water main, sanitary force main or gravity sanitary sewer main that is owned and maintained by County. With prior approval, an approved root barrier may be used with 5 feet of clearance.

I. All distribution waterlines that enter private property become private lines and shall have a back-flow preventer installed at the right-of-way. BFP can be part of a meter assembly or a BFP / detector check assembly.

1.02 HANDLING AND STORAGE

A. Prior to installation, all pipe and fittings shall be inspected. Cracked, broken, or otherwise defective materials not in compliance with these standards shall not be used and shall be removed from the project site.

B. The pipeline installer shall take care in the handling, storage and installation of the pipe and fittings to prevent injury to the materials or coatings. Use proper implements, tools and facilities for the safe and proper protection of the work. Lower the pipe and fittings from the truck to the ground and from the ground into the trench in a manner to avoid any physical damages. Under no circumstances shall the pipe or fittings be dropped onto the ground or into the trenches.

C. The pipeline installer shall not distribute material on the job site faster than it can be used to good advantage. Unless otherwise approved by the County, installer shall not distribute more than one week's supply of material in advance of laying. Any materials not to be installed within two weeks of delivery shall be protected from the sunlight, atmosphere and weather by suitable enclosures or protective wrapping until ready for installation. Stored PVC pipe shall be placed on suitable racks with bottom tiers raised above the ground to avoid damage. Storage of pipe on the job site shall be done in accordance with the pipe manufacturer's written instructions.

1.03 SURVEY MARKINGS

A. As a marker for the Surveyor, a PVC pipe marker or 2" x 4" marker shall be inserted by the Contractor on the top of pipe for potable water mains, reclaimed water mains and sanitary force mains at intervals no greater than 200 feet apart and at locations where there is a substantial grade change. The pipe markers shall indicate the pipe diameter and shall be labeled PWM in "safety" blue, RWM in purple, and FM in green, for potable water mains, reclaimed water mains and sanitary force mains, respectively. The Contractor is responsible for making the aforementioned markers available to the Surveyor. The Contractor shall field locate the mains and fittings when markers are not made available to the Surveyor.

B. As a marker for the Surveyor, a PVC pipe marker or 2" x 4" marker shall be inserted by the Contractor on the top of all pipe fittings (other than sanitary sewer service wyes, potable water saddles and reclaimed water saddles). The markers for fittings shall indicate the type of fitting and shall be labeled PWF in "safety" blue, RWF in purple, and FMF in green, for potable water fittings, reclaimed water fittings, and sanitary force main fittings, respectively. The Contractor is responsible for making the aforementioned markers available to the Surveyor. The Contractor shall field

locate the mains and fittings when markers are not made available to the Surveyor.

C. A PVC pipe marker or 2" x 4" marker shall be inserted by the Contractor at the beginning and end of each horizontal directional drill (HDD). The HDD Contractor shall provide a certified report and bore log indicating the horizontal and vertical location every 25 linear feet or less along the pipe.

D. A 2" PVC pipe marker with a painted end cap shall be inserted by the Contractor at the ROW line indicating each individual new service location or stub out. The marker shall be a 6 foot length of PVC pipe inserted 2 feet into the ground and shall be painted "safety" blue for potable water, purple for reclaimed water, and green for sewer.

1.04 PROCEDURE FOR TESTING WATER LINES, FORCE MAINS AND RECLAIMED WATER LINES

A. A 48-hour notice is needed prior to testing. A letter stating the reasons testing should be scheduled ahead of other jobs must accompany all emergency testing requests.

B. County and Contractor must be present for all testing, except for testing tapping valves and sleeves.

C. HYDROSTATIC TESTING

1. Refer to Manatee County Public Works Utility Standards Part 1-Utility Standards Manual Section 1.8.7.

1.05 INSPECTION/TESTING PROCEDURE COVERING BORED PIPE LINES OR CASING AND CONDUITS INSTALLED ACROSS PREVIOUSLY TESTED AND/OR COUNTY ACCEPTED WATER AND SEWER PIPE WITHIN DEVELOPMENT PROJECTS UNDER ACTIVE CONSTRUCTION

A. Prior to testing water and sewer lines, every effort will be made to install sleeves for underground utilities that will cross these water and sewer lines or services.

B. Where it has not been possible to pre-install sleeves prior to testing and bores or conduits are required, it is the responsibility of the utility company and/or their Contractor performing the work to provide Manatee County Utility Operations Department or the Engineer of Record with accurate horizontal and vertical as-built information of the sleeves, bores and conduits installed by said utility company. This applies to all bores and conduits crossing water and sewer lines.

C. Procedures to be followed for installation of conduits, pipe lines and bores that will cross, or be closer than 5'-0" horizontally and 18 inches vertically to, previously tested water and sewer lines that are still under the ownership of the developer/contractor.

1. Notify the County and obtain the best as-built information available. Allow sufficient time for the County to field locate the existing pipe lines.
2. Submit drawings of proposed location to the County and Manatee County Utility Operations Dept. Utility Locations Section for review.
3. Obtain a County Right-of-Way Use Permit if the work area is within a dedicated area of right-of-way.
4. Perform installation in the presence of a County representative. Call (941) 792-8811, ext. 5061 or ext. 5069 with at least two (2) working days notice.
5. Submit two (2) copies of as-built information to the County to incorporate into the record drawings to be submitted to the County.
6. Failure to follow steps 2) thru 5) will result in additional charges for retesting the previously tested water and sewer lines.

D. Procedures to be followed for installation of conduits, pipe lines and bores crossing or closer than 5'-0" horizontally and 18 inches vertically to previously tested water and sewer lines that have been previously accepted by Manatee County:

1. Obtain record drawing information from the County.
2. If roadway has been dedicated to Manatee County, obtain Right-of-Way Use Permit and copy the Project Management Department Locations Section with proposed location drawing.
3. Follow procedures in "Sunshine State One-Call", paying special attention to the requirements of Section VII.

E. Should water or sewer lines be damaged during the bore pipe line or casing installation, the cost of any repairs and retesting will be paid for by the utility company that installed the bore. The actual clearance between a bored casing crossing a water or sewer pipe should not be less than 18 inches.

1.06 DETECTION

A. Direct buried pipe shall have 3" detectable metallic tape of the proper color placed directly above the pipe and 12" below finished grade or 6" detectable tape between 12" and 24" below finished grade.

B. Direct buried or horizontal directional drilled non-metalic pipe shall also have tracer wire installed along the pipe alignment. The tracer wire to be used shall be a solid, 10 gauge, high strength, copper clad steel wire with a polyethylene jacket of appropriate color manufactured by Copperhead Industries or Manatee County approved equal.

PART 2 – PORDUCTS (NOT USED)

Part 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 02618

PIPELINE CLEANING

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment and incidentals required to clean all new lines 4” and larger, and existing pipelines as specified in this specification and as indicated on the Drawings.

B. This work shall include the furnishing and installation of all pig launching and retrieval devices and the appropriate pigs for the cleaning procedure, and all necessary excavations, shutdowns, fittings and valves required.

1.02 RELATED WORK

A. The contractor is responsible for all necessary supply water.

B. The contractor is responsible for all necessary bypass pumping.

C. The contractor is responsible for the proper disposal of any materials removed from the pipe lines as a result of the cleaning procedure.

1.03 SUBMITTALS

A. The Contractor shall submit prior to construction, a cleaning plan, Shop Drawings, and layout diagram for approval to the County.

B. The Contractor shall submit to the County a list of materials to be furnished, and the names of suppliers.

1.04 QUALIFICATIONS

A. The Contractor performing this work shall be fully qualified, experienced and equipped to complete this work expeditiously and in a satisfactory manner.

B. The Contractor shall also be capable of providing crews as needed to complete this work without undue delay.

C. The County reserves the right to approve or disapprove the Contractor, based on the submitted qualifications.

PART 2 – PRODUCTS

2.01 GENERAL

A. The contractor shall be responsible for furnishing pigs in sufficient numbers and sizes, of appropriate densities, coatings and configurations to properly clean the piping systems.

B. All pigs used for the cleaning of sewer or reclaimed water lines shall not be used in the cleaning of potable water lines.

2.02 MATERIALS

A. The pig launching and retrieval equipment shall be of the latest design and construction and shall include the means to maintain constant monitoring of the in-line flows and pressures of the system being cleaned and the constant location of the cleaning pigs in the system. Launching and retrieval systems shall be fabricated, designed and manufactured according to ANSI standards and capable of withstanding working pressures of 150 psi. Launching and receiving devices shall be sized one diameter larger than the system to which it will be attached with a minimum length of 2.5 times the diameter.

B. The contractor shall have available for immediate use an electronic pig detector for use in the system being cleaned to provide a means of tracking the passage of the pig in the system to locate areas of potential or suspected blockage and other disparities in the system.

C. The pig shall be constructed of elastomer polyurethane with an open cell construction and a density equal to or suitable for use in the piping system being cleaned. Pig configuration shall consist of a parabolic nose with a concave base and coated with a resilient surface material that will maintain a peripheral seal and will effectively clean the piping system without over abrading the interior pipe wall. Pig characteristics shall include the ability to navigate through 90 degree bends, 180 degree turns, bi-directional fittings, full port valves, reduce its cross sectional area and return to its original design configuration and be propelled by hydraulic pressure.

PART 3 – EXECUTION

3.01 PIPELINE CLEANING

A. The cleaning of the pipe line shall be done by the controlled and pressurized passage of a polyurethane pig of varying dimensions, coatings and densities as determined by the County through the piping system.

B. A series of pigs shall be entered into the system at a point as near to the beginning as is logistically and mechanically feasible.

C. A launching assembly shall be used as the entrance point for the pig. This assembly shall allow for the following:

1. The entering of pigs into the system by providing the means to induce flow from an external source, independent of the flows and pressures immediately available from the system, on the back of the pig to develop sufficient pressure to force the pig through the system.
2. A means to control and regulate the flow.
3. A means to monitor the flows and pressures.
4. A means to connect and disconnect from the system without any disruption to the operation of the system.

D. The pig shall be removed or discharged from the system at a point as near to the end as is logistically and mechanically feasible.

E. The contractor shall be responsible for the retrieval of the pig at the discharge point. This may include setting a trap that will not disrupt normal flow and operations but will capture the pig and any debris. A retrieval assembly may also be used but said assembly shall be able to connect and disconnect from the system without any disruption to the operation of the system.

F. Alternative launching and retrieval methods shall be done with the prior approval of the County.

G. Any pig that cannot progress through the piping system shall be located by the contractor and removed by excavation of the pipe in order to remove the blockage. All pipe repairs shall be the responsibility of the contractor and shall be performed with as little disruption to the system as possible.

H. Any increase in pressure that cannot be accounted for, i.e. fittings or valves or additional cleaning runs, shall be investigated, per the Engineers' approval, by locating the pig at the beginning of the increased pressure and excavating to determine the cause of the pressure increase. All pipe repairs shall be the responsibility of the contractor and shall be performed with as little disruption to the system as possible.

I. Final flushing of the cleansed lines shall be performed after the last successful run of the pig as determined by the County. The contractor shall be responsible for all applicable flushing and disinfection requirements for potable water lines.

3.02 ACCEPTANCE

A. The contractor shall maintain and provide a report at the end of the cleaning procedure containing the following:

1. The pressures in the pipe during the pigging procedure.
2. Any inline problems encountered during the procedure including all excavations with detailed locations, reason for the excavation and any corrective measures taken to the pipeline.
3. A record of the pigs used, their sizes, styles and other pertinent information regarding what materials were used during the cleaning.
4. An analysis of the condition of the pipeline before and after the cleaning procedure.

END OF SECTION

SECTION 02622

POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS (AWWA SPECIFICATIONS C-900 & C-905)

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install the PVC piping, iron fittings and other appurtenances complete and ready for use as indicated on the construction drawings.

B. Provide and install complete all fittings and appurtenances not noted specifically on the construction plans as required to complete the utility system in accordance with these Standards.

1.02 DESCRIPTION OF SYSTEM

The Contractor shall install the piping in the locations as shown on the Drawings.

1.03 QUALIFICATIONS

All plastic pipe, fittings and appurtenances shall be furnished by a single manufacturer who is fully experienced, reputable, qualified and specializes in the manufacture of the items to be furnished. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications.

1.04 SUBMITTALS

A. The Contractor shall submit shop drawings to the County including, but not limited to, dimensions and technical specifications for all piping.

B. The Contractor shall submit to the County, samples of all materials specified herein.

C. The Contractor shall submit and shall comply with pipe manufacturer's recommendation for handling, storing and installing pipe and fittings.

D. The Contractor shall submit pipe manufacturer's certification of compliance with these Specifications.

1.05 TOOLS

The Contractor shall supply special tools, solvents, lubricants, and caulking compounds required for proper installation.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Polyvinyl chloride (PVC) pressure pipe, 4 - 12 inches in diameter, shall be Class 235, DR 18, meeting the requirements of AWWA C900 used for potable and reclaimed water. Mains shall be cast-iron-pipe-equivalent outside diameters (also known as ductile iron pipe size (DIPS)). Each length of pipe shall be hydrostatically tested to four times its pressure class of the pipe by the manufacturer in accordance with AWWA C900.

B. Polyvinyl chloride (PVC) pressure pipe, 14 inches in diameter, shall be ductile iron pipe size (DIPS) outside diameter and shall meet the requirements of AWWA C905. Pipe used in water, sewer, and reclaimed water service shall be DR 18 and Pressure Class 235. Each length of pipe shall be hydrostatically tested at twice its pressure class in accordance with AWWA C905. Pipe shall be furnished in standard lengths of approximately 20 feet.

PVC pipe shall not be used for potable and reclaimed water mains 16 inches and larger.

C. Polyvinyl chloride (PVC) pressure pipe, 2-3 inches in diameter, shall be Pressure Rated 200, SDR21, conforming to ASTMD2241, and shall have Iron Pipe Size (IPS) outside diameters. SDR 21 PVC pipe 2-3 inches in diameter shall not be used for working pressures greater than 125 psi. PVC pipe shall not be used in applications, which require pipes that are less than 2 inches in diameter for wastewater force mains. PVC Pipe shall not be used in applications which require pipes that are less than 3 inches in diameter for potable water piping and reclaimed water piping.

D. Standard PVC pressure pipe joints shall be bell and spigot push-on type with elastomeric ring seals. Ring seal gaskets used at push-on joints shall conform to ASTM F 477 and shall be EPDM rubber for potable and reclaimed water pipes.

E. Lubricant furnished for lubricating the push-on joints in potable water pipes shall be nontoxic, water soluble, shall not support the growth of bacteria, shall have no deteriorating effects on the gasket or pipe material, and shall not impart color, taste, or odor to the water, and shall be an approved substance per NSF 61.

F. Thrust restraint devices shall be provided at all horizontal and vertical bends and fittings, in casings under roads and railroads and at other locations as indicated on the construction drawings. Thrust restraint devices for PVC pipe and fittings shall be either concrete thrust blocks or restraining glands as manufactured by Star Pipe Products, Stargrip 3000 and 3100, Allgrip 3600, or as manufactured by EBAA Iron Sales, Megaflange, 2000PV or other approved equal restraining gland products. Restrained joints, where used, shall be installed at bend and fitting locations and at pipe joint locations both upstream and downstream from bends or fittings at distances as required by these Standards.

G. All fittings for PVC pipe shall be ductile iron or gray iron with mechanical joints and shall conform to AWWA C110 or AWWA C153 and to the applicable sections of these Standards for ductile iron and gray iron fittings.

H. All pipe materials used in potable water systems shall comply with NSF Standard 61.

PART 3 – EXECUTION

3.01 INSTALLATION

The Contractor shall install the plastic pipe in strict accordance with the manufacturer's technical data and printed instructions.

3.02 DETECTION

A. Direct buried pipe shall have 3" warning tape of the proper color placed directly above the pipe 12" below finished grade or 6" warning tape between 12" and 24" below grade.

B. PVC pipe shall have a solid, 10 gauge, high strength, copper clad steel wire with a polyethylene jacket of appropriate color installed along the pipe alignment as detailed in these standards. Tracer wire shall be manufactured by Copperhead Industries or Manatee County approved equal.

3.03 IDENTI FICATION

A. PVC pipe shall bear identification markings in accordance with AWWA C900, AWWA C905 or ASTM D2241.

B. PVC pipe shall be color coded blue for water, purple (Pantone purple 522C) for reclaimed water or green for pressure sewer using a solid pipe color pigment.

3.04 INSPECTION AND TESTING

All pipelines shall remain undisturbed for 24 hours to develop complete strength at all joints. All pipelines shall be subjected to a hydrostatic pressure and leak testing. Refer to Manatee County Public Works Utility Standards Part 1-Utility Standards Manual Section 1.8.7. Prior to testing, the pipe lines shall be supported in a manner approved by the County to prevent movement during tests.

END OF SECTION

SECTION 02640

VALVES AND APPURTENANCES

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment and incidentals required and install complete and ready for operation all valves and appurtenances as shown on the Drawings and as specified herein.

B. All of the types of valves and appurtenances shall be products of well-established reputable firms who are fully experienced and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these standards as applicable. Valves used in waterworks applications shall comply with Section 8 of NSF Standard 61 for mechanical devices.

C. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of potable water, reclaimed water, wastewater, etc., depending on the applications.

D. All valves and appurtenances shall be of the size shown on the drawings and, to the extent possible, all equipment of the same type on the project shall be from a single manufacturer.

E. All valves and appurtenances shall have the name of the manufacturer, year of the valve and the working pressure for which they are designed cast in raised letters upon some visible part of the body.

F. Special tools, if required for the normal operation or maintenance, shall be supplied with the equipment.

G. All hand actuated buried valves shall have three-piece adjustable valve boxes and 2-inch square AWWA operating nuts. Provide stainless steel extension stems and alignment rings where needed to bring the operating nut to within 4 feet below the box lid.

H. Water and reclaimed water system isolation valves shall be gate valves for sizes 2-inch through 12-inch and shall be butterfly valves for sizes 16-inch and larger.

I. Isolation valves for sewer force main pipelines shall be gate valves, unless otherwise noted on the plans. Tapping valves shall be used for tapping force mains.

Plug valves shall be full port, have a 100% circular cross section, and must have prior written authorization from the County for use.

J. Valves shall open when turning the operating nut or wheel counterclockwise and shall close when turning clockwise.

K. All bonnet bolts, gland bolts, flange connection bolts, nuts, washers, and other trim hardware exposed to the outside environment shall be stainless steel. Thrust collar tie-rod bolts shall be stainless steel. All MJ-type underground bolts, nuts, and washers shall be COR-TEN or stainless steel.

L. All valves shall have a factory applied, holiday free, fusion bonded epoxy coating on the interior and exterior unless otherwise noted in the plans or the following specification. All other painted items exposed to sunlight, including field painted box lids, etc., shall be painted the appropriate color with an epoxy type paint.

M. No valves with a break-way stem shall be allowed.

N. The equipment shall include, but not be limited to, the following:

1. Gate valves (Sec. 2.01)
2. Combination Pressure Reducing and Pressure Sustaining with Check Valves Option (Sec. 2.02)
3. Ball Valves (Sec. 2.03)
4. Butterfly Valves (Sec. 2.04)
5. Plug Valves (Sec. 2.05)
6. Valve Actuators (Sec. 2.06)
7. Air Release Valves (Sec. 2.07)
8. Valves Boxes (Sec. 2.08)
9. Corporation Stops and Saddles (Sec. 2.09)
10. Flange Adapter and Plain End Couplings (Sec. 2.10)
11. Hose Bibs (Sec. 2.11)
12. Swing Check Values (Sec. 2.12)
13. Hydrants (Sec. 2.13)
14. Restraint Joints (Sec. 2.14)
15. Tapping Sleeves and Tapping Valves (Sec. 2.15)
16. Tracer Wire Boxes (Sec. 2.16)

1.02 SUBMITTALS

A. Submit to the County within 30 days after execution of the contract a list of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site.

B. Complete shop drawings of all valves and appurtenances shall be submitted to the

County for approval in accordance with the Specifications.

1.03 TOOLS

Special tools, if required for normal operation and maintenance shall be supplied with the equipment.

PART 2 – PRODUCTS

2.01 GATE VALVES

A. Gate valves installed underground shall be provided with a box cast in a concrete pad and a box cover. Stainless steel or equivalent valve extension stems shall be provided to place the valve operating nut no more than 4 feet deep. One valve wrench, 6 feet in length, shall be provided for every 15 valves installed.

C. Gate valves 2 inches to 14 inches in diameter shall be resilient seated, manufactured to meet or exceed the requirements of AWWA C509 or AWWA C515 and shall be UL listed and FM approved where applicable. Valves shall have an unobstructed waterway equal to or greater than the full nominal diameter of the valve.

D. The valves shall have a non-rising stainless-steel stem to eliminate lead content. All bolts, nuts and washers shall be stainless steel to eliminate exterior corrosion and maintain fastener strength. Manufacturer shall use Never-Seez or equivalent during assembly of bolt and nut sets to prevent galling of similar metals. Stem seals shall be provided and shall be of the O-ring type, two above and one below the thrust collar. Valves that are located above grade and located in valve vaults shall be OS&Y with flanged joints.

E. The wedge shall be ductile iron fully encapsulated with an EPDM rubber. The Elastomer type shall be permanently indicated on the disc or body of the valve. The resilient sealing mechanism shall provide zero leakage at the water working pressure when installed with the line flow in either direction.

F. The valve body, bonnet, and bonnet cover shall meet or exceed all the requirements of AWWA C515.

G. Valves meeting AWWA C515 requirements shall be rated for an operating pressure of 250 psi and shall be tested in accordance with AWWA C515.

H. The valves are to have 2-inch cast or ductile iron AWWA operating nuts and shall open left or counterclockwise.

I. The valves shall be covered by a Manufacturer's 10 year warranty on manufacturer's defects and reasonable labor costs for replacement. Warranty shall

become effective from the date of purchase by the end user and delivered within 30 days from the receipt of the purchase order. For publicly owned and maintained utilities, the end user is Manatee County Government.

J. Gate valves shall be assembled and tested in a certified ISO 9001:2000 manufacturing facility within the United States and provide their certification of meeting internationally recognized quality control procedures.

2.02 COMBINATION PRESSURE REDUCING & PRESSURE SUSTAINING WITH CHECK VALVE OPTION

A. Pressure sustaining, and check valve shall be pilot operated diaphragm actuated valve with cast iron body, bronze trim, and 125-pound flanged ends. The valve shall be hydraulically operated, diaphragm type globe valve. The main valve shall have a single removable seat and a resilient disc, of rectangular cross section, surrounded on three and a half sides. No external packing glands are permitted and there shall be no pistons operating the main valve or any controls. The valve shall be equipped with isolation valves to service the pilot system while permitting flow if necessary. Main valve and all pilot controls shall be manufactured in the United States of America. Valve shall be single chamber type, with stainless steel stem.

B. Valve shall automatically reduce pressure for the downstream distribution network and sustain a minimum pressure in the high pressure main regardless of distribution demand, and as an option, shall also close when a pressure reversal occurs for check valve operations. The pilot system shall consist of two direct acting, adjustable, spring loaded diaphragm valves.

C. Valve shall be cast iron or ductile iron with main valve trim of brass and bronze. The pilot control valves shall be cast brass with 303 stainless steel trim. Valve shall be similar in all respects to Cla-Val Company, Model 92-01 or a similar control valve such as Bermad Model 723, GA Industries Model 4700 or an approved equal.

2.03 BALL VALVES

A. Ball valves for water and reclaimed water, in sizes 3/4-inch through 2-inch, shall be brass body, stem and ball per ASTM B 62, alloy 85-5-5-5, full port, full flow, 1/4-turn check, ball curb valves, rated for 300 psi, Mueller 300 (as specified in the table below), Ford B-Series, or approved equal, with compression, pack joint, flare, threaded or flanged ends as required. Ball valves for wastewater, 2-inch through 3-inch, shall be 316 stainless steel body, cap, stem and ball per ASTM A351, full port, full flow, 1/4-turn check, ball valves, steam rated for 150 psi, pressure rating 1,000 psi CWT, Apollo 76F or approved equal, with threaded or flanged ends as required.

Curb Stops for Water and Reclaimed Water

Pipe Material	Type of Connection	Model
HDPE	Compression x FIP	B-25170 *
HDPE	Pack Joint x FIP	P-25170 *
Copper	Compression x FIP	B-25170
Copper	Flare x FIP	B-25166
Stainless Steel	FIP x FIP Thread	B-20200

* Insert required, part number per manufacturer product information

B. All valves shall be mounted in such a position that valve position indicators are plainly visible. Above grade ball valves shall have a vinyl coated lever handle. Lever handle, handle nut, and lever packing gland shall be 304 or 316 stainless steel.

C. Potable plastic service pipe material and compression and pack joint connectors shall not be used in soil that is contaminated with low molecular-weight petroleum products, aromatic hydrocarbons, chlorinated hydrocarbons or organic solvents. Appropriate service tubing shall apply.

2.04 BUTTERFLY VALVES

A. Butterfly valves shall conform to AWWA C504, Class 250 B, Mueller Lineseal XPII, DeZurik AWWA, Pratt HP-250II, or an approved equal.

B. Valve seats shall be an EPDM elastomer. Valve seats 24 inches and larger shall be field adjustable and replaceable without dismounting operator dise or shaft and without removing the valve from the line. Valves 20 inches and smaller shall have bonded or mechanically restrained seats as outlined in AWWA C504.

C. All valves shall be subject to hydrostatic and leakage tests at the point of manufacture. The hydrostatic test for Class 250 valves shall be performed with an internal hydrostatic pressure equal to 500 psi applied to the inside of the valve body of each valve. During the hydrostatic test, there shall be no leakage through the metal, the end joints or the valve shaft seal. The leakage test for the Class 250 valves shall be performed at a differential pressure of 250 psi and against both sides of the valve. No adjustment of the valve disc shall be necessary after pressure test for normal operation of valve. All valves shall be leak tight in both directions.

D. Butterfly valve actuators shall conform to AWWA C504. Gearing for the actuators shall be totally enclosed in a gear case. Actuators shall be capable of seating and unseating the disc against the full design pressure and shall transmit a minimum torque to the valve. Actuators shall be rigidly attached to the valve body.E.The valve shaft shall be constructed of 18-8, ASTM A-276, Type 304 stainless steel and designed for both torsional and shearing stresses when the valve is operated under its greatest dynamic or seating torque. Shaft shall be of either a one piece unit

extending full size through the valve disc and valve bearing or it may be of a stub shaft design. Shaft bearings shall be teflon or nylon, self-lubricated type.

F. Gearing for the operators shall be totally enclosed in a gear case in accordance with paragraph 3.8.3 of the above mentioned AWWA Standard Specification.

G. Operators shall be capable of seating and unseating the disc against the full design pressure of velocity, as specified for each class, into a dry system downstream and shall transmit a minimum torque to the valve. Operators shall be rigidly attached to the valve body.

H. The manufacturer shall certify that the required tests on the various materials and on the completed valves have been satisfactory and that the valves conform with all requirements of this Specification and the AWWA standard.

I. Where indicated on the Drawings, extension stems, floor stands, couplings, stem guides, and floor boxes as required shall be furnished and installed..

2.05 PLUG VALVES

A. Plug valves shall be eccentric, non-lubricating type with integral plug and shafts and shall be furnished with end connections and with actuating mechanisms as called for on the construction plans or as otherwise required. Valves shall seal bubble-tight or water drop-tight in both directions when tested according to the Leakage Test method of AWWA C504 with a hydrostatic pressure of 150 psi.

B. Plug valves shall also be subjected to the internal, full body Hydrostatic Test of AWWA C504 at a pressure two times the rated pressure or a minimum pressure of 300 psi, whichever is greater. During the test, there shall be no leakage through the metal, or through the end joints or shaft seal, nor shall any part of the valve be deformed. Plug valves shall be Kennedy or Dezurik.

C. Flanged valve ends shall be faced and drilled according to ANSI B 16.1, Class 125. Mechanical joint valve ends shall conform to AWWA C111. Threaded ends shall conform to the NPT requirements of ANSI B1.20.1.

D. The plug valve body, bonnet and gland shall be ductile iron per ASTM A 126, Class B. The integral plug and shafts shall be cast iron ASTM A 126, Class B, or 316 stainless steel. The entire plug, except for the shafts, shall be covered with nitrile (Buna N) rubber. The rubber compound shall have been vulcanized to the metal plug and shall have a peel strength of not less than 75 pounds per inch when tested according to ASTM D 429, method B. The valve seat shall be at least 90 percent pure nickel, welded-in overlay into the cast iron body. The top and bottom bearings shall be 316 stainless steel.

E. Plug valves shall have a full port area of 100 percent of the nominal pipe size area.

F. Valves shall have worm gear type actuators with 2-inch square operating nuts.

G. Plug valves shall be installed side-ways with plug shaft horizontal so that the plug rotates upward when it opens, with the flow entering the seat end of the valve.

H. Plug valves shall be coated inside with Protecto 401 or amine-cured novolac ceramic epoxy or another two-part epoxy suitable for sanitary sewer service which has been approved by Manatee County.

2.06 VALVE ACTUATORS

A. Butterfly valve and plug valve actuators.

Butterfly valve and plug valve actuators shall conform to the requirements for actuators presented in AWWA C 504 and shall be either manual or motor operated. Actuators shall be capable of seating and unseating the disc against the full design pressure and velocity, as specified for each class, into a dry system downstream, and shall transmit a minimum torque to the valve. Actuators shall be rigidly attached to the valve body.

B. Manual Actuators

Manual actuators shall have permanently lubricated, totally enclosed gearing with handwheel and gear ratio sized on the basis of actual line pressure and velocities. Actuators shall be equipped with handwheel, position indicator, and mechanical stop-limiting locking devices to prevent over travel of the disc in the open and closed positions. They shall turn counter-clockwise to open valves. Manual actuators shall be of the traveling nut, self-locking type or of worm gear type and shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering. Valves located above grade shall have handwheel and position indicator, and valves located below grade shall be equipped with a 2-inch square AWWA operating nut located at ground level and cast iron extension type valve box.

C. Motor Actuators (Modulating)

1. The motor actuated valve controller shall include the motor, actuator unit gearing, limit switch gearing, limit switches, position transmitter which shall transmit a 4-20 mA DC signal, control power transformer, electronic controller which will position the valve based on a remote 4-20 milliamp signal, torque switches, bored and key-wayed drive sleeve for non-rising stem valves, declutch lever and auxiliary handwheel as a self-contained unit.

2. The motor shall be specifically designed for valve actuator service using 480 volt, 60 Hertz, three phase power as shown, on the electrical drawings. The motor shall be sized to provide an output torque and shall be the totally enclosed, non-ventilated type. The power gearing shall consist of helical gears fabricated from heat treated alloy steel forming the first stage of reduction. The second reduction stage shall be a single stage worm gear. The worm shall be of alloy steel with carburized threads hardened and ground for high efficiency. The worm gear shall be of high tensile strength bronze with hobbed teeth. All power gearing shall be grease lubricated. Ball or roller bearings shall be used throughout. Preference will be given to units having a minimum number of gears and moving parts. Spur gear reduction shall be provided as required.
3. Limit switches and gearing shall be an integral part of the valve control. The limit switch gearing shall be made of bronze and shall be grease lubricated, intermittent type and totally enclosed to prevent dirt and foreign matter from entering the gear train. Limit switches shall be of the adjustable type capable of being adjusted to trip at any point between fully opened valve and fully closed valve.
4. The speed of the actuator shall be the responsibility of the system supplier with regard to hydraulic requirements and response compatibility with other components within the control loop. Each valve controller shall be provided with a minimum of two rotor type gear limit switches, one for opening and one for closing. The rotor type gear limit switch shall have two normally open and two normally closed contacts per rotor. Gear limit switches must be geared to the driving mechanism and in step at all times whether in motor or manual operation. Provision shall be made for two additional rotors as described above, each to have two normally open and two normally closed contacts. Each valve controller shall be equipped with a double torque switch. The torque switch shall be adjustable and will be responsive to load encountered in either direction of travel. It shall operate during the complete cycle without auxiliary relays or devices to protect the valve, should excessive load be met by obstructions in either direction of travel. The torque switch shall be provided with double-pole contacts.
5. A permanently mounted handwheel shall be provided for manual operation. The handwheel shall not rotate during electric operations but must be responsive to manual operation at all times except when being electrically operated. The motor shall not rotate during hand operation nor shall a fused motor prevent manual operation. When in manual operating position, the unit will remain in this position until motor is energized at which time the valve operator will automatically return to electric operation and shall remain in motor position until handwheel operation is desired. This movement from motor operation to handwheel operation shall be accomplished by a positive declutching lever which will disengage the motor and motor gearing mechanically, but not electrically. Hand operation must be reasonably fast. It shall be impossible to place the unit in manual

operation when the motor is running. The gear limit switches and torque switches shall be housed in a single easily accessible compartment integral with the power compartment of the valve control. All wiring shall be accessible through this compartment. Stepping motor drives will not be acceptable.

6. The motor with its control module must be capable of continuously modulating over its entire range without interruption by heat protection devices. The system, including the operator and control module must be able to function, without override protection of any kind, down to zero dead zone.
7. All units shall have strip heaters in both the motor and limit switch compartments.
8. The actuator shall be equipped with open-stop-close push buttons, an auto-manual selector switch, and indicating lights, all mounted on the actuator or on a separate locally mounted power control station.
9. The electronics for the electric operator shall be protected against temporary submergence.
10. Actuators shall be Limitorque L120 with Modutronic Control System containing a position transmitter with a 4-20MA output signal or equal.

D. Motor Actuators (Open-Close)

1. The electronic motor-driven valve actuator shall include the motor, actuator gearing, limit switch gearing, limit switches, torque switches, fully machined drive sleeve, declutch lever, and auxiliary handwheel as a self-contained unit.
2. The motor shall be specifically designed for valve actuator service and shall be of high torque totally enclosed, nonventilated construction, with motor leads brought into the limit switch compartment without having external piping or conduit box.
   a) The motor shall be of sufficient size to open or close the valve against maximum differential pressure when voltage to motor terminals is 10% above or below nominal voltage.
   b) The motor shall be prelubricated and all bearings shall be of the anti-friction type.
3. The power gearing shall consist of helical gears fabricated from heat treated steel and worm gearing. The worm shall be carburized and hardened alloy steel with the threads ground after heat treating. The worm gear shall be of alloy bronze accurately cut with a hobbing machine. All power gearing shall be grease lubricated. Ball or roller bearings shall be used throughout.
4. Limit switches and gearing shall be an integral part of the valve actuator. The switches shall be of the adjustable rotor type capable of being adjusted to trip at any point between fully opened valve and fully closed valve. Each valve controller shall be provided with a minimum of two rotor type gear limit switches, one for opening and one for closing (influent valves require

additional contacts to allow stopping at an intermediate position). The rotor type gear limit switch shall have two normally open and two normally closed contacts per toro. Additional switches shall be provided if shown on the control and/or instrumentation diagrams. Limit switches shall be geared to the driving mechanism and in step at all times whether in motor or manual operation. Each valve actuator shall be equipped with a double torque switch. The torque switch shall be adjustable and will be responsive to load encountered in either direction of travel. It shall operate during the complete cycle without auxiliary relays or devices to protect the valve should excessive load be met by obstructions in either direction of travel. Travel and thrusts shall be independent of wear in valve disc or seat rings.

5. A permanently mounted handwheel shall be provided for manual operation. The handwheel shall not rotate during electric operation except when being electrically operated. The motor shall not rotate during hand operation, nor shall a fused motor prevent manual operation. When in manual operating position, the unit will remain in this position until motor is energized at which time the valve actuator will automatically return to electric operation and shall remain in motor position until handwheel operation is desired. Movement from motor operation to handwheel operation shall be accomplished by a positive declutching lever which will disengage the motor and motor gearing mechanically, but not electrically. Hand operation must be reasonably fast. It shall be impossible to place the unit in manual operation when the motor is running.
6. Valve actuators shall be equipped with an integral reversing controller and three phase overload relays, Open-Stop-Close push buttons, local-remote-manual selector switch, control circuit transformer, three-phase thermal overload relays and two pilot lights in a NEMA 4X enclosure. In addition to the above, a close coupled air circuit breaker or disconnect switch shall be mounted and wired to the valve input power terminals for the purpose of disconnecting all underground phase conductors.
7. The valve actuator shall be capable of being controlled locally or remotely via a selector switch integral with the actuator. In addition, an auxiliary dry contact shall be provided for remote position feedback.
8. Valve A.C. motors shall be designed for operation on a 480 volt, 3-phase service. Valve control circuit shall operate from a fuse protected 120 volt power supply.
9. Motor operators shall be as manufactured by Limitorque Corporation, Type L120 or approved equal.

2.07 AIR RELEASE VALVES

A. Air release valves shall be automatic float operated, GA Industries fig-929 for sewer applications, Fig-920 for water and reclaimed water application, or an approved equal, with inlet size and working pressure ratings as required and NPT connections.

B. Valve bodies shall be ductile iron per ASTM A 126, Class B. The orifice, float and linkage shall be stainless steel. The seat shall be (Buna N) nitrile elastomer.

2.08 VALVE BOXES

A. Buried valves shall have adjustable cast iron or HDPE valve boxes. Lids shall be cast iron drop type, and shall have "WATER", "SEWER", or "RECLAIM", as applicable, cast into the top. Lids will be painted "safety" blue for potable, purple for reclaimed, and green for sanitary sewer.

B. Cast iron boxes shall be two-piece, or three-piece, as required, screw type, Tyler Pipe, 6850 Series, Box 461-S through 668-S, with extensions, as required to make the desired box length, or an approved equal. Bottom barrel shall be 5-1/4 inches inside diameter, with a flanged bottom with sufficient bearing area to prevent settling.

C. HDPE boxes shall be two-piece, adjustable, 1/4-inch thick minimum heavy wall, high-density polyethylene, with cast iron top and stainless-steel adjustable stem, Trench Adapter, as manufactured by American Flow Control, or an approved equal. Bottom barrel shall have flanged bottom to prevent settling. All bolts, screws and pins shall be stainless steel.

D. Reclaimed Valve Boxes shall be square 9-inch x 9-inch load bearing marked "Reclaimed Water" and painted Pantone 522C purple.

E. All valves shall either have operating nuts within 4 feet below the top of the lid or shall have extension stems with centering guides to provide an extended operating nut within 4 feet below the lid. Extension stems shall be fixed to the valve operating nut with a stainless-steel fastener.

F. All potable water, sewer, and reclaimed water grade-adjustment risers shall be cast iron material just like the valve box. No plastic or steel risers shall be allowed.

G. A centering device BoxLokor equal shall be installed in the valve box.

H. Stand pipe shall match color code of the system being installed, (blue for potable, Pantone purple 522 C for reclaimed, and green for sanitary sewer).

2.09 CORPORATION STOPS

A. Corporation stops for connections to ductile iron and PVC water and reclaimed water mains shall be all red brass, alloy 85-5-5-5, per ASTM B 62, and shall conform to AWWA C800. 1-inch through 2-inch corporation stops shall be ball

type, 300 psi working pressure rated, with AWWA MIP threaded inlets and compression, pack joint, flare, or FIP threaded joint outlets, Mueller as shown in the table below, or an approved equal. All joints made to CTS size HDPE tubing shall use stainless steel insert stiffeners.

Corporation Stops

Pipe Material	Type of Connection	Mueller 300 Model
HDPE	Compression x AWWA IP Thread	B-25028 (Saddle) *
HDPE	Compression x AWWA Taper Thread	B-25008 (Direct Tap) *
HDPE	Pack Joint x AWWA IP Thread	P-25028 (Saddle) *
HDPE	Pack Joint x AWWA Taper Thread	P-25008 (Direct Tap) *
Copper	Compression x AWWA IP Thread	B-25028 (Saddle)
Copper	Pack Joint x AWWA Taper Thread	B-25008 (Direct Tap)
Copper	Pack Joint x AWWA IP Thread	P-25028 (Saddle)
Copper	Pack Joint x AWWA Taper Thread	P-25008 (Direct Tap)
Copper	Flare x AWWA IP Thread	B-25028 (Saddle)
Copper	Flare x AWWA Taper Thread	B-25008 (Direct Tap)
Stainless Steel	FIP Thread x AWWA IP Thread	B-20046 (Saddle)
Stainless Steel	FIP Thread x AWWA Taper Thread	B-20045 (Direct Tap)

* Insert required, part number per manufacturer product information

B. Potable plastic service pipe material and compression and pack joint connectors shall not be used in soil that is contaminated with low molecular-weight petroleum products, aromatic hydrocarbons, chlorinated hydrocarbons or organic solvents. Appropriate service tubing shall apply.

C. Water and reclaimed water service connections to PVC and DIP mains shall be made using red brass saddles, alloy 85-5-5-5, per ASTM B 62. Straps, washers and nuts shall be brass or stainless steel. No ductile iron, cast iron or steel saddles will be allowed. Saddles shall be Smith Blair 325 Bronze saddles with Stainless Steel or brass extra wide strap or equivalent.

D. Connections to PVC sanitary force mains for services up to 2 inches shall be made using Romac Style 306 double bolt stainless steel service saddles or equivalent.

E. Service and air release valve (ARV) connections to HDPE water, reclaimed water and sewer mains may be made using Romac Style 306H saddle or approved equal. All saddles shall be properly sized per the manufacturer product information and be installed according to the manufacturer's written instructions. Connections to HDPE mains shall not be made using narrower saddles similar to the Smith-Blair 325.

2.10 FLANGE ADAPTER AND PLAIN END COUPLINGS

Plain end couplings and adapters shall be fusion-bonded epoxy coated carbon steel with

Ethylene Propylene Diene Monomer (EPDM) rubber gaskets and stainless steel nuts, bolts and spacers. Acrylonitrile butadiene (NBR) gaskets shall be used for potable water mains that are located in soil that is contaminated with low molecular-weight petroleum products or non-chlorinated organic solvents or non-aromatic organic solvents. Fluorocarbon (FKM) gaskets shall be used for potable water mains that are located in soil that is contaminated with aromatic hydrocarbons or chlorinated hydrocarbons. Fluorocarbon (FKM) gaskets shall be used for potable water mains if the soil is contaminated with aromatic hydrocarbons or chlorinated hydrocarbons, and is also contaminated with low molecular-weight petroleum products or organic solvents. Couplings shall be Dresser Style 38, or another approved equal. Flange adapters shall have a plain end compression seal similar to the style 38, with an ANSI 125 Class flange on the opposite end, and shall be Dresser Style 128W or an approved equal. Stainless steel backup rings shall be used for force mains that are located in corrosive environments including wetwells and valve vaults.

2.11 HOSE BIBS

Hose bibs shall be 3/4" or 1" brass, polished chromium plated brass, with vacuum breaker as noted on the drawings.

2.12 SWING CHECK VALVES

A. Check valves shall be swing type, weighted lever, conforming to AWWA C508. Valves shall be iron-body, bronze-mounted, single disk, 175 psi working pressure for 2- through 12-inch, 150 psi for 14- through 30-inch, with ANSI B16.1 Class 125 flanged ends, by Mueller; No. A-2600-6-01 (sewer), No. A-2602-6-01 (water), or AVK Series 41, or an approved equal.

B. When there is no flow through the line, the disc shall hang lightly against its seat in practically a vertical position. When open, the disc shall swing clear of the waterway.

C. Check valves shall have bronze seat and body rings, extended bronze or stainless steel hinge pins and stainless steel nuts and bolts on bolted covers

D. Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing the valve from the line. Valves shall be fitted with an extended hinge arm with outside lever and weight.

2.13 HYDRANTS

Hydrants shall be dry barrel, nostalgic style, and shall be AVK Series 2780, American Darling B-84-B , Mueller Super Centurian 250, or approved equal and shall conform to AWWA C502, and UL/FM certified, and shall in addition meet the specific requirements and exceptions which follow:

A. Hydrants shall be according to manufacturer's standard pattern or nostalgic style and of standard size, and shall have one 5-inch Storz connection or equivalent with two 2½- inch hose nozzles.

B. Hydrant inlet connections shall have mechanical joints for 6-inch pipe.

C. Hydrant valve opening shall have an area at least equal to that area of a 5 1/4-inch minimum diameter circle and be obstructed only by the valve rod. Each hydrant shall be able to deliver 500 gpm minimum through its two 2 1/2 -inch hose nozzles when opened together with a loss of not more than 2 psi in the hydrant per AWWA C502.

D. The upper and lower stem rod shall be stainless steel and shall have a breakable stem-rod coupling of stainless steel, or cast iron or ductile iron with a fusion bonded epoxy coating, with stainless steel pins and clips.

E. Hydrants shall be hydrostatically tested as specified in AWWA C502 and shall be rated at 250 psi minimum.

F. The operating nut shall be 1 ½ -inch pentagon shaped with a protective weather cover, and open counter clockwise.

G. All nozzle threads shall be American National Standard.

H. Each nozzle cap shall be provided with a Buna N rubber washer.

I. All hydrants shall be traffic break away type and allow for 360 degree rotation to position the Storz connection/nozzle in the desired direction after installation.

J. Hydrants must be capable of being extended without removing any operating parts.

K. Hydrant extensions shall be fusion bonded epoxy coated inside and outside with a stainless steel stem. The breakaway coupling can be fusion bonded epoxy coated or stainless steel. Only one hydrant extension is allowed per hydrant.

L. Weepholes shall be excluded from fire hydrants.

M. Hydrant main valve closure shall be of the compression type opening against the pressure and closing with the pressure. The main valve shall be faced or covered with EPDM elastomer, which shall seat on a bronze ring.

N. Hydrant bonnets, weather cover, nozzle section, caps and shoe shall be cast iron or ductile iron, and shall be holiday free fusion-bonded epoxy coated at the factory, per AWWA C550, inside and outside. Lower barrel shall be fusion bonded epoxy

coated inside and outside. Aboveground parts shall also have a top coat of Sherwin-Williams Acrolon 218 HS acrylic polyurethane or approved equal; color Safety Yellow for fire hydrants that are connected to the potable water system or Pantone 522C purple for fire hydrants that are connected to the reclaimed water system.

O. Exterior nuts, bolts and washers shall be stainless steel. Bronze nuts may be used below grade.

P. All internal operating parts shall be removable without requiring excavation.

2.14 RESTRAINED JOINTS

A. Pipe joints shall be restrained by poured-in-place concrete thrust blocks or by other mechanical methods, including tie rods, Stargrip and Allgrip, as manufactured by Star Pipe Products or Megaflange and 2000 PV, as manufactured by EBAA Iron Sales. Flanged joints may be used above ground.

B. All T-bolts, bolts, nuts, washers, and all thread rods shall meet ASTM A-588 requirements (Cor-ten or equivalent) "weathering steel" or be 316 stainless steel. The use of rebar with welded thread is prohibited.

A certification from the supplier shall be provided to the County during the shop drawing review process ensuring all T-bolts, bolts, nuts, washers, and all thread rods meet the A-588 requirements and shall state the project name and contractor in the certification letter. If stainless steel is to be used, no certification letter is required.

C. Restrained joints may also be Lok-Ring, as manufactured by American Cast Iron Pipe Company, or an approved equal.

D. Restrained joint designs which require wedges and/or shims to be driven into the joints in order to disassemble the pipe shall not be allowed.

2.15 TAPPING SLEEVES AND VALVES

A. Tapping valves shall meet the requirements of AWWA C509/C515 with ductile iron body and shall be rated for a pressure of 250 psi. The valves shall be flanged with alignment ring by mechanical joint with a non-rising stainless steel stem. All bolts, nuts and washers shall be stainless steel. Manufacturer shall use Never-Seez or equivalent during assembly of bolt and nut sets to prevent galling of similar metals. Stem seals shall be provided and shall be of the O-ring type, two above and one below the valve's thrust collar. Valve shall be designed for vertical burial and shall open counterclockwise. Operating nut shall be AWWA standard 2-inch square for valves 2 inches and up. Valves shall have an unobstructed waterway equal to or greater than the full nominal diameter of the valve to accommodate full size shell

cutter. Gaskets shall cover the entire area of the flange surface and be 1/8-inch minimal thickness of red rubber. The wedge shall be ductile iron fully encapsulated with EPDM rubber. All bolts, nuts and washers between the sleeve and valve shall be stainless steel.

B. Tapping sleeves and saddles shall be stainless steel, seal to the pipe by the use of a gasket compounded for water or sewer, and shall be able to withstand a pressure test of 180 psi for water lines or 150 psi for sewer force mains for one hour with no leakage in accordance with AWWA C110. A stainless steel 3/4-inch NPT test plug shall be provided for pressure testing. All bolts joining the two halves shall be stainless steel and shall be included with the sleeve or saddle.

2.16 TRACER WIRE TEST STATION BOXES

Tracer wire test station boxes shall be provided at plug valves, butterfly valves, blowoff valves, gate valves, fire hydrants and backflow preventers as indicated in these Standards. Tracer wire test station boxes for yard service shall be 2 ½ inch diameter, 15 inch length, ABS plastic with a cast iron rim and lid, P200NFGT as manufactured by Bingham & Taylor, or equal approved by Manatee County. Where test boxes will be in streets or subject to vehicular traffic, use B&T Model P525RD, 5 ¼ -inch diameter or equal, centered in a separate concrete pad similar to a valve box pad.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All valves and appurtenances shall be installed in the location shown, true to alignment and rigidly supported. Any damage occurring to the above items before they are installed shall be repaired to the satisfaction of the County.

B. After installation, all valves and appurtenances shall be tested at least two hours at the working pressure corresponding to the class of pipe, unless a different test pressure is specified. If any joint proves to be defective, it shall be repaired to the satisfaction of the County.

C. Install all floor boxes, brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings that are in masonry floors or walls, and install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured. Before setting these items, the Contractor shall check all plans and figures which have a direct bearing on their location and he shall be responsible for the proper location of these valves and appurtenances during the construction of the structures.

D. Pipe for use with flexible couplings shall have plain ends as specified in the

respective pipe sections.

E. Flanged joints and mechanical joints shall be made with high strength, low alloy Corten or 316 stainless steel bolts, nuts and washers.

F. Prior to assembly of split couplings, the grooves as well as other parts shall be thoroughly cleaned. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap or graphite paste, and the gasket shall be slipped over one pipe end. After the other pipe has been brought to the correct position, the gasket shall be centered properly over the pipe ends with the lips against the pipes. The housing sections then shall be placed. After the bolts have been inserted, the nuts shall be tightened until the housing sections are firmly in contact, metal-to-metal, without excessive bolt tension.

G. Prior to the installation of sleeve-type couplings, the pipe ends shall be cleaned thoroughly for a distance of 8". Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6" from the end.

H. Valve boxes with concrete bases shall be installed as shown on the Drawings. Mechanical joints shall be made in the standard manner. Valve stems shall be vertical in all cases. Place cast iron box over each stem with base bearing on compacted fill and the top flush with final grade. Boxes shall have sufficient bracing to maintain alignment during backfilling. Knobs on cover shall be parallel to pipe. Remove any sand or undesirable fill from valve box.

3.02 HYDRANTS

A. Hydrants shall be set at the locations designated by the County and/or as shown on the Drawings and shall be bedded on a firm foundation. A drainage pit on crushed stone as shown on the Drawings shall be filled with gravel or crushed stone and satisfactorily compacted. During backfilling, additional gravel or crushed stone shall be brought up around and 6" over the drain port. Each hydrant shall be set in true vertical alignment and shall be properly braced. Concrete thrust blocks shall be placed between the back of the hydrant inlet and undisturbed soil at the end of the trench. Minimum bearing area shall be as shown on the plans. Felt paper shall be placed around the hydrant elbow prior to placing concrete. CARE MUST BE TAKEN TO ENSURE THAT CONCRETE DOES NOT PLUG THE DRAIN PORTS. Concrete used for backing shall be as specified herein.

B. When installations are made under pressure, the flow of water through the existing main shall be maintained at all times. The diameter of the tap shall be a minimum of 2" less than the inside diameter of the branch line.

C. The entire operation shall be conducted by workmen thoroughly experienced in the

installation of tapping sleeves and valves, and under the supervision of qualified personnel furnished by the manufacturer. The tapping machine shall be furnished by the Contractor if tap is larger than 12" in diameter.

D. The Contractor shall determine the locations of the existing main to be tapped to confirm the fact that the proposed position for the tapping sleeve will be satisfactory and no interference will be encountered such as the occurrence of existing utilities or of a joint or fitting at the location proposed for the connection. No tap will be made closer than 30" from a pipe joint.

E. Tapping valves shall be set in vertical position and be supplied with a 2" square operating nut for valves 2" and larger. The valve shall be provided with an oversized seat to permit the use of full sized cutters.

F. Tapping sleeves and valves with boxes shall be set vertically or horizontally as indicated on the Drawings and shall be squarely centered on the main to be tapped. Adequate support shall be provided under the sleeve and valve during the tapping operation. Sleeves shall be no closer than 30" from water main joints. Thrust blocks shall be provided behind all tapping sleeves. Proper tamping of supporting earth around and under the valve and sleeve is mandatory. After completing the tap, the valve shall be flushed to ensure that the valve seat is clean.

3.03 SHOP PAINTING

Ferrous surfaces of valves and appurtenances shall receive a coating of rust-inhibitive primer. All pipe connection openings shall be capped to prevent the entry of foreign matter prior to installation.

3.04 FIELD PAINTING

All metal valves and appurtenances specified herein and exposed to view shall be painted safety blue.

3.05 INSPECTION AND TESTING

All pipelines shall remain undisturbed for 24 hours to develop complete strength at all joints. All pipelines shall be subjected to a hydrostatic pressure and leak testing. Refer to Manatee County Public Works Utility Standards Part 1-Utility Standards Manual Section 1.8.7. Prior to testing, the pipe lines shall be supported in a manner approved by the County to prevent movement during tests.

All leaks shall be repaired and lines retested as approved by the County.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE AND RELATED WORK

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete, reinforcing, and related materials.
   2. The Work includes:
      a. Providing concrete consisting of portland cement, fine and coarse aggregates, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured.
      b. Fabricating and placing reinforcing, including ties and supports.
      c. Design, erection, and removal of formwork.
      d. Building into the concrete all sleeves, frames, anchorage devices, inserts, and other items required to be embedded in concrete.
      e. Providing openings in concrete as required to accommodate Work under this and other Sections.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work.

C. Classifications of Concrete:
   1. Class “A” concrete shall be steel-reinforced and includes all concrete unless otherwise shown or indicated.
   2. Class “B” concrete shall be placed without forms or with simple forms, with little or no reinforcing and includes the following:
      a. Concrete fill.
      b. Duct banks.
      c. Unreinforced encasements.
      d. Curbs and gutters.
      e. Sidewalks.
      f. Thrust blocks.
      g. Unreinforced concrete and used where required as concrete fill under foundations, filling abandoned piping, and where “lean concrete” or “mudmat” or “working slab” is shown or indicated in the Contract Documents.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ACI 224R, Control of Cracking in Concrete Structures.
   2. ACI 301, Specifications for Structural Concrete for Buildings.
   3. ACI 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
   4. ACI 305R, Specification for Hot Weather Concreting.
   5. ACI 306R, Cold Weather Concreting.
   6. ACI 309R, Guide for Consolidation of Concrete.
   7. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
   8. ACI 347, Guide to Formwork for Concrete.
   9. ACI SP-66, ACI Detailing Manual.
   10. ASTM A82/A82M, Specification for Steel Wire, Plain, for Concrete Reinforcement.
   12. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   13. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.
   14. ASTM C33/C33M, Specification for Concrete Aggregates.
   15. ASTM C39/C39M, Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   16. ASTM C42/C42M, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   16. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
   17. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
   18. ASTM C143/C143M, Test Method for Slump of Hydraulic-Cement Concrete.
   19. ASTM C150/C150M, Specification for Portland Cement.
   20. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
   21. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
   22. ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
   23. ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   24. ASTM C494/C494M, Specification for Chemical Admixtures for Concrete.
   25. ASTM C579, Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   26. ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
   28. ASTM E96/E96M, Test Methods for Water Vapor Transmission of Materials
   29. ASTM E154, Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
   31. CRSI 1MSP, Manual of Standard Practice.

1.3 QUALITY ASSURANCE

A. Laboratory Trial Batch:
   1. Employ independent testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.
   2. Each concrete mix design specified shall be verified by laboratory trial batch, unless indicated otherwise.
   3. Perform the following testing on each trial batch:
      a. Aggregate gradation for fine and coarse aggregates.
      b. Slump.
      c. Air content.
      d. Compressive strength based on three cylinders each tested at seven days and at 28 days.
   4. Submit for each trial batch the following information:
      a. Project identification name and number (if applicable).
      b. Date of test report.
      c. Complete identification of aggregate source of supply.
      d. Tests of aggregates for compliance with the Contract Documents.
      e. Scale weight of each aggregate.
      f. Absorbed water in each aggregate.
      g. Brand, type, and composition of cementitious materials.
      h. Brand, type, and amount of each admixture.
      i. Amounts of water used in trial mixes.
      j. Proportions of each material per cubic yard.
      k. Gross weight and yield per cubic yard of trial mixtures.
      l. Measured slump.
      m. Measured air content.
      n. Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28-day test, and for each design mix.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. List of concrete materials and concrete mix designs proposed for use. Include results of tests performed to qualify the materials and to establish the mix designs. Do not start laboratory trial batch testing until this submittal is approved by ENGINEER.
      b. Laboratory Trial Batch Reports: Submit laboratory test reports for concrete cylinders, materials, and mix design tests.
      c. Concrete placement drawings showing the location and type of all joints.
      d. Drawings for fabricating, bending, and placing concrete reinforcing.

Comply with ACI SP-66. For walls and masonry construction, provide elevations to a minimum scale of 1/4-inch to one foot. Show bar schedules, stirrup spacing, adhesive dowels, splice lengths, diagrams of bent bars, arrangements, and assemblies, as required for fabricating and placing concrete reinforcing.

2. Product Data:
   a. Manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
3. Samples:
   a. Samples: Submit samples of materials as specified and as otherwise requested by ENGINEER, including names, sources, and descriptions.

B. Informational Submittals: Submit the following:

1. Delivery Tickets: Copies of all delivery tickets for each load of concrete delivered to or mixed at the Site. Each delivery tickets shall contain the information in accordance with ASTM C94/C94M along with project identification name and number (if any), date, mix type, mix time, quantity and amount of water introduced.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transportation, Delivery, and Handling:
1. Deliver concrete reinforcing products to Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings on approved Shop Drawings.
2. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.
3. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
4. Deliver grout materials from manufacturers in unopened containers that bear intact manufacturer labeling.5. Comply withProduct Storage and Handling Requirements.

B. Storage:
1. Store formwork materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective, waterproof covering. Provide for adequate air circulation or ventilation under cover.
2. Store concrete reinforcing materials to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground. Space framework or blocking supports to prevent excessive deformation of stored materials.

3. Store concrete joint materials on platforms or in enclosures or covered to prevent contact with ground and exposure to weather and direct sunlight.
4. For storage of concrete materials, provide bins or platforms with hard, clean surfaces.
5. Comply Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type II.

B. Aggregates: ASTM C33/C33M.
1. Fine Aggregate: Clean, sharp, natural sand free of loam, clay, lumps, and other deleterious substances. Dune sand, bank run sand, and manufactured sand are unacceptable.
2. Coarse Aggregate:
   a. Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter.
   b. Coarse aggregate shall comply with the following:
      1) Crushed stone, processed from natural rock or stone.
   c. Coarse Aggregate Size: ASTM C33/C33M, Nos. 57 or 67, unless otherwise approved by ENGINEER.

C. Water: Clean, potable.

D. Admixtures:
1. Air-Entraining Admixture: ASTM C260.
2. Water-Reducing Admixture: ASTM C494/C494M, Type A.
3. Water Reducing and Set-Adjusting Admixtures: ASTM C494/C494M, Types D and E.

5. Use only admixtures that have been tested and approved in the mix designs.
6. Do not use calcium chloride or admixtures containing chloride ions.

2.2 CONCRETE MIX

A. General:
1. Normal weight: 145 pounds per cubic foot.
2. Use air-entraining admixture in all concrete. Provide not less than four percent, nor more than six percent, entrained air for concrete exposed to freezing and thawing, and provide from three to five percent entrained air for other concrete.

B. Proportioning and Design of Class "A" Concrete Mix:
   1. Minimum compressive strength at 28 days: 4,500 psi.
   2. Maximum water-cement ratio by weight: 0.42.
   3. Minimum cement content: 564 pounds per cubic yard.

C. Proportioning and Design of Class "B" Concrete Mix:
   1. Minimum compressive strength at 28 days: 3,000 psi.
   2. Maximum water-cement ratio by weight: 0.50.
   3. Minimum cement content: 517 pounds per cubic yard.

D. Slump Limits:
   1. Proportion and design mixes to result in concrete slump at point of placement of not less than one inch and not more than four inches.
   2. When using high-range water reducers, slump prior to addition of admixture shall not exceed three inches. Slump after adding admixture shall not exceed eight inches at point of placement.

E. Adjustment of Concrete Mixes:
   1. Concrete mix design adjustments may be requested by CONTRACTOR when warranted by characteristics of materials, Site conditions, weather, test results, or other, similar circumstances.
   2. Submit for ENGINEER's approval laboratory test data for adjusted concrete mix designs, including compressive strength test results.
   3. Implement adjusted mix designs only after ENGINEER's approval.
   4. Adjustments to concrete mix designs shall not result in additional costs to OWNER.

2.3 FORM MATERIALS

A. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection. CONTRACTOR shall be responsible for designing the formwork system to resist all applied loads including pressures from fluid concrete and construction loads.

B. Smooth Form Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces in accordance with ACI 301.

C. Unexposed Concrete Surfaces: Material to suit project conditions.

D. Provide 3/4-inch chamfer at all external corners. Chamfer is not required at re-entrant corners unless otherwise shown or indicated.

E. Form Ties:

1. Provide factory-fabricated, removable, or snap-off metal form ties, that prevent form deflection and prevent spalling of concrete surfaces upon removal. Materials used for tying forms are subject to approval of ENGINEER.
2. Unless otherwise shown or indicated, provide ties so that portion remaining within concrete after removal of exterior parts is at least 1.5 inches from outer surface of concrete. Unless otherwise shown or indicated, provide form ties that, upon removal, will leave a uniform, circular hole not larger than one-inch diameter in the concrete surface.
3. Ties for exterior walls, below-grade walls, and walls subject to hydrostatic pressure shall be provided with waterstops.
4. Wire ties are unacceptable.

2.4 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed bars.

C. Steel Wire: ASTM A82/A82M.

D. Provide supports for reinforcing including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing in place.
1. Use wire bar-type supports complying with CRSI MSP1 recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.
2. For slabs on grade, use precast concrete blocks, four inches square minimum with compressive strength equal to or greater than the surrounding concrete, or supports with sand plates or horizontal runners where base materials will not support chair legs.
3. For all concrete surfaces where legs of supports are in contact with forms, provide supports having plastic-protected, or stainless steel legs in accordance with CRSI MSP1.
4. Provide precast concrete supports over waterproof membranes.

E. Adhesive Dowels:
1. Dowels:
   a. Dowel reinforcing bars shall comply with ASTM A615, Grade 60.
2. Adhesive:
   a. Provide Hilti RE-500 V3 or Simpson SET-XP or approved equal as adhesive. Follow manufacturer's instruction and requirements.

2.5 RELATED MATERIALS

A. Vapor Retarder:
1. Products and Manufacturers: Provide one of the following:

a. Stego Wrap Class A 10-mil Vapor Retarder, by Stego Industries LLC.
b. Griffolyn 10-mil, by Reef Industries.
c. Moistop Ultra 10, by Fortifiber Industries.
d. Or equal.

2. Vapor retarder membrane shall comply with the following.
a. Water Vapor Transmission Rate, ASTM E96/E96M: 0.04 perms or lower.
b. Water Vapor Retarder, ASTM E1745: Meets or exceeds Class C.
c. Thickness of Retarder (plastic), ACI 302 1R: Not less than 10 mils.
d. Provide accessories by same manufacturer as vapor retarder.

B Membrane-Forming Curing Compound: ASTM C309, Type I.

C. Epoxy Bonding Agent:
1. Two-component epoxy resin bonding agent.
2. Products and Manufacturers: Provide one of the following:
a. Sikadur 32, Hi-Mod LPL, by Sika Corporation.
b. Eucopoxy LPL, by the Euclid Chemical Company.
c. Or equal.

D. Preformed Expansion Joint Filler:
1. Provide preformed expansion joint filler complying with ASTM D1752, Type I (sponge rubber) or Type II (cork).

2.6 GROUT

A. Non-shrink Grout:
1. Pre-packaged, non-metallic, cementitious grout requiring only the addition of water at the Site.
2. Minimum 28-day Compressive Strength: 7,000 psi.
3. Products and Manufacturers: Provide one of the following:
a. NS Grout by Euclid Chemical Company.
b. MasterFlow 100 by Master Builders Solutions by BASF.
c. Five Star Grout by Five Star Products, Inc.
d. Or equal.

B. Grout Fill:
1. Grout mix shall consist of cement, fine and coarse aggregates, water, and admixtures complying with requirements specified in this Section for similar materials in concrete.
2. Proportion and mix grout fill as follows:
a. Minimum Cement Content: 564 pounds per cubic yard.
b. Maximum Water-Cement Ratio: 0.45.
c. Maximum Coarse Aggregate size: 1/2-inch, unless otherwise indicated.

d. Minimum 28-day Compressive Strength: 4,000 psi.

PART 3 – EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the substrate and the conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 FORMWORK

A. Construct formwork in accordance with ACI 347 such that concrete members and structures are of correct size, shape, alignment, elevation, and position.

B. Provide openings in formwork to accommodate the Work of other trades. Accurately place and securely support items required to be built into formwork.

C. Clean and adjust forms prior to placing concrete. Apply form release agents or wet forms as required. Re-tighten forms during and after concrete placing, when required, to eliminate cement paste leaks.

D. Removing Formwork:
   1. Comply with ACI 301 and ACI 347, except as otherwise indicated in the Contract Documents.
   2. Do not remove formwork and shoring until supported concrete members have acquired minimum of 90 percent of specified compressive strength. Results of suitable quality control tests of field-cured specimens may be submitted to ENGINEER for review as evidence that concrete has attained sufficient strength for removal of supporting formwork and shoring prior to removal times indicated in the Contract Documents.
   3. Removal time for formwork is subject to ENGINEER's acceptance.
   4. Repair form tie-holes following in accordance with ACI 301.

3.3 REINFORCING, JOINTS, AND EMBEDDED ITEMS

A. Comply with the applicable recommendations of Laws and Regulations and standards referenced in this Section, including CRSI MSP1, for details and methods of placing and supporting reinforcing.

B. Clean reinforcing to remove loose rust and mill scale, earth, ice, and other materials which act to reduce or destroy bond between reinforcing material and concrete.

C. Position, support, and secure reinforcing against displacement during formwork construction and concrete placing. Locate and support reinforcing by means of metal chairs, runners, bolsters, spacers, and hangers, as required.
   1. Place reinforcing to obtain minimum concrete coverages as shown on the Drawings and as required in ACI 318. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcing accurately in position during concrete placing. Set with ties so that twisted ends are directed away from exposed concrete surfaces.
   2. Do not secure reinforcing to formwork using wire, nails or other ferrous metal. Metal supports subject to corrosion shall not be in contact with formed or exposed concrete surfaces.

D. Provide sufficient quantity of supports of strength required to carry reinforcing. Do not place reinforcing more than two inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

E. Splices: Provide standard reinforcing splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown or indicated for minimum lap of spliced bars, as shown on the drawings or in accordance with the requirements of ACI (whichever is greater).

F. Do not place concrete until reinforcing is inspected and ENGINEER indicates that conditions are acceptable for placing concrete. Concrete placed in violation of this paragraph will be rejected. Notify ENGINEER in writing at least two working days prior to proposed concrete placement.

G. Joints:
   1. Provide construction, isolation, expansion, and control joints as indicated or required. Locate construction joints so as to not impair the strength and appearance of the structure. Place isolation and control joints in slabs-on-grade to stabilize differential settlement and random cracking.
   2. In walls, locate joints at a maximum spacing of 40 feet and approximately 12 feet from corners.
   3. In foundation slabs and slabs-on-grade, locate joints at intervals of approximately 40 feet.
   4. In mats and structural slabs and beams, locate joints in compliance with ACI 224R.
   5. Locations of joints shall be in accordance with the Contract Documents and as approved by ENGINEER in the Shop Drawings.
   6. Where construction joints are indicated to be roughened, intentionally roughen surfaces of previously-placed concrete to amplitude of 1/4-inch.

H. Installation of Embedded Items: Set and build into the Work anchorage devices and embedded items required for other Work that is attached to, or supported by, cast-in-

place concrete. Use setting diagrams, templates, and instructions provided under other Sections for locating and setting. Refer to Paragraph 1.1.B of this Section. Do not embed in concrete uncoated aluminum items. Where aluminum items are in contact with concrete surfaces, coat aluminum to prevent direct contact with concrete.

I. Adhesive Dowels:
   1. Adhesive dowels shall be reinforcing bar dowels set in an adhesive in hole drilled into hardened concrete. Comply with adhesive system manufacturer's installation instructions regarding hole diameter, drilling method, embedment depth required to fully develop required tensile strength, and hole cleaning and preparation instructions. Unless more-stringent standards are required by adhesive system manufacturer, comply with the following.
   2. Drill holes to adhesive system manufacturer's recommended diameter and depth to develop required tensile strength. Holes shall not be more than 1/4-inch greater than nominal bar diameter, and hole depth shall not be less than twelve times nominal bar diameter. Hammer-drill holes. Cored holes are not allowed.

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3.4 CONCRETE PLACING

A. Site Mixing: Use drum-type batch machine mixer, mixing not less than 1.5 minutes for one cubic yard or smaller capacity. Increase required mixing time by minimum of 15 seconds for each additional cubic yard or fraction thereof.

B. Ready-Mixed Concrete: Comply with ASTM C94/C94M.

C. Concrete Placing:
   1. Place concrete in a continuous operation within planned joints or sections in accordance with ACI 304R.
   2. Do not begin placing concrete until work of other trades affecting concrete is completed.
   3. Wet concrete and subgrade surfaces to saturated surface dry condition immediately prior to placing concrete.
   4. Deposit concrete as near its final location as practical to avoid segregation due to re-handling or flowing.
   5. Avoid separation of the concrete mixture during transportation and placing. Concrete shall not free-fall for distance greater than four feet during placing.
   6. Complete concrete placing within 90 minutes of addition of water to the dry ingredients.

D. Consolidate placed concrete in accordance with ACI 309R using mechanical vibrating equipment supplemented with hand rodding and tamping, such that concrete is worked around placing and other embedded items and into all parts of

formwork. Insert and withdraw vibrators vertically at uniformly-spaced locations. Do not use vibrators to transport concrete within the formwork. Vibration of formwork or placing is not allowed.

E. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing.
   1. In hot weather comply with ACI 305R.
   2. In cold weather comply with ACI 306R.

3.5 QUALITY OF CONCRETE WORK

A. Make concrete solid, compact, smooth, and free of laitance, cracks, and cold joints.

B. Concrete for liquid-retaining structures and concrete in contact with earth, water, or exposed directly to the elements shall be watertight.

C. Cut out and properly replace to extent directed by ENGINEER, or repair to satisfaction of ENGINEER, surfaces that contain cracks or voids, are unduly rough, or are in defective in any way. Patches or plastering are unacceptable.

D. Repair, removal and replacement of defective concrete directed by ENGINEER shall be at no additional cost to OWNER.

3.6 CURING

A. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by using moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until formwork is removed. Provide protection, as required, to prevent damage to exposed concrete surfaces. Total curing period shall not be less than seven days. Curing methods and materials shall be compatible with scheduled finishes.

3.7 FINISHING

A. Slab Finish:
   1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently. Use a wood float only. Check and level surface plane to a tolerance not exceeding 1/4-inch in ten feet when tested with a ten foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float the surface to a uniform, smooth, granular texture. Slab surfaces shall receive a float finish. Provide additional trowel finishing as required in this Section.

2. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over the surface.
3. Consolidate concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten-foot straightedge. Grind smooth surface defects that would telegraph through applied floor covering system.
4. Use trowel finish for the following:
    a. Interior exposed slabs, unless otherwise shown or indicated.
    b. Apply non-slip broom finish, after troweling, to exterior concrete slab and elsewhere as shown.

C. Formed Finish:
1. Provide smooth form concrete finish at exposed surfaces. Use largest practical form panel sizes to minimize form joints. Exposed surfaces include interior water-contacting surfaces of tanks, whether or not directly visible. All surfaces shall be considered as exposed, unless buried or covered with permanent structural or architectural material. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/8-inch in height. Where surface will be coated or will receive further treatment, remove all fins flush with concrete surface.
2. Provide rough form finish at all unexposed surfaces. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/2-inch in height.

3.8 GROUT PLACING

A. Place grout as shown and indicated, and in accordance with grout manufacturer's instructions and recommendations. If grout manufacturer's instructions conflict with the Contract Documents, notify ENGINEER and not proceed until obtaining ENGINEER's clarification.

B. Dry-packing is not allowed, unless otherwise indicated.

C. Manufacturers of proprietary grout materials shall make available upon 72 hours notice the services of qualified, full-time, factory-trained employee to aid in ensuring proper use of grout materials at the Site.

D. Placing grout shall comply with temperature and weather limitations described in Article 3.4 of this Section.

3.9 FIELD QUALITY CONTROL

A. Site Testing Services:

1. OWNER will employ testing laboratory to perform field quality control testing for concrete. ENGINEER will direct the testing requirements.
2. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.
3. CONTRACTOR shall provide curing and necessary cylinder storage in accordance with 01410Testing and Testing Laboratory Services.

B. Quality Control Testing During Construction:
   1. Perform sampling and testing for field quality control during concrete placing, as follows:
      a. Sampling Fresh Concrete: ASTM C172.
      b. Slump: ASTM C143/C143M; one test for each concrete load at point of discharge.
      c. Concrete Temperature: ASTM C1064/C1064M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.
      d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.
      e. Unit Weight: ASTM C138/C138M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
      f. Compression Test Specimens:
         1) In accordance with ASTM C31/C31M, make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by ENGINEER.
         2) Cast, store, and cure specimens in accordance with ASTM C31/C31M.
      g. Compressive Strength Tests:
         1) In accordance with ASTM C39/C39M; one specimen tested at seven days, and three specimens tested at 28 days.
         2) Concrete that does not comply with strength requirements will be considered as defective Work.
      h. Within 24 hours of completion of test, testing laboratory will transmit certified copy of test results to CONTRACTOR and ENGINEER.
      i. When there is evidence that strength of in-place concrete does not comply with the Contract Documents, CONTRACTOR shall employ the services of concrete testing laboratory to obtain cores from hardened concrete for compressive strength determination. Cores and tests shall comply with ASTM C42/C42M and the following:
         a. Obtain at least three representative cores from each concrete member or suspect area of concrete at locations directed by ENGINEER.
         b. Strength of concrete for each series of cores will be acceptable if average compressive strength is at least 85 percent of specified

compressive strength and no single core is less than 75 percent of required 28-day required concrete compressive strength.

c. Testing laboratory shall submit test results to ENGINEER on same day that tests are completed. Include in test reports Project name and number (if any), date of sampling and testing, CONTRACTOR name, name of concrete testing laboratory, exact location of test core in the Work, type or class of concrete represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength, and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plane of concrete as placed, and moisture condition of the core at time of testing.

d. Fill core holes solid with non-shrink grout in accordance with Grouting, and finish to match adjacent concrete surfaces.

e. If results of core tests are unacceptable or if it is impractical to obtain cores, perform static load test and evaluations complying with ACI 318 and ACI 350, as directed by ENGINEER.

3.10 REPAIR OF CONCRETE PLACED UNDER THIS CONTRACT

A. Repair of Formed Surfaces:

1. Repair the following defects in all formed finishes:
   a. Spalls, air bubbles, rock pockets, form depressions, and other defects that are more than 1/4-inch in depth.
   b. Holes from tie rods and other form tie systems.
   c. Fins, offsets, and other projections that extend more than 1/4-inch beyond designated concrete member surface.
   d. Structural cracks, as defined by ENGINEER.
   e. Non-structural cracks greater than 0.010-inch wide as defined by ENGINEER. In liquid-retaining structures, elevated slabs subject to the elements or washdowns, below-grade members, and cracks that evidence leakage. Where it is not possible to verify whether a crack is leaking, repair the crack.
2. Repair the following defects in smooth-finish surfaces, in addition to those listed above in this Section:
   a. Spalls, air bubbles, rock pockets, form depressions, and other defects that extend to more than 1/2-inch in width in any direction, no matter how deep.
   b. Spalls, air bubbles, rock pockets, form depressions, and other defects of any size that exceed three in number in a 12-inch by 12-inch area, or 12 in number in a three-foot by three-foot area.

c. Fins, offsets, and other projections shall be completely removed and smoothed.
d. Scratches and gouges in concrete surface.
e. Texture and color irregularities. In liquid-retaining surfaces, texture and color irregularities need not be repaired when greater than 12 inches below minimum normal operating liquid surface elevation, except where such defects are indicative of reduced durability.

3. Where smooth rubbed or grout cleaned finish is specified, minor surface defects repairable by the finishing process need not be repaired prior to finish application, when approved by ENGINEER.

B. Method of Repair of Formed Surfaces:
1. Immediately after removing forms, repair and patch defective areas with cement mortar or concrete repair mortar as directed by ENGINEER. Make repairs to liquid-retaining structures and below-grade surfaces with repair mortar only. Repair form tie holes in liquid-retaining or below-grade surfaces with non-shrink.
2. Honeycombs, Rock Pockets, and Holes Left by Tie Rods and Bolts:
a. Cut out honeycomb, rock pockets, voids, and holes left by tie rods and bolts, down to solid concrete but, in no case, to depth less than one-inch for cement mortar and 1/2-inch for repair mortar. Make edges of cuts perpendicular to concrete surface.
b. Before placing cement mortar, thoroughly clean and brush-coat area to be patched with specified bonding agent.
c. When using concrete repair mortar, use of bonding agent is optional; prepare the surface and place mortar in accordance with mortar manufacturer's recommendations.
d. Repairs at exposed-to-view surfaces shall match the color of surrounding concrete, except color matching is not required for interior surfaces of liquid-retaining surfaces up to one foot below typical minimum liquid level. Impart texture to repaired surfaces to match texture of existing adjacent surfaces. Provide test areas at inconspicuous locations to verify mixture, texture, and color match before proceeding with patching.
e. Compact mortar in place and strike off slightly higher than the surrounding surface.
3. Structural Cracks: Pressure-grout structural cracks using injectable epoxy installed using pressurized system. Apply in accordance with epoxy manufacturer's directions and recommendations.
4. Non-structural Cracks: Shall be pressure-grouted using injection material as required by Engineer. Install in accordance with manufacturer's directions and recommendations.
5. Determination of the crack type shall be made by the ENGINEER.

6. Holes Through Concrete:
    a. Using plunger-type gun or other suitable device, fill holes extending through concrete from least-exposed face, using flush stop held at exposed face; completely fill the hole with specified repair material.
    b. At below-grade and liquid-containing members, fill holes with concrete repair mortar and use color-matched cement mortar for outer two inches at exposed-to-view surfaces.
7. Where powerwashing or scrubbing is not adequate, abrasive blast exposed-to-view surfaces that require removal of stains, grout accumulations, sealing compounds, and other substances marring the surfaces. Use sand finer than No. 30 and air pressure from 15 to 25 psi.

C. Repair of Unformed Surfaces:
1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to specified tolerances for each surface and finish. Correct low and high areas in accordance with this Section.
2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using template having the required slope. Correct high and low areas in accordance with this Section.
3. Repair finish of unformed surfaces containing defects that adversely affect concrete durability. Surface defects include crazing, cracks in excess of 0.01-inch wide, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
4. Repair structural cracks in all structures and non-structural cracks in liquid-retaining structures. In liquid-retaining structures, where dry face of concrete member can be observed, repair all cracks evidencing any rate of water flow through crack. Where dry face of member cannot be observed, repair all cracks.

D. Methods of Repair of Unformed Surfaces:
1. Correct high areas in unformed surfaces by grinding, after concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.
2. Correct low areas in unformed surfaces, during or immediately after completion of surface finishing, by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Where repairs are required and concrete has already set, sawcut around perimeter of area to be repaired to depth of 1/2-inch and remove concrete so that minimum thickness of repair is 1/2-inch. Apply specified concrete repair mortar in accordance with repair mortar manufacturer's directions and recommendations.

3. Repair defective areas, except random cracks and single holes not exceeding one-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4-inch clearance all around. Minimum thickness of repair shall be 1.5 inches. Dampen concrete surfaces in contact with patching concrete and brush with specified bonding agent. Place patching concrete while bonding agent is tacky. Mix patching concrete of same materials and proportions to provide concrete of same classification as original, adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
4. Repair isolated, random, non-structural cracks (in members that are not below grade or liquid-retaining), and single holes not greater than one-inch diameter, by dry-pack method. Groove top of cracks, and cut out holes to sound concrete, and clean repair area of dust, dirt, and loose particles. Dampen all cleaned concrete surfaces and brush with the specified bonding agent. Place dry-pack before cement grout takes its initial set. Mix dry-pack, consisting of one part portland cement to 2.5 parts fine aggregate passing No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for at least 72 hours.
5. Structural cracks shall be pressure-grouted using injectable epoxy. Apply in accordance with epoxy manufacturer's directions and recommendations.
6. Non-structural cracks in below-grade and liquid-retaining structures shall be pressure-grouted using injection material as specified by Engineer. Apply in accordance with resin manufacturer's directions and recommendations.
7. Determination of crack type will be by ENGINEER.

+ + END OF SECTION + +

SECTION 03350

CONCRETE FINISHES

PART 1 – GENERAL

1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required to finish cast-in-place concrete surfaces as specified herein.

1.02 SUBMITTALS

Submit to the County as provided in the Contract Documents, the proposed chemical hardener manufacturer's surface preparation and application procedures.

1.03 SCHEDULE OF FINISHES

A. Concrete for the Project shall be finished in the various specified manners either to remain as natural concrete or to receive an additional applied finish or material under another Section.

B. The base concrete for the following conditions shall be finished as noted and as further specified herein:

1. Exterior, exposed concrete slabs and stairs - broomed finish.
2. Interior, exposed concrete slabs - steel trowel finish.
3. Concrete on which process liquids flow or in contact with sludge - steel trowel finish.
4. Concrete where not exposed in the finished work and not scheduled to receive an additional applied finish or material - off-form finish.
5. Provide concrete surfaces to be left exposed such as walls, columns, beams and joists with smooth rubbed finish.

1.04 RESPONSIBILITY FOR CHANGING FINISHES

A. The surface finishes specified for concrete to receive additional applied finishes or materials are the finishes required for the proper application of the actual products specified under other Sections. Where different products are approved for use, it shall be the Contractor's responsibility to determine if changes in finishes are required and to provide the proper finishes to receive these products.

B. Changes in finishes made to accommodate product different from those specified shall be performed at no additional cost to the County. Submit the proposed new

finishes and their construction methods to the County for approval.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Portland cement and component materials required for finishing the concrete surfaces shall be as specified in the Contract Documents.

B. Hardener shall be Lapidolith as manufactured by Sonneborn Building Products or approved equal. Hardener shall be used on all floors, stair treads and platforms.

PART 3 – EXECUTION

3.01 FORMED SURFACES

A. Forms shall not be stripped before the concrete has attained a strength of at least 50 percent of the ultimate design strength. This is equivalent to approximately five "100 day-degrees" of moist curing.

B. Care shall be exercised to prevent damaging edges or obliterating the lines of chamfers, rustications, or corners when removing the forms or doing any work adjacent thereto.

C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to the satisfaction of the County.

D. Off-form finish. Fins and other projections shall be removed as approved. Tie cone holes and other minor defects shall be filled with non-shrink grout specified under the Contract Documents.

3.02 FLOORS AND SLABS

A. Floors and slabs shall be screeded to the established grades and shall be level with a tolerance of 1/8-inch when checked with a 10-foot straight edge, except where drains occur, in which case floors shall be pitched to drains as indicated. Failure to meet either of above shall be cause for removal, grinding, or other correction as approved by the County.

B. Following screeding as specified above, power steel trowel as follows:

1. Immediately after final screeding, a dry cement/sand shake in the proportion of 2-sacks of portland cement to 350-pounds of coarse natural concrete sand shall be sprinkled evenly over the surface at the rate of approximately 500 pounds per 1,000 square feet of floor. Neat, dry cement shall not be sprinkled on the surface. This shake shall be thoroughly floated into the

surface with an approved disc type power compacting machine weighing at least 200 pounds if a 20-inch disc is used or 300 pounds if a 24-inch disc is used (such as a "Kelly Float" as manufactured by the Weisner-Rapp Corporation of Buffalo, New York). A mechanical blade-type float or trowel is not acceptable for this work.

NOTE: This operation (application of the cement/sand shake) may be eliminated at the discretion of the County if the base slab concrete exhibits adequate fattiness and homogeneity.

2. In lieu of power steel troweling, small areas as defined by the County shall be compacted by hand steel troweling with the dry cement/sand shake as ordered.
3. The floor or slab shall be compacted to a smooth surface and the floating operation continued until sufficient mortar is brought to the surface to fill all voids. The surfaces shall be tested with a straight edge to detect high and low spots which shall be eliminated.
4. Compaction shall be continued only until thorough densification is achieved and a small amount of mortar is brought to the surface. Excessive floating shall be avoided.

C. After Paragraph 3.02 A and B procedures are accomplished, floors and slabs for particular conditions shall be completed as scheduled in one of the following finishes:

1. Wood float finish. Hand wood float, maintaining the surface tolerance to provide a grained, nonslip finish as approved.
2. Broomed finish. Hand wood float maintaining the surface tolerance and then broom with a stiff bristle broom in the direction of drainage to provide a nonslip finish as approved.
3. Steel trowel finish. Hand steel trowel to a perfectly smooth, hard even finish free from high or low spots or other defects as approved.

D. Floors, stair treads and platforms shall be given a floor hardener. Application shall be according to manufacturer's instructions.

3.03 APPROVAL OF FINISHES

A. All concrete surfaces will be inspected during the finishing process by the County.

B. Surfaces which, in the opinion of the County, are unsatisfactory shall be refinished or reworked until approved by the County.

END OF SECTION

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SECTION 03410

STRUCTURAL PRECAST CONCRETE

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies the materials and labor required for the manufacture and erection of structural precast concrete.

B. TYPE:

Precast concrete includes precast structural concrete.

1.02 QUALITY ASSURANCE

A. GENERAL:

The General Contractor shall provide certification from the precast concrete manufacturer that the materials and manufacture of precast work supplied conforms to these specifications. The certification shall be signed by an officer of the manufacturer's corporation.

The responsibility for furnishing and installing precast concrete conforming to the specifications is solely that of the General Contractor.

The precast concrete manufacturer shall have PCI certification.

B. TESTING LABORATORY:

All testing shall be performed by recognized independent laboratories specializing in the particular test to be performed, and conforming to the requirements of the National Bureau of Standards and ASTM E329.

C. REFERENCE STANDARDS:

The appropriate reference standards are specified in specification Sections 03200 and 03300 of this project manual, and the following documents. They are part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ACI 318	Building Code Requirements for Reinforced Concrete
AWS D1.1	Structural Welding Code - Steel
AASHTO	Standard Specification for Highway Bridges
MNL-116	Prestressed Concrete Institute's Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products, third edition
PCI MNL 120	Design Handbook – Precast and Prestressed Concrete.
PCI MNL 126	Manual for the Design of Hollow Core Slabs
PCI MNL 135	Tolerance Manual for Precast and Prestressed Concrete Construction.

1.03 SUBMITTALS

In accordance with specification Section 01300 and in addition to the requirements of that section, the following submittals shall be provided:

A. CONCRETE MIX:

Prior to casting any precast elements, concrete mix design shall be submitted to the Construction Manager for acceptance.

B. SHOP DRAWINGS:

Three copies of shop drawings shall be provided showing product location, fabrication details, number identification marks, reinforcement, connection details including field installed anchor sizes and locations, if required, openings, loose or embedded items and inserts, dimensions and relationship to adjacent materials in sufficient detail to cover manufacture, handling, and erection. CONTRACTOR or precast concrete hollow plank units manufacturer shall retain a registered professional engineer legally qualified to practice in the jurisdiction where the Site is located. Professional engineer shall have not less than five years experience designing precast concrete hollow plank units. Shop drawings and calculation shall be accompanied by a letter signed by a Florida Registered Engineer, certifying that, the shop drawings submitted represent construction which meets or exceeds the requirements of the Contract Documents and the requirements of codes and agencies having jurisdiction over the Work.

1.04 LABELING

Each panel or member shall have an identification mark indicating its location in the structure as shown on the placing diagrams and date of casting.

1.05 HANDLING AND STORAGE

Unless specified otherwise herein, fabrication, handling and erection of precast elements shall be in accordance with the recommendations made by ACI 318 and ACI Committee 533.

Precast elements shall be properly supported off the ground to avoid damage during curing, storage, handling and hauling. Lateral support shall be sufficient to prevent bowing, warping, or permanent set due to creep. Edges of the units shall be adequately protected by padding or other means to prevent staining, chipping or spalling of concrete. Lifting devices shall have a minimum safety factor of 4.

PART 2--PRODUCTS

2.01 PERFORMANCE AND DESIGN REQUIREMENTS

A. Concrete mix design and compressive strength shall meet or exceed that as specified for Class C concrete in specification Section 03300.

B. Design live loads for structural precast units are given on Structural drawings. The General Contractor shall furnish the precast supplier with locations and loads of mechanical equipment. The precast units shall be designed for the actual mechanical equipment to be supplied.

2.02 PRECAST CONCRETE MATERIALS

A. CEMENT:

Concrete in contact with soil or liquids shall be formulated using Type II or Type V portland cement conforming to ASTM C150. Concrete not in contact with soil or liquids may be formulated using Type I or Type III portland cement. Cement shall contain less than .60 percent alkalies and shall be from one source throughout the entire project.

B. AGGREGATES:

Aggregates for normal weight concrete shall conform to ASTM C33 with a maximum size of 3/4 inch.

C. WATER:

Water shall be clean, potable, free from injurious amounts of oil, alkalies, organic materials and other deleterious substances.

D. ADMIXTURE:

Admixture shall be Pozzolith 300-R manufactured by Master Builders, Plastiment manufactured by Sika Chemical Corp., or equal. Admixture shall be used in strict accordance with

manufacturer's recommendations. Calcium chloride or any admixture containing calcium chloride shall not be used.

E. REINFORCING STEEL:

Reinforcing steel shall conform to ASTM A615, including supplementary requirements, and shall be Grade 60 except that bars to be welded shall be Grade 40 or ASTM A706.

Prestressing strands shall be uncoated, seven-wire, stress-relieved strands complying with ASTM A416/A416M, Grade 250 or Grade 270.

F. EMBEDDED ITEMS AND ANCHORAGE DEVICES:

All embedded items, inserts, and anchorage devices exposed to view, moisture or weather shall be hot-dipped galvanized steel. Anchorage devices shall be fabricated from ASTM A36 steel.

G. PENETRATIONS:

All required penetrations and openings larger than 6-inches in diameter or 6-inches square shall be formed in place at the time of casting. Additional reinforcing shall be added where required to meet loading requirements. Openings and penetrations smaller than 6-inches may be core drilled.

H. MOLDS:

Material from which molds are to be fabricated shall be steel, concrete, fiberglass, reinforced plastic or wood. The selection of materials for molds shall be at the manufacturer's option, except that wood shall not be used without the express approval of the Construction Manager. All elements shall be cast in molds of rigid construction, accurate in detail with precise corners and arises, and designed to provide a close control of dimensions and details as indicated on the drawings.

Prior to casting of precast elements, molds shall have all surface joints, radii, corners, etc., filled, ground, filed, straightened or otherwise removed to provide a finished concrete surface that is smooth and dense, free of honeycombing, large air pockets, offsets, sinkages, or other irregularities.

I. PARTING COMPOUND:

All molds shall be coated with parting compound to facilitate removal of elements from molds. Parting compound shall be non-petroleum, nonstaining and shall be of a nature and composition not deleterious to concrete.

J. MANHOLE STEPS:

Manhole steps shall be the cast aluminum type or extruded aluminum type, Florida Department of Highways Standard.

2.03 PRODUCT DATA

The following information shall be provided in accordance with paragraph 00710-4.02.

A. LABORATORY TEST REPORTS:

Before delivery of materials, three copies of the reports of the tests specified herein shall be provided. Test reports on previously tested materials shall be accompanied by the manufacturer's statement that the previously tested material is the same type, quality, manufacture, and make as that proposed for use in this project. Test reports are required for the following:

1. Cement
2. Aggregates
3. Pozzolan
4. Admixtures
5. Curing compounds
6. Waterstops
7. Concrete mix designs

PART 3--EXECUTION

3.01 INSTALLATION

A. CASTING:

Casting shall be accomplished by methods and equipment that are in conformance with generally acceptable systems for this type of Work. All precast concrete shall be manufactured by a plant thoroughly experienced in this type of Work. The manufacturer shall meet all production schedules. Surfaces on which units are cast shall be level and free from any imperfections detrimental to the surface appearance of the finished units. Parting compound shall be applied evenly as per manufacturer's recommendations.

Concrete shall be so handled as to prevent segregation of materials and shall be continuously vibrated during casting, either internally or externally, to achieve proper compaction, finish and distribution of concrete. All precautions must be taken to keep the reinforcing steel in the proper location during placing and consolidation of the concrete. Unless shown otherwise and except at concrete faces exposed to soil or liquids, all reinforcing steel shall have a minimum cover of 3/4 inch. At concrete faces exposed to soil or liquids, cover shall be 1-1/2 inches minimum. Embedded items shall be accurately placed and maintained in their proper location during the casting operation. Special inserts or other devices for handling of panels for the convenience of the manufacturer shall not be exposed to view after members are erected. Embedded anchors, inserts, plates, angles and other cast-in items shall have sufficient anchorage and embedment for design requirements.

Casting, bowing, warpage and dimensional tolerances shall be in accordance with MNL-116, third edition.

B. FINISHES:

1. Exterior surfaces exposed to view shall meet the existing concrete surfaces.
2. Interior surfaces specified to be painted shall have surfaces prepared similar to a existing finish for concrete per Section 03300.
3. Surfaces not exposed to view shall have a float finish.

C. CURING:

All precast units shall be steam cured for a period of at least 12 hours. Fog spraying may be used when reviewed by the Construction Manager. Precast elements shall not be removed from molds for a minimum period of 12 hours after casting, or until concrete has attained a minimum compressive strength of 3500 pounds per square inch, whichever governs. After removal from the forms, curing by steam or fog spraying shall be continued until concrete has attained specified strength and confirmed by standard tests. Curing procedures shall be consistent and uniform throughout the entire project.

D. WELDING:

The quality of material and fabrication of all welded connections shall conform to the latest AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings." All weldments shall be made in accordance with the applicable provisions of AWS. All welding, other than tacks, shall be done by certified welders. All units shall be protected from damage by field welding or cutting operations. Noncombustible shields shall be provided as necessary for this purpose.

D. JOINTS AND JOINT SEALANTS:

In all instances, the edges of precast concrete units and of adjacent material shall be sound, smooth, clean and free of all contaminants prior to joint treatment.

Sealant and primer shall be supplied by the same manufacturer and the primer, when required, shall be as recommended for the particular sealant used. All sealant compounds shall be delivered to the job in the manufacturer's original sealed containers with labels intact and shall be applied in strict accordance with the manufacturer's recommendations. Sealant shall be as specified in specification Section 07900 of these specifications.

3.02 ERECTION

Any errors or misalignment in the structure which would prevent the proper setting of the elements shall be corrected by the General Contractor before the erection is commenced. Erection shall be supervised and performed by workmen skilled in this type of Work. Each element shall be

set in the proper position, carefully plumbed and anchored securely to the structural frame. Adjustments or changes in connections which could involve additional stresses in the products or connections shall not be permitted without approval of the Construction Manager. All bearing surfaces shall be true to line and grade. Erection tolerances shall be in accordance with MNL-116. All joints shall be uniform and straight.

3.03 CLEANING AND REPAIRING

After installation, precast elements shall be protected from all damage until final acceptance by the Construction Manager. Precast units with cracks, spalls, and other defects shall be subject to rejection. Units reviewed for repair shall be repaired to the satisfaction of the Construction Manager.

3.04 ALTERNATIVE DESIGN

The General Contractor may offer an alternative design for any precast element. Such design shall be comparable in terms of strength, deflection, finish and all other design criteria indicated. Complete drawings prepared and sealed by a civil or structural engineer registered in the State of Colorado where applicable shall be submitted to the Construction Manager for his review in accordance with specification Section 01300 of this project manual. No alternative design will be permitted unless it has been specifically accepted in writing by the Construction Manager. If an alternative design is accepted, all expenses resulting therefrom shall be borne by the General Contractor.

END OF SECTION

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SECTION 03600

GROUT

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies grout for columns and other structural support bases, equipment bases, crack repair, surface repair and uses other than masonry.

1.02 QUALITY ASSURANCE

A. QUALITY CONTROL BY CONTRACTOR

If a product other than those listed below is proposed and test data is not available from the supplier to demonstrate equivalence to the specified grout, then to demonstrate equivalence with the grout properties of the specified product, the Contractor shall provide the services of an independent testing laboratory which complies with the requirements of ASTM E329. The testing laboratory shall sample and test the proposed grout materials. Costs of testing laboratory services shall be borne by the Contractor.

B. REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM C230	Standard Specification for Flow Table for Use in Tests of Hydraulic Cement
ASTM C307	Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
ASTM C531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM C579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
ASTM C942	Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1181	Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts
ASTM E329	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
COE CRD-C611	Flow of Grout for Preplaced Aggregate Concrete
COE CRD-C621	Specification for Nonshrink Grout
FBC	Florida Building Code, 2014 edition

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Complete product literature and installation instructions for the following: Cementitious non-shrink grout, epoxy grout, adhesive for dowel and anchor setting, and concrete repair mortar products to be used on the project.

2. Current ICC Evaluation Report for adhesives used for dowel and anchor setting.

3. Installer certification in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined adhesive anchors.

PART 2 – PRODUCTS

2.01 CEMENTITIOUS NONSHRINK GROUT

Cementitious nonshrink nonmetallic aggregate grout shall be Five Star Products, Inc. Five Star Grout, BASF Masterflow 928, Sika Corporation SikaGrout 212, Euclid Chemical Company Hi-Flow Grout, or approved equal.

2.02 EPOXY GROUT FOR EQUIPMENT MOUNTING

Epoxy grout for equipment mounting shall be a non-cementitious, resin based, multi-component formulation. Epoxy grout shall be flowable, with shrinkage minimized to achieve minimum 98% effective bearing area. Epoxy grout shall be BASF Masterflow 648, Sika Corporation Sikadur 42, Euclid Chemical Company E3-G; or approved equal.

2.03 ADHESIVE FOR DOWEL AND ANCHOR SETTING

Adhesive for setting dowels and anchoring connection/base plate bolts shall be an injectable two-component epoxy adhesive. Adhesive shall be approved for the intended use per the product ICC Report. Adhesive shall be HIT-RE 500-SD by Hilti or approved equal (equivalent product must have ICC approval for use in cracked concrete).

2.04 CONCRETE REPAIR MORTAR

Horizontal repair mortars shall be BASF MasterEmaco S 466CI, Sika Corporation SikaTop 111 Plus, or approved equal.

Vertical and overhead repair mortars shall be BASF MasterEmaco 1500HCR Vertical Overhead, Sika Corporation SikaTop 123 Plus, or approved equal.

PART 3 – EXECUTION

3.01 CEMENTITIOUS NONSHRINK GROUT

Nonshrink, cementitious, nonmetallic aggregate grout shall be used for column base plates, structural bearing plates, and all locations where the general term “non-shrink grout” is indicated on the drawings. Use of this grout to support the bearing surfaces of machinery shall be as specified in Section 11002 or as detailed on the Drawings for specific locations or pieces of equipment. If guidance is not provided in locations noted above, use of non-shrink grout for equipment mounting shall be limited to equipment less than 25 horsepower or 750 pounds. Grout shall be placed and cured in accordance with manufacturer's instructions.

Nonshrink cementitious grout shall not be used as a surface patch or topping. Nonshrink cementitious grout must be used in confined applications only.

3.02 EPOXY GROUT FOR EQUIPMENT MOUNTING

Prepare concrete surfaces of equipment pads as indicated in details on the Drawings and as required by the epoxy grout manufacturer. Epoxy grout for equipment mounting shall be placed and cured in accordance with the requirements of Section 11002, details on the Drawings, and in strict conformance with manufacturer's recommendations.

3.03 CONCRETE REPAIR MORTAR

Concrete repair materials and procedures shall be submitted for review to the Engineer and shall be accepted prior to commencement of the repair work.

Follow all manufacturer's instructions, including those for minimum and maximum application thickness, surface preparation and curing. Add aggregate as required per manufacturer's recommendations. Any deviations from the manufacturer's instructions shall be submitted for review to the Engineer and shall be accepted prior to commencement of the work.

END OF SECTION

SECTION 05501

ANCHOR BOLTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes: Bolts and all-thread rods used to attach structural elements and equipment to concrete. Included are cast-in-place and post-installed anchors (adhesive systems and wedge type expansion anchors), nuts and washers.

B. Cast-in-place and post-installed anchors shall be Type 316 stainless steel unless noted otherwise.

1.01 RELATED SECTIONS

A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.
   1. Section 03300 Cast-In-Place Concrete
   2. Section 03600 Grouting
   3. Section 11002 Rigid Equipment Mounts

1.02 REFERENCES

A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ACI 318	Building Code Requirements for Structural Concrete
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A320	Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
ASTM A563	Carbon and Alloy Steel Nuts
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts

Reference	Title
ASTM F844	Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F1554	Anchor Bolts, Steel, 36, 55, 105-ksi Yield Strength
IBC	International Building Code with local amendments
Florida State & Manatee County	Building Code with local amendments

1.03 SUBMITTALS

A. Action Submittals

1. Procedures: Section 01 33 00.
2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
4. Anchor bolt placement plans.
5. Anchor bolt, nut, and washer material information, including material certifications.
6. Record copy of design calculations and details showing the required diameter, length, embedment, edge distance, confinement, anchor reinforcement, anchor bolt sleeves, connection redesign, and other conditions, stamped and signed by a Professional Engineer currently registered in the state of FL. Calculations shall comply with the provisions of ACI 318-14, Chapter 17 ACI 318, Appendix D. Base anchor capacity determination on cracked concrete condition and compressive strength of new concrete per Section 03 30 00. Assume compressive strength of existing concrete is 3,000 psi unless otherwise noted.
7. Submit record copy of proof loading test results within five days after test.
8. Product Data:
    a. ICC Evaluation Service Reports for post-installed adhesive type anchors and expansion (wedge type) anchors when allowed. Products shall be ICC approved for use in cracked concrete in high seismic areas (Seismic Design Category D, E and F).

b. Product data indicating load capacity charts/calculations.

c. Chemical resistance.

d. Temperature limitations.

e. Manufacturers written installation instructions.

9. Installer certification for horizontal or upwardly inclined adhesive anchors in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program.

1.04 QUALITY ASSURANCE

A. Quality Assurance By Owner

1. Special inspection of anchor bolts shall be performed by the Special Inspector under contract with the Owner and in accordance with IBC Chapter 17.
2. A five percent sample of installed post-installed anchors shall be proof-loaded by an independent laboratory contracted by the Contractor. The quantity of samples and locations shall be coordinated with the Owner's Representative.
3. Adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be continuously inspected during installation by a Special Inspector.
4. The Special Inspector shall furnish a report to the Engineer, Owner's Representative, and Building Official that the work covered by the report has been performed and that the materials used and the installation procedures used conform with the approved Project Manual and the Manufacturer's Printed Installation Instructions (MPII).

B. Certifications

1. Installer certification shall be in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined adhesive anchors.

PART 2 – PRODUCTS

2.01 GENERAL

A. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch. Anchor bolts for equipment mounting and vibration isolation systems shall be provided as specified in Sections 43 05 13 and 43 05 18, respectively.

B. Tapered washers shall be provided where mating surface is not square with the nut.

C. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings. Substitution of post-installed anchors will not be permitted unless specifically requested by the Contractor and approved by the Engineer.

2.02 PERFORMANCE/DESIGN CRITERIA

A. Anchor bolts for equipment shall be designed by the equipment manufacturer to include equipment operational loads combined with seismic and wind forces when applicable. Design criteria provided in Section 01 73 24.

B. Design anchor bolts for support and bracing of non-structural components and non-building structures for loading specified in Section 01 73 24.

2.03 MATERIALS

A. Anchor bolt materials shall be as specified in the following table:

Material	Specification
Stainless Steel Anchor Bolts	ASTM A193 or A320, Type 316
Stainless Steel Threaded Rods	ASTM F593, Type 316
Stainless Steel Nuts	ASTM A194 Heavy Hex Nuts, Type 316 ASTM F594 Heavy Hex Nuts at Adhesive Anchors, Type 316
Stainless Steel Washers	Type 316 to match bolt material
Carbon Steel Anchor Bolts	ASTM F1554, Grade 36, Hot Dip Galvanized
High-Strength Carbon Steel Anchor Bolts	ASTM F1554, Grade 55, Weldable per Supplementary Requirement S1, Hot Dip Galvanized
Carbon Steel Nuts and Washers	ASTM A563 and F844, Heavy Hex, Hot-Dip Galvanized
Concrete Adhesive Anchors	Hilti “HIT-RE 500v3”, Simpson Strong-Tie “SET-XP”, or approved equal, with Type 316 Stainless Steel threaded rods
Concrete Masonry Adhesive Anchors	Hilti "HIT-HY 70", Simpson Strong-Tie “SET-XP”, or approved equal, with Type 316 Stainless Steel threaded rods
Concrete Masonry Expansion (wedge) Anchors*	Hilti "KWIK BOLT 3", or approved equal, Type 316 Stainless Steel
Concrete Expansion (wedge) Anchors *	Hilti “KWIK BOLT TZ”, or approved equal, Type 316 Stainless Steel

**Post installed anchors shall always be an adhesive type anchor system except where noted otherwise or when Contractor makes a request for a specific application and Engineer approves.*

2.04 STAINLESS STEEL FASTENER LUBRICANT (ANTI-SEIZING)

A. Anti-seizing Lubricant for Stainless Steel Threaded Connections:
   1. Formulated to resist washout.
   2. Acceptable manufacturers are Bostik, Saf-T-Eze, or equal.

2.05 ANCHOR BOLT SLEEVES

A. Provide anchor bolt sleeves as shown on design drawings and as required by equipment manufacturer's design.
   1. Provide high density polyethylene plastic sleeves of single unit construction with deformed sidewalls such that the concrete and grout lock in place.
   2. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor bolt projection.
   3. Acceptable manufacturers are Contec, Wilson, or equal.

PART 3 – EXECUTION

3.01 GENERAL

A. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings.

B. Grouting of anchor bolts using plastic sleeves with non-shrink or epoxy grout, where specified, shall be in accordance with Section 03 60 00.

C. The threaded end of anchor bolts and all-thread rods shall be long enough to project through the entire depth of the nut and if too long, shall be cut off at ½-inch beyond top of nut and ground smooth.

3.02 CAST-IN-PLACE ANCHOR BOLTS

A. Anchor bolts to be embedded in concrete shall be placed accurately and held in correct position using templates while the concrete is placed.

B. After anchor bolts have been embedded, their threads shall be protected by grease and the nuts run on.

3.03 ADHESIVE ANCHOR BOLTS

A. Note that adhesive anchors shall not be substituted for cast-in-place anchor bolts unless the adhesive anchors have been specified or shown on the Drawings, or approval has been obtained from the Engineer that substitution of adhesive

anchors is acceptable for the specific use and location. Use of adhesive anchors shall be subject to the following conditions:

1. Limit to locations where intermittent or continuous exposure to the following is extremely unlikely:
   a. Acid concentrations higher than 10 percent
   b. Chlorine gas
   c. Machine or diesel oils
2. Limit to applications where exposure to the following is extremely unlikely:
   a. Fire
   b. Concrete or rod temperature above 120 degrees F
3. Overhead applications (such as pipe supports) shall not be allowed unless approved by the Engineer and installation is by an Installer specially certified for overhead applications.
4. Approval from Engineer for specific application and from supplier of equipment to be anchored, if applicable.
5. Anchor diameter and material shall be per Contract Documents or equipment manufacturer's specifications. Anchor shall be threaded or deformed the full length of embedment and shall be free of rust, scale, grease, and oils.
6. Embedment depth shall be as specified or as required by the equipment manufacturer.
7. Follow the anchor system manufacturer's installation instructions.
8. Holes shall have rough surfaces created by using a hammer drill with carbide bit. Core drilled holes are not allowed.
9. Holes shall be blown clean with oil-free compressed air and be free of dust or standing water prior to installation. Follow additional requirements of the adhesive manufacturer.
10. Concrete and air temperature shall be compatible with curing requirements of adhesives per adhesive manufacturer's instructions. Anchors shall not be placed in concrete when the temperature is below 25 degrees F.
11. Anchors shall be left undisturbed and unloaded for full adhesive curing period, which is based on temperature of the concrete.

3.04 EXPANSION ANCHORS

A. Expansion (wedge type) anchors shall not be substituted for cast-in-place anchor bolts or adhesive anchors unless approved by the Engineer for a specific application. Use of expansion anchors shall be subject to conditions 4 through 9 as specified above for adhesive anchors. Expansion anchors shall not be used in a submerged condition or in mounting of equipment subject to vibration or cyclic motion.

3.05 REINFORCING STEEL CONFLICTS WITH POST-INSTALLED ANCHOR INSTALLATION

A. When reinforcing steel is encountered in the drill path, slant drill to clear obstruction and provide beveled washer to match angle of anchor. Drill shall not be slanted more than 10 degrees.

B. Where slanting the drill does not resolve the conflict, notify the Owner's Representative and resolve the conflict to the satisfaction of the Owner's Representative in consultation with the Engineer.

C. Abandoned post-installed anchor holes shall be cleaned and filled with non-shrink grout and struck off flush with adjacent surface.

D. The costs of determining and executing the resolution shall be borne by the Contractor. The determination and execution of the resolution shall not result in additional cost to the Owner.

E. Reinforcing steel in masonry shall not be damaged.

F. In order to avoid or resolve a conflict, locate embedded reinforcing steel using non-destructive methods and/or redesign the attachment.

1. Redesign shall be done by the Contractor's Professional Engineer currently registered in the state of FL.
2. Calculations and details for redesign shall be submitted.

** END OF SECTION**

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SECTION 07100

WATERPROOFING, DAMPPROOFING AND CAULKING

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. Furnish all materials, labor, equipment, and incidentals required to perform all through wall flashing work, waterproofing, dampproofing, caulking, and related work necessary for the proper completion of the project as required by the Drawings and as specified herein.

B. Dampproof the exterior surfaces of all exterior poured- in-place concrete walls or concrete masonry foundation walls from the top of the footings up to 6 inches below finished grade.

1.02 APPLICABLE SCHEDULE

A. Deliver all materials in original manufacturer's packages with labels and seals intact. Handle and store in accordance with manufacturer's instructions.

B. Inspect job conditions for defects which would prevent proper installation of caulking. Do not proceed until defects have been corrected.

C. Caulk all exterior wall joints between metal wall panels and adjacent materials, between frames in openings and adjacent materials, between masonry and cast-in-place concrete, brick paver expansion and control joints and all other joints shown on the Drawings or required for the completion of the Work.

D. Caulk all interior joints between frames and masonry, at tops of masonry walls, between masonry and structural concrete, expansion and control joints in ceramic tile and brick pavers, exterior window and door frames, louvers, and all other joints shown on the drawings or required for the completion of the Work.

E. Joints noted as "caulk", "caulking", or "sealant" shall be caulked with the sealant specified herein.

F. Furnish and place through wall flashing in exterior masonry walls as shown on the Drawings.

G. Furnish and place vapor barrier under all building structure slabs contacting soil as specified herein.

1.03 SUBMITTALS

Submit two representative samples of any or all other proposed materials and installation method required for the work of this Section as requested by the County.

PART 2 – PRODUCTS

2.01 DAMPPROOFING

A. Dampproofing shall be Bitumastic Black Solution by the Koppers Company, Inc., Dehydrating 4 by W.R. Grace and Co., or equal.

2.02 CAULKING

A. Caulking Compound: One component, synthetic rubber base sealant, soft curing, nonstaining, conforming to F.S. TT-S-00230 and Thiocol's Building Trade Performance Specifications for Type 1 Class B sealants. Colors shall match material receiving caulking, as directed by the County.

B. Interior Silicone Sealant: F.S. TT-001543 for perimeter of plumbing fixtures against walls and floors and joints between laminated plastic counters and walls shall be transparent.

C. Primer: As recommended by caulking compound manufacturer.

D. Back-up Material: Closed cell foam polyethylene, or similar nonbituminous material as recommended by manufacturer of caulking compound and completely compatible with selected compound.

2.03 HYDRAULIC CEMENT

A. Material for quick-set hydraulic cement shall be Waterplug as manufactured by Thoro System Products, or equal.

2.04 VAPOR BARRIER

A. Vapor barrier shall be 10 mil thick polyethylene sheet with a vapor transmission rating of 0.20 perms. Laps between adjacent sheets shall be 10 inches minimum. Vapor barrier shall be carefully inspected by the County prior to concrete placement. Additional polyethylene sheet required for repair or replacement of damaged vapor barrier shall be furnished and installed by the Contractor as directed by the County at no additional cost to the County.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation of Dampproofing

1. Surface to be treated shall be free from oil and dirt and shall be in the proper condition as indicated by the manufacturer prior to the application of the dampproofing material. The concrete shall have been completely cured and the surface shall be dry and free from frost at the time of application.
2. Surfaces to be dampproofed shall receive two (2) heavy coats 10 mils thick, the first coat being carefully applied so that "holidays" or untreated air-bubble depressions in the surface shall be completely filled and the second coat will guarantee a 100% coating of the surface.
3. Particular care shall be given to the application of dampproofing at all construction joints which are encountered.
4. The number of coats specified is in addition to primer coats as recommended by the manufacturer.

B. Installation of Caulking

1. Surface Preparation: Clean metal surfaces free of grease, oil, wax, lacquer, and other foreign residue by wiping with a clean cloth moistened with a suitable solvent. Scrape or brush masonry surfaces clean. Apply appropriate primer to contact surfaces.
2. Joint Preparation: Joints to be caulked having a depth in excess of 3/8-inch shall be packed with back-up material. Round back-up material shall be sized to require 20 percent to 5 percent compression upon insertion. In joints not of sufficient depth to allow packing, install polyethylene bond-breaking tape at back of joint. Avoid lengthwise stretching of back-up material. Cut all corners, avoid wrapping around corners.
3. Application: Apply compound with pressure flow gun with nozzle of proper size and shape to suit width of joint, promptly after mixing and with sufficient pressure to fill joint. Apply as a continuous operation horizontally in one direction and vertically from bottom to top, except joints having excessive widths where compound might sag, the joints shall be built up with excessive beads. Finish joints smooth and slightly covered.
4. Cleaning: Immediately clean adjacent material which may be soiled by caulking operation.

C. Installation of Quick-Set Hydraulic Cement

1. The surface shall be cleaned and free of dirt, loose mortar particles, paints, films, protective coatings, efflorescence, laitance, form treatments, curing compounds, and other materials.

2. Cut out crack at least 3/4 inches wide and deep, cutting back into wall slightly. Flush away all cuttings and dirt. Force water-plug into prepared crack with a round tool and smooth out. Form cove at junction.
3. To be applied under manufacturer's recommendations.

** END OF SECTION**

SECTION 09900

COATING SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:

1. This Section specifies coating systems, surface preparations, and application requirements for coating systems.

B. Definitions:

1. Specific coating terminology used in this Section is in accordance with definitions contained in ASTM D16, ASTM D3960, and the following definitions.

a. Definitions:

1) Abrasive: Material used for blast cleaning, such as sand, grit or shot.

2) Abrasive Blast Cleaning: Cleaning/surface preparation by abrasive propelled at high speed.

3) Anchor Pattern: Profile or texture of prepared surface(s).

4) ANSI: American National Standards Institute.

5) Bug Holes: Small cavities, usually not exceeding 15 mm in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and compaction.

6) Coating/Paint/Lining Thickness: The total thickness of primer, intermediate and/or finish coats.

7) Coating System Applicator (CSA): A generic reference to the specialty subcontractor or subcontractors retained by the Contractor to install the coating systems specified in this Section.

8) Coating System Manufacturer (CSM): Refers to the acceptable coating system manufacturer, abbreviated as the CSM.

9) Coating System Manufacturer's Technical Representative(s) (CTR): Refers to the technical representative(s) of the acceptable Coating System Manufacturer and is abbreviated as CTR.

10) Dew point: Temperature of a given air/water vapor mixture at which condensation starts.

11) Dry Film Thickness (DFT): Depth of cured film, usually expressed in mils (0.001 inch). Use this definition as opposed to existing definition.

12) Drying Time: Time interval between application and curing of material.

13) Dry to Recoat: Time interval between application of material and ability to receive next coat.

14) Dry to Touch: Time interval between application of material and ability to touch lightly without damage.

15) Feather Edging: Reducing the thickness of the edge of paint.

16) Feathering: Operation of tapering off the edge of a point with a comparatively dry brush.

17) Field Coat: The application or the completion of application of the coating system after installation of the surface at the site of the work.

18) Hold Point: A defined point, specified in this Section, at which work shall be halted for inspection.

19) Holiday: a discontinuity, skip, or void in coating or coating system film that exposes the substrate.

20) Honeycomb: Segregated condition of hardened concrete due to non-consolidation.

21) ICRI: International Concrete Repair Institute.

22) Incompatibility: Inability of a coating to perform well over another coating because of bleeding, poor bonding, or lifting of old coating; inability of a coating to perform well on a substrate.

23) Laitance: A layer of weak, non-durable concrete containing cement fines that is brought to the surface through bleed water because of concrete finishing and/or over-finishing.

24) Mil: 0.001 inch.

25) NACE: National Association of Corrosion Engineers.

26) Overspray: Dry spray, particularly such paint that failed to strike the intended surface.

27) Pinhole: A small diameter discontinuity in a coating or coating system film that is typically created by outgassing of air from a void in a concrete substrate resulting in exposure of the substrate or a void between coats.

28) Pot Life: Time interval after mixing of components during which the coating can be satisfactorily applied.

29) Resurfacer/Resurfacing Material: A layer of cementitious and/or resin-base material used to fill or otherwise restore surface continuity to worn or damaged concrete surfaces.

30) Shelf Life: Maximum storage time for which a material may be stored without losing its usefulness.

31) Shop Coat: One or more coats applied in a shop or plant prior to shipment to the site of the work, where the field or finishing coat is applied.

32) Spreading Rate: Area covered by a unit volume of paint at a specific thickness.

33) SSPC: The Society for Protective Coatings.

34) Stripe Coat: A separate coat of paint applied to all weld seems, pits, nuts/bolts/washers and edges by brush. This coat shall not be applied until any previous coat(s) have cured and, once applied, shall be allowed to cure prior to the application of the subsequent coat(s).

35) Surface Saturated Dry (SSD): Refers to concrete surface condition where the surface is saturated (damp) without the presence of standing water.

36) Tie Coat: An intermediate coat used to bond different types of paint coats. Coatings used to improve the adhesion of a succeeding coat.

37) Touch-Up Painting: The application of paint on areas of painted surfaces to repair marks, scratches, and areas where the coating has deteriorated to restore the coating film to an unbroken condition.

38) TPC: Technical Practice Committee.

39) Volatile Organic Compound (VOC) Content: The portion of the coating that is a compound of carbon, is photochemically reactive, and evaporates during drying or curing, expressed in grams per liter (g/l) or pounds per gallon (lb/gal).

40) Immersion: Refers to a service condition in which the substrate is below the waterline or submerged in water or wastewater at least intermittently if not constantly.

41) Weld Splatter: Beads of metal scattered near seam during welding.

42) Wet Film Thickness (WFT): The primer or coating film's thickness immediately following application. Wet film thickness is measured in mils or thousandths of an inch (0.001 inch) and is abbreviated WFT.

1.02 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ANSI/ASC 29.4 Exhaust Systems	Abrasive Blasting Operations – Ventilation and Safe Practice
ANSI/NSF 61	Drinking Water System Components Health Effects
ANSI B74.18	Grading of Certain Abrasive Grain on Coated Abrasive Material
ASTM D16	Standard Terminology for Paint, Related Coatings, Materials, and Applications
ASTM D2200 (SSPC-VIS1)	Pictorial Surface Preparation Standards for Painting Steel Surfaces
ASTM D3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D4262	Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
ASTM D4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4414	Standard Practice for Measurement of Wet Film Thickness by Notch Gages
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D4541	Standard Test Methods for Pull-Off Strength of Coatings On Metal Substrates Using Portable Adhesion Testers

Reference	Title
ASTM D4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
ASTM D5162	Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
ASTM D7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Adhesion Testers.
ASTM E337	Standard Test Method for Measuring Humidity With a Psychrometer
ASTM F1869	Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
FS 595b	Federal Standard Colors
ICRI 03732	Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
NACE Publication 6D-163	A Manual for Painter Safety
NACE Publication 6F-163	Surface Preparation of Steel or Concrete Tank/Interiors
NACE Publication 6G-164 A	Surface Preparation Abrasives for Industrial Maintenance Painting
NACE Standards	January 1988 Edition of the National Association of Corrosion Engineers, TPC.
NACE Standard RP0188	Standard Recommended Practice – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE Standard RP0288	Standard Recommended Practice, Inspection of Linings on Steel and Concrete
NACE Standard RP0892	Standard Recommended Practice, Linings Over Concrete in Immersion Service
NACE Publication TPC2	Coatings and Linings for Immersion Service
NAPF 500-03	Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings
NAPF 500-03-04	Abrasive Blast Cleaning for Ductile Iron Pipe
NAPF 500-03-05	Abrasive Blast Cleaning for Cast Ductile Iron Fittings
OSHA 1910.144	Safety Color Code for Marking Physical Hazards
OSHA 1915.35	Standards – 29CFR - Painting
SSPC	Paint Application Specification No. 1.
SSPC-AB 1	Mineral and Slag Abrasives
SSPC-PA 1	Shop, Field, and Maintenance Painting of Steel

Reference	Title
SSPC-PA 2	Measurement of Dry Coating Thickness with Magnetic Gages
SSPC-PA 9	Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages
SSPC-PA Guide 1	Guide for Illumination of Industrial Painting Project
SSPC-PA Guide 3	A Guide to Safety in Paint Application
SSPC-PA Guide 6	Guide for Containing Debris Generated During Paint Removal Operations
SSPC-PA Guide 11	Guide for Coating Concrete
SSPC SP1	Solvent Cleaning
SSPC SP2	Hand Tool Cleaning
SSPC SP3	Power Tool Cleaning
SSPC SP5	White Metal Blast Cleaning
SSPC SP6	Commercial Blast Cleaning
SSPC SP7	Brush-Off Blast Cleaning
SSPC SP10	Near-White Blast Cleaning
SSPC SP11	Power Tool Cleaning to Bare Metal
SSPC SP12	Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultra-High Pressure Water Jetting Prior to Recoating
SSPC SP13	Surface Preparation of Concrete
SSPC-TR2	Wet Abrasive Blast Cleaning
SSPC-TU-3	Overcoating
SSPC-TU-4	Field Methods for Retrieval and Analysis of Soluble Salts on Substrates.
SSPC V2	Systems and Specifications: Steel Structures Painting Manual, Volume 2
SSPC-VIS 1	Visual Standard for Abrasive Blast Cleaned Steel
SSPC-VIS 3	Visual Standard for Power and Hand – Tool Cleaned Steel
SSPC-VIS 4	Visual Standards (Waterjetting)
SSPC-VIS 5	Visual Standards (Wet Abrasive Blast Cleaning)
WPCF Manual of Practice No. 17	Paints and Protective Coatings for Wastewater Treatment Facilities. Guide and Paint Application Specifications.

B. Standardization:

1. Materials and supplies provided shall be the standard products of CSMs. Materials in each coating system shall be the products of a single CSM.
2. The standard products of CSMs other than those specified may be acceptable when it is demonstrated to the Construction Manager that they

are equal in composition, durability, usefulness, and convenience for the purpose intended. Requests for consideration of CSMs other than those specified in this Section will be considered, provided the following minimum conditions are met. Such requests are not a substitution for submittals after the alternative CSMs have been considered and accepted.

a. The proposed coating system shall use an equal or greater number of separate coats to achieve the required total dry film thickness.

b. The proposed coating system shall use coatings of the same generic type as that specified including curing agent type.

c. Requests for consideration of products from CSMs other than those specified in this Section shall include information listed in paragraph 1.04, demonstrating that the proposed CSM's product is equal to the specified coating system.

d. The Contractor and the proposed alternative CSM shall provide a list of references for the proposed product where the coating of the same generic type has been applied. The reference list shall include the project name, city, state, owner, phone number of owner; coating system reference and number from this Section 09900; type of facility in which it was used, generic type, and year coating was applied.

C. Quality Control Requirements:

1. The Contractor is responsible for the workmanship and quality of the coating system installation. Inspections by the Construction Manager or the CTR will not relieve or limit the Contractor's responsibilities.

2. The Contractor's methods shall conform to requirements of this specification and the standards referenced in this Section. Changes in the coating system installation requirements will be allowed only with the written acceptance of the Construction Manager before work commences.

3. Only personnel who are trained by the CTR specifically for this contract or who are approved by the CSM specifically for this contract shall be allowed to perform the coating system installation specified in this Section.

4. Contaminated, outdated, diluted materials, and/or materials from previously opened containers shall not be used.

5. For repairs, the Contractor shall provide the same products, or products recommended by the CSM, as used for the original coating.

6. The Contractor shall identify the points of access for inspection by the Owner or the Construction Manager. The Contractor shall provide ventilation, ingress and egress, and other means necessary for the Construction Manager's personnel to access safely the work areas.

7. The Contractor shall conduct the work so that the coating system is installed as specified and shall inspect the work continually to ensure that

the coating system is installed as specified. Coating system work that does not conform to the specifications or is otherwise not acceptable shall be corrected as specified.

8. The Contractor shall complete the Coating System Inspection Checklist, Form 09900-A, included in Section 01999, for coating system installations. Follow the sequential steps required for proper coating system installation as specified and as listed in the Coating System Inspection Checklist. For each portion of the work, install the coating system and complete sign-offs as specified prior to proceeding with the next step. After completing each step as indicated on the Coating System Inspection Checklist, the Contractor shall sign the checklist indicating that the work has been installed and inspected as specified.
9. The Contractor shall provide written daily reports that present, in summary form, test data, work progress, surfaces covered, ambient conditions, quality control inspection test findings, and other information pertinent to the coating system installation.

D. Inspection at Hold Points:

1. The Contractor shall conduct inspections at Hold Points during the coating system installation and record the results from those inspections on Form 09900-A. The Contractor shall coordinate such Hold Points with the Construction Manager such that the Construction Manager may observe Contractor's inspections on a scheduled basis. The Contractor shall provide the Construction Manager a minimum of two (2) hours of notice prior to conducting Hold Point Inspections. The Hold Points shall be as follows:
    a. Environment and Site Conditions. Prior to commencing an activity associated with coating system installation, the Contractor shall measure, record, and confirm acceptability of ambient air temperature and humidity as well as other conditions such as proper protective measures for surfaces not to be coated and safety requirements for personnel. The acceptability of the weather and/or environmental conditions within the structure shall be determined by the requirements specified by the CSM of the coating system being used.
    b. Conditions Prior to Surface Preparation. Prior to commencing surface preparation, the Contractor shall observe, record, and confirm that oil, grease, and/or soluble salts have been eliminated from the surface.
    c. Monitoring of Surface Preparation. Spot checking of degree of cleanliness, surface profile, and surface pH testing, where applicable. In addition, the compressed air used for surface preparation or blow down cleaning shall be checked to confirm it is free from oil and moisture.

d. Post Surface Preparation – Upon completion of the surface preparation, the Contractor shall measure and inspect for proper degree of cleanliness and surface profile as specified in this Section 09900 and in the CSM's written instructions.

e. Monitoring of Coatings Application – The Contractor shall inspect, measure, and record the wet film thickness and general film quality (visual inspection) for lack of runs, sags, pinholes, holidays, etc. as the application work proceeds.

f. Post Application Inspection – The Contractor shall identify defects in application work including pinholes, holidays, excessive runs or sags, inadequate or excessive film thickness and other problems as may be observed.

g. Post Cure Evaluation – The Contractor shall measure and inspect the overall dry film thickness. The Contractor shall conduct a DFT survey, as well as perform adhesion testing, holiday detection, or cure testing as required based on the type of project and the specific requirements in this Section 09900 and/or in the CSM's written instructions.

h. Follow-up to Corrective Actions and Final Inspection. The Contractor shall measure and reinspect corrective coating work performed to repair defects identified at prior Hold Points. This activity also includes final visual inspection along with follow-up tests such as holiday detection, adhesion tests, and DFT surveys.

1.03 DELIVERY AND STORAGE

A. General:

1. Materials shall be delivered to the job site in their original, unopened containers. Each container shall be properly labeled. Materials shall be handled and stored to prevent damage to or loss of label.
2. Labels on material containers shall show the following information:
   a. Name or title of product.
   b. CSM's batch number.
   c. CSM's name.
   d. Generic type of material.
   e. Application and mixing instructions.
   f. Hazardous material identification label.
   g. Shelf life expiration date.
3. Materials shall be stored in enclosed structures and shall be protected from weather and excessive heat or cold in accordance with the CSM's recommendations. Flammable materials shall be stored in accordance with state and local requirements.

4. Containers shall be clearly marked indicating personnel safety hazards associated with the use of or exposure to the materials.
5. Material Safety Data Sheets (MSDS) for each material shall be provided to the Construction Manager.
6. The Contractor shall store and dispose of hazardous waste according to federal, state and local requirements. This requirement specifically addresses waste solvents and coatings.

1.04 SUBMITTALS:

A. General:

1. Provide in accordance with Section 01300:

a. A copy of this specification section, with addendum updates included, and referenced and applicable sections, with addendum updates included, with each paragraph check-marked (□) to indicate specification compliance or marked to indicate requested deviations from specification requirements or those parts which are to be provided by the Contractor or others. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined shall signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for requested deviations to the specification requirements shall be cause for rejection of the entire submittal and no further submittal material will be reviewed.

b. CSM's current printed recommendations and product data sheets for coating systems including:

1) Volatile organic compound (VOC) data.
2) Surface preparation recommendations.
3) Primer type, where required.
4) Maximum dry and wet-mil thickness per coat.
5) Minimum and maximum curing time between coats, including atmospheric conditions for each.
6) Curing time before submergence in liquid.
7) Thinner to be used with each coating.
8) Ventilation requirements.

9) Minimum atmospheric conditions during which the paint shall be applied.

10) Allowable application methods.

11) Maximum allowable moisture content.

12) Maximum shelf life.

c. Affidavits signed and sealed by an officer of the CSM's corporation, attesting to full compliance of each coating system component with current and promulgated federal, state, and local air pollution control regulations and requirements.

d. Material Safety Data Sheets (MSDS) for materials to be delivered to the job site, including coating system materials, solvents, and abrasive blast media.

e. List of cleaning and thinner solutions allowed by the CSMs.

f. Storage requirements including temperature, humidity, and ventilation for Coating System Materials as recommended by the CSMs.

g. CSM's detailed, written instructions for coating system treatment and graphic details for coating system terminations in the structures to be coated including pipe penetrations, metal embedments, gate frames, and other terminations to be determined from the contract drawings. This information shall also include detail treatment for coating system at joints in concrete.

h. The Contractor and CSA shall provide a minimum of five project references each including contact name, address, and telephone number where similar coating work has been performed by their companies in the past five years.

1.05 RESPONSIBILITIES OF THE CTR

A. General:

1. The Contractor shall retain or obtain the services of the CTR to be on site to perform the Contractor and/or CSA application training and to routinely inspect and verify in writing that the application personnel have successfully performed surface preparation, filler/surface application, coating system application, and Quality Control Inspection in accordance with this Section 09900 and to warrantable level of quality. This must include checking the required degree of cleanliness, surface pH for concrete substrates, surface profile of substrates, proper mixing of coating materials, application (including checking the wet and dry film thickness of the coating systems), proper cure of the coating systems, and proper treatment of coating systems at terminations, transitions, and joints and cracks in substrates. Refer to paragraph 1.05 Coating System Installation Training. for further details on these CTR requirements. This inspection is

in addition to the inspection performed by the Contractor in accordance with this Section 09900.

B. Coating System Installation Training:

1. Provide a minimum of 8 hours of classroom and off site training for application and supervisory personnel (both the Contractor's and CSA's). Provide training to a minimum of two supervisory personnel from the CSA and one supervisor from the Contractor. Alternatively, the CTR shall provide a written letter from the CSM stating that the application personnel (listed by name) who shall perform coating work are approved by the CSM without further or additional training.
2. One CTR can provide training for up to fourteen application personnel and three supervisory personnel at one time. The training shall include the following as a minimum:
    a. A detailed explanation of mixing, application, curing, and termination details.
    b. Hands-on demonstration of how to mix and apply the coating systems.
    c. A detailed explanation of the ambient condition requirements (temperature and humidity) and surface preparation requirements for application of the coating system as well as a detailed explanation of re-coat times, cure times, and related ambient condition requirements.
    d. When training is performed, the CTR shall provide a written letter stating that training was satisfactorily completed by the personnel listed by name in the letter.

C. Coating System Inspection:

1. While on site to routinely inspect and verify, the CTR shall perform the following activities to confirm acceptability and conformance with the specifications:
    a. Inspect ambient conditions during various coating system installation at hold points for conformance with the specified requirements.
    b. Inspect the surface preparation of the substrates where the coating system will terminate or will be applied for conformance to the specified application criteria.
    c. Inspect preparation and application of coating detail treatment (for example, terminations at joints, metal embedments in concrete, etc.).
    d. Inspect application of the filler/surface materials for concrete and masonry substrates.

e. Inspect application of the primers and finish coats including wet and dry film thickness of the coatings.

f. Inspect coating systems for cure.

g. Review adhesion testing of the cured coating systems for conformance to specified criteria.

h. Review coating system continuity testing for conformance to specified criteria.

i. Inspect and record representative localized repairs made to discontinuities identified via continuity testing.

j. Conduct a final review of completed coating system installation for conformance to the specifications.

k. Prepare and submit a site visit report following each site visit that documents the acceptability of the coating work in accordance with the CSM's Recommendations.

D. Final Report:

1. Upon completion of coating work for the project, the CTR shall prepare a final report. That report shall summarize daily test data, observations, drawings, and photographs in a report to be submitted in accordance with paragraph 2.02. Include substrate conditions, ambient conditions, and application procedures, observed during the CTR's site visits. Include a statement that the completed work was performed in accordance with the requirements of this Section 09900 and the CSM's recommendations.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General:

1. Notwithstanding the listing of product names in this Section 09900, the Contractor shall provide affidavits, signed and sealed by an officer of the CSM's corporation, attesting to full compliance of each coating system component with current and promulgated federal, state, and local air pollution control regulations and requirements. No coatings shall be applied to a surface until the specified affidavits have been submitted and have been reviewed and accepted. Failure to comply with this requirement shall be cause for rejection and removal of such materials from the site.

2. The following list specifies the material requirements for coating systems. Coating systems are categorized by generic name followed by an identifying abbreviation. If an abbreviation has a suffix number, it is for identifying subgroups within the coating system. Coating Systems E-5 and E-6 shall be NSF 61 certified.

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
Epoxy Coatings			
E-1	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI *	Devran 224 HS	Devran 224
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
E-1-G	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 894	Carboguard 894
	International Paint/ICI *	Devran 223/224HS	Devran 224HS
	Sherwin Williams	Macropoxy 646 Epoxy B67-600	Macropoxy 646 Epoxy B67-600
	Tnemec	Series V27 or V69	Series V69
E-2	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Sea Guard 6000 Epoxy N11-400	Sea Guard 6000 Epoxy N11-400
	Tnemec	Series V27 or V69	Series V69
E-3	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Sea Guard 6000 Epoxy N11-400	Sea Guard 6000 Epoxy N11-400
	Tnemec	Series V69	Series V69
E-4	PPG PMC	Amerlock 2/400 Series	Amerlock 2/400 Series
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Macropoxy 646	Macropoxy 646

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
	Tnemec	Series V69	Series V69
E-5	PPG PMC	Amercoat 395FD	Amercoat 395FD
	Carboline	Carboguard 691	Carboguard 691
	International Paint/ICI	Bar-Rust 233H	Bar-Rust 233H
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
E6	PPG PMC	Amercoat 395FD	Amercoat 395FD
	Carboline	Carboguard 691	Carboguard 691
	International Paint/ICI	Tru-Glaze 4408 - WB	Tru-Glaze 4408 - WB
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
E7	PPG PMC	Amercoat 385	Amercoat 385
	Carboline	Sanitile 120	Carboguard 890
	International Paint/ICI	Bar-Rust 236	Bar-Rust 236
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series V69	Series V69
E8	PPG PMC	Amercoat 385	Amercoat 385
	Carboline	Carboguard 1340	Carboguard 1340
	International Paint/ICI	Prep and Prime (Gripper)	Tru-Glaze 4408 - WB
	Sherwin Williams	Macropoxy 646	Macropoxy 646
	Tnemec	Series 201	Series 201
E-9	PPG PMC	Amercoat 395 FD	Amercoat 395 FD
	Carboline	Carboguard 890	Carboguard 890
	International Paint/ICI	Bar-Rust 231	Bar-Rust 231
	Sherwin Williams	Sea Guard 6000 Epoxy N11-400	Sea Guard 6000 Epoxy N11-400

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)		Finish Coat(s)
	Tnemec	Series 104		Series 104
E-9-C	PPG PMC	Amercoat 395 FD		Amercoat 395 FD
	Carboline	Carboguard 890		Carboguard 890
	International Paint/ICI	Bar-Rust 231		Bar-Rust 231
	Sherwin Williams	Sea Guard 6000 Epoxy N11-400		Sea Guard 6000 Epoxy N11-400
	Tnemec	Series 104		Series 104
E-10	PPG PMC	Amerlock 2/400 Series		Amerlock 2/400 Series
	Carboline	Carboguard 890		Carboguard 890
	International Paint/ICI	Bar-Rust 236		Bar-Rust 236
	Sherwin Williams	Macropoxy 646		Macropoxy 646
	Tnemec	Series V69		Series V69
Specialty Epoxy Linings				
EA-1	Carboline	Plasite 4500S		Plasite 4500S
	Sauereisen	Sewergard 210S		Sewergard 210S
	Tnemec	Series 435		Series 435
Coating System	CSM	Base Coat	Filler/Surfacer	Glaze Coat
EA-2	Carboline Carboguard	Plasite 4500S	Carboguard 510	Plasite 4500S
	Sauereisen	Sewergard 210S	Series 209 HB	Sewergard 210S
	Tnemec	Series 435	Series 218	Series 435
EA-3	Carboline	N/A	Carboguard 510	Plasite 5371
	Sauereisen	N/A	Series 209 HB	Sewergard 210T
	Tnemec	N/A	Series 218	Series 434
Coating System	CSM	Primer	Base Coat	Glaze Coat
EA-4	Carboline	N/A	Plasite 5371	Plasite 4500S
	Sauereisen	N/A	Sewergard 210T	Sewergard 210G
	Tnemec	N/A	Series 434	Series 435

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)			Finish Coat(s)	
Coating System	CSM	Primer	Filler/ Surfacer	Base Coat w/Scrim Cloth	Saturation Coat w/Silica Sand	Finish Coats
EA-5	Tnemec	Series 201	Series 218	Series 239	Series 239	Series 282
	Carboline	Semstone 110/110EP	Carboguard 510	Semstone 145	Semstone 145	Semstone 145
Elastomeric Coatings						
EC-1	Carboline	Carboguard 671			Polibrid 705 (2 coats)	
	Sherwin Williams	Corobond 100			Envirolastic 170 (2 coats)	
	Tnemec	Series 1			Series 406 (2 coats)	
EC-2	Carboline	Carboguard 671			Polibrid 705 (2 coats)	
	Sherwin Williams	Corobond 100			Envirolastic 520PW (2 coats)	
	Tnemec	Series V69			Series 264	
Epoxy Flooring Systems						
Coating System	CSM	Primer	Intermediate Coat		Finish Coat	
EF-1	Stonhard	Stonhard Standard Primer	Stonshield Undercoat and Broadcoat		Stoneshield Sealer	
	Tnemec	Series 238	Series 238 with Broadcoat		Series 284 Clear	
EF-2	Stonhard	Stonhard Standard Primer	Stonclad GS		Stonkote GS-4	
	Tnemec	Series 238	Series 238		Series 280	
Epoxy Polyurethane						
		Primer Coat(s)	Intermediate Coat(s)			
EU-1	PPG PMC	Amercoat	Amercoat 385		Amercoat 450H	
	Carboline	Carbozinc 859	Carboguard 890		Carbothane 134 VOC	
	International Paint/ICI	Cathacoat 313	Devran 233 or 224HS		Devthane 379	

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)		Finish Coat(s)
	Sherwin Williams	Zinc Clad IV	Macropoxy 646	Hi Solids Polyurethane
	Tnemec	Series 90-97	Series V69	Series 1075
EU-1-FRP	PPG PMC	Amerlock 2/400 Series		Amershield VOC
	Carboline	Carbocrylic 120		Carbothane 134 VOC
	International Paint/ICI	Devran 223/224		Devthane 378H
	Sherwin Williams	Macropoxy 646		High Solids Polyurethane
	Tnemec	Series V27		Series 1075
Grease				
G	Texaco	N/A		Rust Inhibitive Grease
	Chevron	N/A		E.P. Roller Grease
High Heat				
HH-1	High Temperature Coatings, Inc.	Hi Temp 1027		1000 VS (any color)
HH-2	High Temperature Coatings, Inc.	Hi Temp 1027		1000 VS (black or aluminum)
Latex Acrylic				
L-1	PPG PMC	Amercoat 148		Amercoat 220
	Carboline	Carbocrylic 120		Carbocrylic 3359
	International Paint/ICI	UH Gripper 3210		Dulux Pro 1406
	Sherwin Williams	Loxon Acrylic Primer		Sher Cryl HPA
	Tnemec	Series 1028 or 1029		Series 1028 or 1029
L-2	PPG PMC	Amercoat 220		Amercoat 220
	Carboline	Carbocrylic 120		Carbocrylic 3359
	International Paint/ICI	Prep and Prime Gripper		Ultrahide 250-1406
	Sherwin Williams	Sher Cryl HPA		Sher Cryl HPA
	Tnemec	Series 1028 or 1029		Series 1028 or 1029
L-3	PPG PMC	Amercoat 148		Amercoat 220

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
	Carboline	Carbocrylic 3359 DTM	Carbocrylic 3359 DTM
	International Paint/ICI	Devflex 4020 PF	Dulux Pro 1406
	Sherwin Williams	Procryl Primer	Sher Cryl HPA
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
L-4	PPG PMC	Amercoat 148	Amercoat 220
	Carboline	Sanitile 120	Sanitile 155
	International Paint/ICI	Prepared Prime Gripper	Ultrahide 250-1406
	Sherwin Williams	Prep Rite ProBlock	Sher Cryl HPA
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
Miscellaneous			
M-1	Carboline	Carbowrap Priming Paste	Tape A, B, or C (temp. dependent)
	Denso	Denso Paste	Densyl Tape
	Trenton	Waxtape Primer	#1 Wax Tape
M-2	Carboline	Carbomastic 15	Carbomastic 15
	International Paint/ICI	Bar-Rust 231 (231K 9100)	Bar-Rust 231 (231K 9100)
	Sherwin Williams	Epoxy Mastic Aluminum II	Epoxy Mastic Aluminum II
	Tnemec	Series 135 (1243)	Series 135 (1243)
Penetrating Stain			
	CSM	Primer	Finish
S-1	Carboline	Carbocrete Sealer WB	Carbocrete Sealer WB
	International Paint/ICI	Groundworks	Groundworks
	Sherwin Williams	H&C Acrylic Concrete Stain	H&C Acrylic Concrete Stain
	Tnemec	Series 617	Series 617
S-2	Tnemec	N/A	Series 636 Dur A Pell 20
	Curecrete Chemical Company	N/A	Ashford Formula

Material Requirements for Coating Systems: All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
S-3	Tnemec	N/A	Series V626 Dur A Pell GS
S-4	Tnemec Professional Products of Kansas	N/A N/A	Series V626 Dur A Pell GS PWS-15 Super

**See CSM's Product Data Sheets for acceptable thinners for VOC compliance or do not thin.*

2.02 PRODUCT DATA

A. General:

1. Prior to application of coatings, submit letter(s) from the CTR(s) identifying the application personnel who have satisfactorily completed training as specified in paragraph 1.05 or a letter from the CSM stating that personnel who shall perform the work are approved by the CSM without need for further or additional training.
2. Submit reports specified in paragraph 1.02 Quality Control Requirements and 1.05 Coating System Inspection when the work is underway.
3. Submit the Coating System Inspection Checklists, using Form 09900-A, included in Section 01 99 90, for the coating work.
4. CTR final report in accordance with paragraph 1.05 Final Report.

PART 3 – EXECUTION

3.01 COATINGS

A. General:

1. Coating products shall not be used until the Construction Manager has accepted the affidavits specified in paragraphs 1.04 and 2.01, the Construction Manager has inspected the materials, and the CTR has trained the Contractor and CSA in the surface preparation, mixing and application of each coating system.
2. Erect and maintain protective enclosures as stipulated per SSPC-Guide 6 Guide for Containing Debris Generated During Paint Removal Operations.

B. Shop and Field Coats:

1. Shop Applied Prime Coat: Except as otherwise specified, prime coats may be shop-applied or field-applied. Shop-applied primer shall be compatible with the specified coating system and shall be applied at the minimum dry

film thickness recommended by the CSM. Data sheets identifying the shop primer used shall be provided to the on-site coating application personnel. Adhesion tests shall be performed on the shop primer as specified in paragraph 3.01 Adhesion Confirmation. Damaged, deteriorated and poorly applied shop coatings that do not meet the requirements of this Section 09900 shall be removed and the surfaces recoated. If the shop primer coat meets the requirements of this Section 09900, the field coating may consist of touching up the shop prime coat and then applying the finish coats to achieve the specified film thickness and continuity.

2. Field Coats: Field coats shall consist of one or more prime coats and one or more finish coats to build up the coating to the specified dry film thickness. Unless otherwise specified, finish coats shall not be applied until other work in the area is complete and until previous coats have been inspected.

3. Adhesion Confirmation: The Contractor shall perform an adhesion test after proper cure in accordance with ASTM D3359 to demonstrate that (1) the shop applied prime coat adheres to the substrate, and (2) the specified field coatings adhere to the shop coat. Test results showing an adhesion rating of 5A on immersed surfaces and 4A or better on other surfaces shall be considered acceptable for coatings 5 mils or more in thickness (Method A). Test results showing an adhesion rating of 5B on immersed surfaces and 4B or better on other surfaces shall be considered acceptable for coating thicknesses less than 5 mils.

C. Application Location Requirements:

1. Equipment, Nonimmersed: Items of equipment, or parts of equipment that are not immersed in service, shall be shop primed and then finish coated in the field after installation with the specified or acceptable color. If the shop primer requires topcoating within a specified period, the equipment shall be finish coated in the shop and then touch-up painted after installation. If equipment removal and reinstallation is required for the project, touch-up coating work shall be performed in the field following installation.

2. Equipment, Immersed: Items of equipment, or parts and surfaces of equipment that are immersed when in service, with the exception of pumps and valves, shall have surface preparation and coating work performed in the field. Coating systems applied to immersed equipment shall be pinhole free.

3. Steel Water Tanks: The interior surfaces of steel water tanks or reservoirs shall have surface preparation and coating work performed in the field.

3.02 PREPARATION

A. General:

1. Surface preparations for each type of surface shall be in accordance with the specific requirements of each coating specification sheet (COATSPEC) and the following. In the event of a conflict, the COATSPEC sheets shall take precedence.
2. Surfaces to be coated shall be clean and dry. Before applying coating or surface treatments, oil, grease, dirt, rust, loose mill scale, old weathered coatings, and other foreign substances shall be removed. Oil and grease shall be removed before mechanical cleaning is started. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded and free from contaminants that might interfere with the adhesion of the coatings. The air used for blast cleaning shall be sufficiently free of oil and moisture so as not to cause detrimental contamination of the surfaces to be coated.
3. Where deemed necessary by the Owner's representative, a NACE International certified coatings inspector, provided by the Owner, will inspect and approve surfaces to be coated before application of a coating. Surface defects identified by the inspector shall be corrected by the Contractor at no additional cost to the Owner.
4. Cleaning and painting shall be scheduled so that dust and spray from the cleaning process shall not fall on wet, newly coated surfaces. Hardware, hardware accessories, nameplates, data tags, machined surfaces, sprinkler heads, electrical fixtures, and similar uncoated items which are in contact with coated surfaces shall be removed or masked prior to surface preparation and painting operations. Following completion of coating, removed items shall be reinstalled. Equipment adjacent to walls shall be disconnected and moved to permit cleaning and painting of equipment and walls and, following painting, shall be replaced and reconnected.

B. Blast Cleaning:

1. When abrasive blast cleaning is required to achieve the specified surface preparation the following requirements for blast cleaning materials and equipment shall be met:
    a. Used or spent blast abrasive shall not be reused on this project.
    b. The compressed air used for blast cleaning shall be filtered and shall contain no condensed water and no oil. Moisture traps shall be cleaned at least once every four hours or more frequently as required to prevent moisture from entering the supply air to the abrasive blasting equipment.
    c. Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges.

These shall be checked on the same frequency as the moisture traps as defined above.

d. Regulators, gauges, filters, and separators shall be in use on compressor air lines to blasting nozzles times during this work.

e. An air dryer or desiccant filter drying unit shall be installed which dries the compressed air prior to blast pot connections. This dryer shall be used and maintained for the duration of surface preparation work.

f. The abrasive blast nozzles used shall be of the venturi or other high velocity type supplied with a minimum of 100 psig air pressure and sufficient volume to obtain the blast cleaning production rates and cleanliness/specified.

g. The Contractor shall provide ventilation for airborne particulate evacuation (meeting pertinent safety standards) to optimize visibility for both blast cleaning and inspection of the substrate during surface preparation work.

h. If, between final surface preparation work and coating system application, contamination of prepared and cleaned metallic substrates occurs, or if the prepared substrates' appearance darkens or changes color, recleaning by water blasting, reblasting and abrasive blast cleaning shall be required until the specified degree of cleanliness is reclaimed.

i. The Contractor is responsible for dust control and for protection of mechanical, electrical, and other equipment adjacent to and surrounding the work area.

C. Solvent Cleaning:

1. Any solvent wash, solvent wipe, or cleaner used, including but not limited to those used for surface preparation in accordance with SSPC SP-1 Solvent Cleaning and shall be of the emulsifying type which emits no more than 340 g/l VOCs for AIM regions, 250 g/l for CARB regions and 100 g/l for SCAQMD regions, contains no phosphates, is biodegradable, removes no zinc, and is compatible with the specified primer.

2. Clean white cloths and clean fluids shall be used in solvent cleaning.

D. Metallic Surfaces:

1. Metallic surfaces shall be prepared in accordance with applicable portions of surface preparation specifications of the Society for Protective Coatings (SSPC) specified for each coating system. See Coat Spec for each coating system in this Section 09900. The profile depth of the surface to be coated shall be in accordance with the COATSPEC requirements in this Section measured by Method C of ASTM D4417. Blast particle size shall be selected by the Contractor to produce the specified surface profile. The

solvent in solvent cleaning operations shall be as recommended by the CSM.

2. Preparation of metallic surfaces shall be based upon comparison with SSPC-VIS1-89 (ASTM D2200), and as described in the Coat Spec for each coating system. If dry abrasive blast cleaning is selected and to facilitate inspection, the Contractor shall, on the first day of cleaning operations, abrasive blast metal panels to the standards specified. Plates shall measure a minimum of 8-1/2 inches by 11 inches. Panels meeting the requirements of the specifications shall be initialed by the Contractor and the Construction Manager and coated with a clear non-yellowing finish. One of these panels shall be prepared for each type of abrasive blasting and shall be used as the comparison standard throughout the project.
3. Blast cleaning requirements for steel, ductile iron and stainless steel substrates are as follows:
    a. Steel piping shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) and primed before installation. Ductile iron piping surfaces including fittings shall be prepared in accordance with NAPF 500-03, NAPF 500-03-04, and NAPF 500-03-05.
    b. Stainless steel surfaces shall be abrasive blast cleaned to leave a clean uniform appearance with a minimum surface profile of 1.5 to 2.5 mils that is uniform.
    c. Remove traces of grit, dust, dirt, rust scale, friable material, loose corrosion products or embedded abrasive from substrate by vacuum cleaning prior to coating application.
    d. Care must be taken to prevent contamination of the surface after blasting from worker's fingerprints, deleterious substances on workers' clothing, or from atmospheric conditions.
    e. Ambient environmental conditions in the enclosure must be constantly monitored and maintained to ensure the degree of cleanliness is held and no "rust back" occurs prior to coating material application.

E. Concrete Surfaces:

1. Inspection of concrete surfaces prior to surface preparation and surface preparation of concrete surfaces shall be performed in accordance with SSPC-SP13 (also called NACE 6).
2. Prepare substrate cracks, areas requiring resurfacing and perform detail treatment including but not limited to, terminating edges, per CSM recommendations. This shall precede surface preparation for degree of cleanliness and profile.
3. The surface profile for prepared concrete surfaces to be coated shall be evaluated by comparing the profile of the prepared concrete with the profile of graded abrasive paper, as described in ANSI B74.18 or by

comparing the profile with the ICRI 03732 (surface profile replicas). Surface profile requirements shall be in accordance with the Coat Spec requirements and the CSM's recommendations.

4. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to making repairs or applying a coat in the coating system. If concrete surfaces are repaired, they shall be reinspected for surface cleanliness prior to application of the coating system.

5. Surface preparation of concrete substrates shall be accomplished using methods such as dry abrasive blast cleaning, high, or ultra high-pressure water blast cleaning in accordance with SSPC-SP-13. The selected cleaning method shall produce the requirements set forth below.

    a. A clean substrate that is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances shall be achieved. Blast cleaning and other means necessary shall be used to open up air voids or bugholes to expose their complete perimeter. Leaving shelled over, hidden air voids beneath the exposed concrete surface is not acceptable. Concrete substrate must be dry prior to the application of filler/surface or coating system materials.

    b. Acceptable surface preparation must produce a concrete surface with a minimum pH of 8.0 to be confirmed by surface pH testing. If after surface preparation, the surface pH remains below 8.0, perform additional water blasting, cleaning, or abrasive blast cleaning until additional pH testing indicates an acceptable pH level.

    c. Following inspection by the Contractor of the concrete surface preparation, thoroughly vacuum clean concrete surfaces to be coated to remove loose dirt, and spent abrasive (if dry blast cleaning is used) leaving a dust free, sound concrete substrate. Debris produced by blast cleaning shall be removed from the structures to be coated and disposed of legally off site by the Contractor.

6. Should abrasive blast cleaning or high or ultrahigh pressure water blasting not remove degraded concrete, chipping or other abrading tools shall be used to remove the deteriorated concrete until a sound, clean substrate is achieved which is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances. Concrete substrates must be dry prior to the application of filler/surfacers or coating system materials.

7. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to application of coating materials. If concrete surfaces are repaired, they shall be reinspected for

surface cleanliness and required surface profile prior to application of the coating system.

8. Moisture content of concrete to be coated shall be tested in accordance with ASTM D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method and ASTM F 1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride. The ASTM D4263 plastic sheet test shall be conducted at least once for every 500 sq. ft. of surface area to be coated. The presence of any moisture on plastic sheet following test period constitutes a non-acceptable test. For concrete surfaces to be coated which are on the negative or back side of concrete walls or structures exposed to soils (back filled) or immersed and waterproofed in accordance with Section 07100, perform calcium chloride tests in accordance with ASTM F-1869 once for each 500 sq. ft. of surface area to be coated. Comply with CSM's written recommendations regarding acceptance/non-acceptance of moisture vapor emissions.

F. Masonry Surfaces:

1. Prepare masonry surfaces such as Concrete Masonry Units (CMU) to remove chalk, loose dirt, dried mortar splatter, dust, peeling, or loose existing coatings, or otherwise deleterious substances to leave a clean, sound substrate.

2. Be certain masonry surfaces are dry prior to coating application. If pressure washing or low-pressure water blast cleaning is used for preparation, allow the masonry to dry for at least 5 days under dry weather conditions or when the minimum ambient temperature is 70 degrees F prior to coating application work.

G. Fiberglass Reinforced Plastic (FRP) Surfaces:

1. Prepare FRP surfaces by sanding to establish uniform surface roughness and to remove gloss from the resin in the FRP. Next, vacuum clean to remove loose FRP dust, dirt, and other materials. Next, solvent clean using clean white rags and allow solvent to evaporate completely before application of coating materials.

3.03 APPLICATION

A. Workmanship:

1. Coated surfaces shall be free from runs, drips, ridges, waves, laps, and brush marks. Coats shall be applied to produce an even film of uniform thickness completely coating corners and crevices.

2. The Contractor's equipment shall be designed for application of the materials specified. Compressors shall have suitable traps and filters to remove water and oils from the air. A paper blotter test shall be performed by the Contractor when requested by the Construction Manager to

determine if the air is sufficiently free of oil and moisture so as not to produce deteriorating effects on the coating system. The amount of oil and moisture in spray air shall be less than the amount recommended by the CSM. Spray equipment shall be equipped with mechanical agitators, pressure gages, and pressure regulators, and spray nozzles of the proper sizes.

3. Each coat of coating material shall be applied evenly and sharply cut to line. Care shall be exercised to avoid overspraying or spattering paint on surfaces not to be coated. Glass, hardware, floors, roofs, and other adjacent areas and installations shall be protected by taping, drop cloths, or other suitable measures.
4. Coating applications method shall be conventional or airless spray, brush or roller, or trowel as recommended by CSM.
5. Allow each coat to cure or dry thoroughly, according to CSM's printed instructions, prior to recoating.
6. Vary color for each successive coat for coating systems when possible.
7. When coating complex steel shapes, prior to overall coating system application, stripe coat welds, edges of structural steel shapes, metal cut-outs, pits in steel surfaces, or rough surfaces with the primer coat. This involves applying a separate coat using brushes or rollers to ensure proper coverage. Stripe coat via spray application is not permitted.

B. Coating Properties, Mixing and Thinning:

1. Coatings, when applied, shall provide a satisfactory film and smooth even surface. Glossy undercoats shall be lightly sanded to provide a surface suitable for the proper application and adhesion of subsequent coats. Coating materials shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings consisting of two or more components shall be mixed in accordance with the CSM's instructions. Where necessary to suit the conditions of the surface, temperature, weather and method of application, the coating may be thinned as recommended by the CSM immediately prior to use. The volatile organic content (VOC) of the coating as applied shall comply with prevailing air pollution control regulations. Unless otherwise specified, coatings shall not be reduced more than necessary to obtain the proper application characteristics. Thinner shall be as recommended by the CSM.

C. Atmospheric Conditions:

1. Coatings shall be applied only to surfaces that are dry, and only under conditions of evaporation rather than condensation. Coatings systems shall not be applied during rainy, misty weather, or to surfaces upon which there is frost or moisture condensation. During damp weather, when the temperature of the surface to be coated is within 10 degrees F of the dew point, forced dehumidification equipment may be used to maintain a

temperature of minimum 40 degrees F and 10 degrees F above the dew point for the surfaces to be coated, the coated surface, and the atmosphere in contact with the surface. These conditions shall be maintained for a period of at least 8 hours or as recommended by the CSM. Where conditions causing condensation are severe, dehumidification equipment, fans, and/or heaters shall be used inside enclosed areas to maintain the required atmospheric and surface temperature requirements for proper coating application and cure.

D. Concrete Substrate Temperatures and Detail Treatment:

1. When the surface temperatures of the concrete substrates to be coated are rising or when these substrates are in direct sunlight, outgassing of air from the concrete may result in bubbling, pinhole formations, and/or blistering in the coating system. The application of the filler/surface and the coating system will only be allowed during periods of falling temperature. This will require that application of the filler/surface and coating system shall only occur during the cooler evening hours. Contractor shall include any cost for working outside of normal hours in the bid.
2. Should bubbles, pinholes, or discontinuities form in the applied coating system material, they shall be repaired as recommended by the CSM. Should pinholes develop in the filler/surfacer material or in the first coat of the coating material, the pinholes shall be repaired in accordance with the CSM's recommendations prior to application of the next coat of material. Whenever pinholes occur, the air void behind or beneath the pinhole shall be opened up completely and then completely filled with the specified filler/surfacer material. Next, the coated area around the pinhole repair shall be abraded and the coating reapplied over that area.
3. Perform application detail work per CSM's current written recommendations and/or drawings.

E. Protection of Coated Surfaces:

1. Items that have been coated shall not be handled, worked on, or otherwise disturbed, until the coating is completely dry and hard. After delivery at the site, and upon permanent erection or installation, shop-coated metalwork shall be recoated or retouched with specified coating when it is necessary to maintain the integrity of the film.

F. Method of Coating Application:

1. Where two or more coats are required, alternate coats shall contain sufficient compatible color additive to act as indicator of coverage, or the alternate coats shall be of contrasting colors. Color additives shall not contain lead, or lead compounds, which may be destroyed or affected by hydrogen sulfide or other corrosive gas, and/or chromium.

2. Mechanical equipment, on which the equipment manufacturer's coating is acceptable, shall be touch-up primed and coated with two coats of the specified coating system to match the color scheduled. Electrical and instrumentation equipment specified in Divisions 26 and 40 shall be coated as specified in paragraph 3.03 Electrical and Instrumentation Equipment and Materials.

3. Coatings shall not be applied to a surface until it has been prepared as specified. The primer or first coat shall be applied by brush to ferrous surfaces that are not blast-cleaned. Coats for blast-cleaned ferrous surfaces and subsequent coats for nonblast-cleaned ferrous surfaces may be either brush or spray applied. After the prime coat is dry, pinholes and holidays shall be marked, repaired in accordance with CSM's recommendations and retested before succeeding coats are applied. Unless otherwise specified, coats for concrete and masonry shall be brushed, rolled, or troweled.

G. Film Thickness and Continuity:

1. WFT of the first coat of the coating system and subsequent coats shall be verified by the Contractor, following application of each coat.

2. The surface area covered per gallon of coating for various types of surfaces shall not exceed those recommended by the CSM. The first coat, referred to as the prime coat, on metal surfaces refers to the first full paint coat and not to solvent wash, grease emulsifiers or other pretreatment applications. Coatings shall be applied to the thickness specified, and in accordance with these specifications. Unless otherwise specified, the average total thickness (dry) of a completed protective coating system on exposed metal surfaces shall be not less than 1.25 mils per coat. The minimum thickness at any point shall not deviate more than 25 percent from the required average. Unless otherwise specified, no less than two coats shall be applied.

3. In testing for continuity of coating about welds, projections (such as bolts and nuts), and crevices, the Construction Manager shall determine the minimum conductivity for smooth areas of like coating where the dry-mil thickness has been accepted. This conductivity shall be the minimum required for these rough or irregular areas. Pinholes and holidays shall be recoated to the required coverage.

4. The ability to obtain specified film thickness is generally compromised when brush or roller application methods are used and, therefore, more coats may need to be applied to achieve the specified dry film thickness.

5. For concrete substrates, the Contractor shall apply a complete skim coat of the specified filler/surfacer material over the entire substrate prior to application of the coating system. This material shall be applied such that all open air voids and bugholes in the concrete substrate are completely filled prior to coating application.

H. Special Requirements:

1. Before erection, the Contractor shall apply all but the final finish coat to interior surfaces of roof plates, roof rafters and supports, pipe hangers, piping in contact with hangers, and contact surfaces that are inaccessible after assembly. The final coat shall be applied after erection. Structural friction connections and high tensile bolts and nuts shall be coated after erection. Areas damaged during erection shall be hand-cleaned or power-tool cleaned and recoated with primer coat prior to the application of subsequent coats. Touch-up of surfaces shall be performed after installation. Surfaces to be coated shall be clean and dry at the time of application. Except for those to be filled with grout, the underside of equipment bases and supports that have not been galvanized shall be coated with at least two coats of primer specified for system E-2 prior to setting the equipment in place. Provide coating system terminations at leading edges and transitions to other substrates in accordance with the CSM's recommendations or detail drawings.

I. Electrical and Instrumentation Equipment and Materials:

1. Electrical and instrumentation equipment and materials shall be coated by the equipment manufacturer as specified below.

   a. Finish: Electrical equipment shall be treated with zinc phosphate, bonderized or otherwise given a rust-preventive treatment. Equipment shall be primed, coated with enamel, and baked. Minimum dry film thickness shall be 3 mils.

      1) Unless otherwise specified, instrumentation panels shall be coated with system E-1 for indoor mounting and system EU-1 for outdoor mounting.

      2) Before final acceptance, the Contractor shall touch up scratches on equipment with identical color coating. Finish shall be smooth, free of runs, and match existing finish. Prior to touching up scratches, Contractor shall fill them with an appropriate filler material approved by the CSM.

   b. Color: Exterior color of electrical equipment shall be FS 26463 (ANSI/NSF 61) light gray. Interior shall be painted FS 27880 white. Nonmetallic electrical enclosures and equipment shall be the equipment manufacturer's standard grey color.

      1) Exterior color of instrumentation panels and cabinets mounted indoors shall be FS 26463 light gray; unless otherwise specified, exterior color for cabinets mounted outdoors shall be FS 27722, white. Cabinet interiors shall be FS 27880, white.

J. Soluble Salt Contamination of Metallic Substrates:

1. Contractor shall test in accordance with SSPC-TU-4 metallic substrates to be coated that have been exposed to seawater or coastal air or to industrial fallout of particulate or other sources of soluble chlorides (such as wastewater exposure). If testing indicates detrimental levels of soluble salts, those in excess of 25 ppm, the Contractor shall clean and prepare these surfaces to remove the soluble salts.

3.04 CLEANUP

A. General:

1. Upon completion of coating, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean surfaces and repair overspray or other coating-related damage.

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

A. General:

1. Coating systems for different types of surfaces and general service conditions for which these systems are normally applied are specified on the following COATSPEC sheets. Surfaces shall be coated in accordance with the COATSPEC to the system thickness specified. Coating systems shall be as specified in paragraph 3.06. In case of conflict between the schedule and the COATSPECS, the requirements of the schedule shall prevail.
2. Coating Specification Sheets included in Table A are included this paragraph 3.05.

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
E-1	Epoxy	Metal	Interior; exterior, covered, not exposed to direct sunlight, non-corrosive exposure.
E-1-G	Epoxy	Galvanized Steel	Interior; exterior, covered non-corrosive exposure. Do not use in immersion service.
E-2	Epoxy	Metal	Immersed, nonpotable; non-immersed, moderately corrosive environment, color required.
E-3	Epoxy	Concrete or Masonry	Immersed, nonpotable; non-immersed, corrosive environment, color required.

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
E-4	Epoxy	Concrete, masonry, plaster, gypsum board	Interior
E-5 (NSF 61 certified)	Epoxy	Metal	Interior potable water tanks and reservoirs and other metal components in contact with water being treated and stored for potable use.
E-6 (NSF 61 certified)	Epoxy	Concrete	Interior potable water tanks and reservoirs and other metal components in contact with water being treated or stored.
E-7	Epoxy	Plastic	Interior; exterior covered, not exposed to direct sunlight.
E-8	Clear epoxy	Wood	Interior
E-9	Epoxy	Metal	Immersed, nonpotable; non-immersed, corrosive environment, color required. (Not for Biogenic Sulfide Corrosion areas.)
E-9-C	Epoxy	Concrete or masonry	Immersed, nonpotable; non-immersed, moderately corrosive environment, color required. (Not for Biogenic Sulfide Corrosion areas.)
E-10	Polyamidoamine epoxy	Metal or concrete	Below grade (buried).
EF-1	Amine Epoxy Broadcast Floor Coating	Concrete Floors	Light duty, wheeled traffic, frequent foot traffic, mildly corrosive.
EF-2	Amine Epoxy Troweled Floor Coating	Concrete Floors	Heavy-duty, wheeled traffic, frequent foot traffic, wet and moderately corrosive.
EA-1	Blended Amine Cured Epoxy	Metal	Immersed, nonpotable; non-immersed, corrosive environment, color not required especially for headspace environments that are corrosive due to biogenic sulfide corrosion.

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
EA-2	Blended Amine Cured Epoxy	Concrete or masonry	Immersed, nonpotable; non-immersed, corrosive environment, color not required, new construction especially for headspace environments that are corrosive due to biogenic sulfide corrosion.
EA-3	Blended Amine Cured Epoxy	Concrete or Masonry	Immersed, nonpotable; non-immersed, corrosive environment, color not required, new or existing construction, especially for headspace environments that are corrosive due to biogenic sulfide corrosion.
EA-4	Blended Amine Cured Epoxy – For Very Corrosive Conditions	Concrete or Masonry Potable	Non-immersed or immersed, very corrosive environment. Very high H_2S conditions.
EA-5	Novolac Epoxy Lining	Concrete	Secondary containment for spills of HFS acid or ferric chloride.
G	Grease	Metal	Ferrous Metal: Ferrous metal surfaces shall be prepared in accordance with SSPC SP-1 (Solvent Cleaning.)
HH-1	Proprietary Primer Plus Silicone Topcoat	Metal	Temperature to 750 degrees F.
HH-2	Proprietary Primer Plus Silicone Topcoat (black or aluminum only)	Metal	Temperature to 1200 degrees F.
L-1	Latex	Concrete, masonry, plaster, gypsum board	Interior and Exterior including existing exterior coated concrete.
L-2	Latex	PVC and CPVC pipe	Exterior, direct sunlight exposure.
L-3	Latex-Direct to Metal	Ferrous Metal	Interior or Exterior
L-4	Latex	Wood	Interior
M-1	Petrolatum based mastic or wax based wrapping tapes	Metal	Below grade (buried) or where little to no surface preparation can be performed on piping or structural steel.

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
M-2	Epoxy mastic or equal	Ferrous Metal	Interior, corrosive environment, confined enclosures, where minimal surface preparation is possible.
EU-1	Zinc-epoxy-polyurethane system	Ferrous Metal	Exterior, exposed to direct sunlight, moderately corrosive non-immersed.
EU-1-FRP	Specialty Primer plus Polyurethane Finish Coat	Exterior of FRP pipe and tanks, etc.	Exterior, exposed to direct sunlight, non-immersed.
EC-1	Hybrid Polyurethane	Concrete or dense masonry where existing crack or joint movement is suspected of propagating through rigid cured epoxy coatings	Service Condition: Interior or exterior, exposed to direct sunlight or not, corrosive (immersion pH 4.0 or lower and/or headspace pH 4.0 or lower and/or gaseous H_2S concentrations between 10 and 150 ppm typically.)
EC-2 (NSF-61)	Modified Polyurethane	Concrete or dense masonry where existing crack or joint movement is suspected due to thermal conditions and would propagate through rigid epoxy coating systems and/or where NSF-61 certification is required	Interior or exterior, submerged or non-submerged indirect sunlight – moderately corrosive.
S-1	Penetrating acrylic stain, color required	Concrete	Non-immersed, exposure to moisture and sunlight.
S-2	Silane/Siloxane or Blended Sealer	Concrete Floors	Wet, non-immersed, non-corrosive. Interior or exterior for waterproofing.
S-3	RTV Silicone Rubber Based Sealer	Concrete or Masonry Walls	Exterior or Interior – Weathering Exposure, Non-Corrosive.
S-4	Acrylic Co-polymer Blend	Concrete Floors	Wet, non-immersed, non-corrosive, interior for oil and water repellent.

Coating System Specification Sheets (COATSPEC)

A. Coating System Identification: E-3	
1. Coating Material:	Epoxy
2. Surface:	Concrete or masonry
3. Service Condition:	Immersed, nonpotable; non-immersed, corrosive environment, color required.
4. Surface Preparation:	
a. Concrete:	Concrete surfaces shall be allowed to cure for at least 28 days and allowed to dry to the moisture content recommended by the CSM before coating work proceeds. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Except as otherwise specified, loose concrete, form oils, surface hardeners, curing compounds, and laitance shall be removed from surfaces by abrasive blasting and chipping, and voids and cracks shall be repaired as specified in Section 03300. Surface preparation can be performed by abrasive blast cleaning or water blast cleaning and must achieve a uniform concrete surface profile of CSP3 in accordance with ICRI 03732. After cleaning, air voids or bugholes in the concrete shall be filled with a surfacer or block filler compatible with the specified primer and finish coats.
b. Masonry:	Masonry surfaces shall be allowed to cure for at least 28 days after being constructed and be allowed to dry to the moisture content recommended by the CSM. Holes or other joint defects shall be filled with a material compatible with the primers and finish coats or shall be filled with masonry mortar that shall cure for at least 28 days. Loose or splattered mortar shall be removed by scraping and chipping.
	Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign, loose, and deleterious substances.
	Muriatic acid shall not be used. After cleaning, masonry surfaces shall be sealed or filled with a sealer or block filler compatible with the specified primer.
5. Application:	Field
a. General:	Apply filler/surfacer as recommended by CSM to fill bugholes and air voids or block texture, etc. leaving a uniformly filled surface that does not produce blowholes or outgassing causing pinholing of the coating system. Filler/surfacers shall dry a minimum of 48 hours prior to application of prime coat or as required by the CSM.

	Prime coat shall be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.
	Drying time between coats shall be as recommended by CSM.
6. System Thickness:	15 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

B. Coating System Identification: E-4

1. Coating Material:	Epoxy
2. Surfaces:	Concrete, masonry, plaster, gypsum board.
3. Service Condition:	Interior
4. Surface Preparation:	
a. Concrete:	Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Loose concrete, form oils, surface hardeners, curing compounds and laitance shall be removed from surfaces, and voids and cracks shall be repaired as specified in Section 03300. Surface preparation shall produce a concrete surface profile of CSP-2 in accordance with ICRI 03732. After cleaning, air voids or bugholes in the concrete shall be filled with a surfacer or block filler compatible with the specified primer and finish coats.
b. Masonry:	Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered mortar shall be removed by scrapping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. Muriatic acid shall not be used. After cleaning, exterior masonry surfaces shall be sealed or filled with a sealer or block filler compatible with the specified primer.
c. Plaster:	Plaster surfaces shall be dry, clean, and free from grit, loose plaster, and surface irregularities. Cracks and holes shall be repaired with acceptable patching materials, keyed to existing surfaces, and sandpapered smooth. Surfaces shall be cleaned

	with clean water by washing and scrubbing to remove foreign and deleterious substances.
5. Application:	Field
a. General:	Block Filler shall be multiple component epoxy block filler or an acrylic based or waterborne epoxy based block filler and shall dry a minimum of 48 hours prior to primer application or as required by the CSM.
	Prime coat shall be thinned and applied as recommended by CSM, provided the coating as applied complies with prevailing air pollution control regulations.
	Drying time between coats shall be as recommended by CSM.
6. System Thickness:	10 mils dry film, excluding block filler and sealer.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

C. Coating System Identification: L-1

1. Coating Material:	Latex
2. Surfaces:	Concrete, masonry, plaster, gypsum board.
3. Service Condition:	Interior and exterior including existing exterior coated concrete.
4. Surface Preparation:	
a. Concrete:	Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Loose concrete and laitance shall be removed from surfaces, and voids and cracks shall be repaired as specified in Section 03300.
b. Existing Coated Concrete:	Remove all loose coating down to a sound substrate or intact, well-adhered existing coating by scraping or other means. Then, abrade all surfaces to achieve a 0.5- to 1.5-mil uniform profile and vacuum clean to remove all loose dirt, paint chips, and dirt.
c. Masonry:	Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered mortar shall be removed by scraping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. Muriatic acid shall not be used. After cleaning, masonry surfaces shall be filled with block filler

	compatible with the specified primer.
d. Plaster:	Plaster surfaces shall be dry, clean, and free from grit, loose plaster, and surface irregularities. Cracks and holes shall be repaired with acceptable patching materials, keyed to existing surfaces, and sandpapered smooth. Surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. After cleaning, surfaces shall be sealed with a compatible sealer.
e. Gypsum Wallboard:	Tape joints and spackled nail heads shall be sanded smooth and dusted. Seal with PVA sealer for interior uses only.
5. Application:	Field
a. General:	Sealer or filler shall dry a minimum of 48 hours prior to primer application.
	Drying time between coats shall be as recommended by CSM.
6. System Thickness:	4 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

D. Coating System Identification: L-2

1. Coating Material:	Latex
2. Surface:	PVC and CPVC pipe.
3. Service Condition:	Exterior, direct sunlight exposure.
4. Surface Preparation:	Plastic pipe shall be cleaned with solvent compatible with the specified primer and sanded to roughen surfaces to achieve a uniform surface profile of 1.0 to 1.5 mils. Vacuum clean after sanding to remove all loose dust, plastic particles, and dirt.
5. Application:	Field
6. System Thickness:	3 mils dry film.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

E. Coating System Identification: L-3

1. Coating Material:	Latex – Direct to Metal
2. Surface:	Ferrous Metal
3. Service Condition:	Interior or Exterior
4. Surface Preparation:	

a. Ferrous Metals:	Bare ferrous metal surfaces shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) unless specified otherwise. Impart a 1.5- to 2.0-mil profile to substrate.
	Ferrous metal with rust bleeding shall be cleaned in accordance with SSPC SP-1 (Solvent Cleaning). Areas of rust penetration shall be spot blasted to SSPC SP-10 (Near White Blast) and spot primed with the specified primer.
	Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning) or SSPC-SP-3 (Power Tool Cleaning).
b. Nonferrous and Galvanized Metal:	Galvanized or nonferrous surfaces shall be prepared in accordance with SSPC SP-1 (Solvent Cleaning) after Brush Blast Cleaning in accordance with SSPC-SP-7.
5. Application:	Field
6. System Thickness:	6 to 8 mils dry film excluding sealer
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

3.06 COATING SYSTEMS SCHEDULE (FINISH SCHEDULE)

A. General:

1. Specific coating systems, colors, and finishes for rooms, galleries, piping, equipment, and other items that are coated or have other architectural finishes are specified in the following coating system schedule. Unless otherwise specified in the coating system schedule, the word "interior" shall mean the inside of a building or structure, and the word "exterior" shall mean outside exposure to weather elements.

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
A. General: All Surfaces not Specified by Area or Structure		
1. Structural Steel, Metal Decking, and Galvanized Acoustical Decking	Uncoated or E-2	
2. Equipment and Metal Appurtenances		
a. Equipment, non immersed, unless otherwise specified		
1) Indoors	E-1	FS 25051 Blue
2) Outdoors	EU-1	FS 20040 Brown
b. Equipment, immersed, unless otherwise specified	E-2	Beige
c. High temperature equipment operable at		
1) 200 to 750 degrees F	HH-1	FS 26306 Grey
2) above 750 degrees F to 1200 degrees F	HH-2	Aluminum or Black
d. Existing equipment		
1) Not damaged nor modified by work in this contract	Uncoated	--
2) Damaged, exposed, or modified by work in this contract		
a) Indoors	E-1 (see paragraph 3.02)	Match existing color
b) Outdoors	EU-1 without primer (see paragraph 3.02)	Match existing color
e. Diffusers and grilles on coated surfaces, unless otherwise specified		
1) Indoors	E-1	Match background color
2) Outdoors	EU-1	Match background color

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
f. Diffusers and grilles on uncoated surfaces, unless otherwise specified		
1) Indoors	E-1	FS 25051 Blue
2) Outdoors	EU-1	FS 20040 Brown
g. Existing diffusers and grilles		
1) Not damaged not modified by work in this contract	Uncoated	--
2) Damaged, exposed, or modified by work in this contract		
a) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
b) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	Match existing color
h. Electrical switchgear panels, unit substations, motor control centers, power transformers, distribution centers, and relay panels; indoors and outdoors	See paragraph 3.03 Electrical and Instrumentation Equipment and Materials	ANSI 61 Grey (outside) FS 27880 White (inside)
i. Instrumentation panels, graphic indicating panels, indicating and transmitting field panels, unless otherwise specified		
1) Indoors	See paragraph 3.03 Electrical and Instrumentation Equipment and Materials	FS 26306 Grey (outside) FS 27880 White (inside)

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
2) Outdoors	See paragraph 3.03 Electrical and Instrumentation Equipment and Materials	FS 27722 White (outside) FS 27880 White (inside)
j. Existing electrical and instrumentation panels		
1) Not damaged by work in this contract	Uncoated	--
2) Damaged or exposed to outside surfaces by work in this contract		
a) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	FS 26306 Grey
b) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	FS 26306 Grey (Electrical) FS 27722 White (Instrumentation)
3. Conduit, Piping and Ductwork		
a. Ferrous, non-ferrous and galvanized piping, and appurtenant hangers and supports, non-immersed, unless otherwise specified.		
1) Indoors – noncorrosive	E-1	FS 25051 Blue
2) Outdoors – noncorrosive	EU-1	FS 20040 Brown
3) Indoors – in corrosive environment	EA-1	To be determined
4) Buried piping	M-1 or M-2	Not required
b. Ferrous piping, appurtenant and supports, immersed	E-2	To be determined

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
c. Conduit, outlet and junction boxes, lighting transformers, lighting, communication and small power panels, control stations, piping, lagged ductwork, appurtenant hangers, clamps, and supports on coated surfaces, unless otherwise specified.		
1) Indoors	E-1	Match background color
2) Outdoors	EU-1	Match background color
d. Conduit, outlets and junction boxes, lighting transformers, lighting, communication and small power panels, control stations, piping, lagged ductwork, appurtenant hangers, clamps and supports on uncoated surfaces, unless otherwise specified		
1) Indoors	E-1	FS 25051 Blue
2) Outdoors	EU-1	FS 20040 Brown
e. Existing conduit, outlet and junction boxes, lighting transformers, lighting communication and small power panels, control stations, piping, lagged ductwork, appurtenant hangers, clamps, and supports		
1) Not damaged nor modified by work in this contract	Uncoated	--
2) Damaged, exposed, or modified by work in this contract		
a) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
b) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	Match existing color
f. Racked conduits and cable trays	Uncoated	--

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
g. Insulated pipe jacketing	Uncoated	--
h. Plastic, fiberglass and flexible conduit and piping		
1) Unless otherwise specified	Uncoated	--
2) PVC and CPVC Piping	L-2	FS 25051 Blue
a) Exposed to direct sunlight	L-2	FS 25051 Blue
b) Not exposed to direct sunlight	E-7	FS 25051 Blue
i. High temperature piping operable at		
1) 200 to 750 degrees F	HH-1	FS 26306 Grey
2) Above 750 degrees F to 1,200 degrees F	HH-2	Aluminum or Black
j. Exposed ductwork, unless otherwise specified	Uncoated	--
4. Concrete, Grout, Masonry and Plaster		
a. Immersed tank and channel walls and bottoms unless otherwise specified	Uncoated	--
b. Outside concrete walls below grade common with dry area or room	In accordance with Section 07100	--
c. Walls and ceilings		
1) Precast concrete or colored masonry	Uncoated	--
2) Outdoors, unless otherwise specified	Uncoated	--
3) Indoors, unless otherwise specified	E-4	FS 23617 Beige
d. Concrete equipment bases unless otherwise specified	E-4	Match equipment color
e. Floors unless otherwise specified	S-2	
f. Existing coated surfaces.	L-1	Match existing color
5. Door and Door Frames		
a. Doors unless otherwise specified		

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
1) Ferrous metal		
a) Indoors	E-1	FS 20040 Brown
b) Outdoors	EU-1	FS 25051 Blue
2) Aluminum	Uncoated	--
3) Other	Plastic laminate	Formica 947 Brown
4) Existing		
a) Not damaged by work in this contract	Uncoated	--
b) Damaged, exposed, or modified by work in this contract		
(1) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
(2) Outdoors	EU-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
b. Door frames unless otherwise specified		
1) Adjacent wall coated		
a) Indoors	E-1	Match wall color
b) Outdoors	EU-1	Match wall color
2) Adjacent wall uncoated		
a) Indoors	E-1	FS 20040 Brown
b) Outdoors	EU-1	FS 25051 Blue
3) Aluminum	Uncoated	--
4) Existing		
a) Not damaged by work in this contract	Uncoated	--
b) Damaged, exposed, or modified by work in this contract		

Coating Systems Schedule (Finish Schedule)

Location/Surface	Coating System Identification	Standard Color
(1) Indoors	E-1 (see paragraph 3.02 Masonry Surfaces)	Match existing color
(2) Outdoors	EU-1 without primer (see paragraph 3.02 Masonry Surfaces)	Match existing color

Note: Owner will select color from coating manufacturer's list of EPA approved colors for potable water.

3.07 INSPECTION AND TESTING BY OWNER

A. General:

1. Inspection by the Owner or others does not limit the Contractor's or CSA's responsibilities for quality workmanship or quality control as specified or as required by the CSM's instructions. Inspection by the Owner is in addition to any inspection required to be performed by the Contractor.
2. The Owner may perform, or contract with an inspection agency to perform, quality control inspection and testing of the coating work covered by this Section 09900. These inspections may include the following:
   a. Inspect materials upon receipt to ensure that are supplied by the CSM.
   b. Inspect to verify that specified storage conditions for the coating system materials, solvents and abrasives are provided.
   c. Inspect and record findings for the degree of cleanliness of substrates.
   d. Inspect and record the pH of concrete and metal substrates.
   e. Inspect and record substrate profile (anchor pattern)
   f. Measure and record ambient air and substrate temperature.
   g. Measure and record relative humidity.
   h. Check for the presence of substrate moisture in the concrete.
   i. Inspect to verify that correct mixing of coating system materials is performed in accordance with CSM's instructions.
   j. Inspect, confirm, and record that the "pot life" of coating system materials is not exceeded during installation. Inspect to verify that recoat limitations for coating materials are not exceeded.

k. Perform adhesion testing.

l. Measure and record the thickness of the coating system.

m. Inspect to verify proper curing of the coating system in accordance with the CSM's instructions.

n. Perform holiday or continuity testing for coatings that will be immersed or coatings that will be exposed to aggressively corrosive conditions.

3.08 FINAL INSPECTION

A. General

1. Contractor shall conduct a final inspection to determine whether coating system work meets the requirements of the specifications.
2. The Construction Manager will subsequently conduct a final inspection with the Contractor to determine the work is in conformance with requirements of the contract documents.
3. Any rework required shall be marked. Such areas shall be recleaned and repaired as specified at no additional cost to the Owner.

END OF SECTION

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SECTION 11000

GENERAL REQUIREMENTS FOR EQUIPMENT

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE

This section specifies general requirements which are applicable to all mechanical equipment. The Contractor is responsible for ensuring that all mechanical equipment meets the requirements of this section in addition to the specific requirements of each individual equipment specification section.

B. EQUIPMENT LISTS

Equipment lists, presented in these specifications and as specified on the drawings, are included for the convenience of the Contractor and are not complete listings of all equipment, devices and material required to be provided under this contract. The Contractor shall prepare his own material and equipment takeoff lists as necessary to meet the requirements of this project manual.

1.02 QUALITY ASSURANCE

A. ARRANGEMENT

The arrangement of equipment shown on the drawings is based upon information available to the County at the time of design and is not intended to show exact dimensions conforming to a specific manufacturer. The drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual submitted equipment installation requirements; these may vary significantly from manufacturer to manufacturer. The contractor shall, in determining the cost of installation, include these differences as part of his bid proposal. Structural supports, foundations, connected piping, valves, and electrical conduit specified may have to be altered to accommodate the equipment actually provided. No additional payment shall be made for such revisions and alterations.

B. REFERENCES

This section contains references to the documents listed below. They are a part of this section as specified and modified. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, has been discontinued or has been replaced.

Reference	Title
ABMA Std 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA Std 11	Load Ratings and Fatigue Life for Roller Bearings
ANSI B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Gray Iron Pipe Flanges and Flanged Fittings, (Classes 25, 125, and 250)
ANSI B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ANSI S2.19	Mechanical Vibration – Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Unbalance, Including Marine Applications

C. UNIT RESPONSIBILITY

The Contractor shall require equipment assemblies made up of two or more components to be provided as a working unit by the unit responsibility manufacturer, where specified. The unit responsibility manufacturer shall coordinate selection, coordinate design, and shall provide all mechanical equipment assembly components such that all equipment components furnished under the specification for the equipment assembly, and all equipment components specified elsewhere but referenced in the equipment assembly specification, is compatible and operates reliably and properly to achieve the specified performance requirements. Unless otherwise specified, the unit responsibility manufacturer shall be the manufacturer of the driven component equipment in the equipment assembly. The unit responsibility manufacturer is designated in the individual equipment specifications found elsewhere in this project manual. Agents, representatives or other entities that are not a direct division of the driven equipment manufacturing corporation shall not be accepted as a substitute for the driven equipment manufacturer in meeting this requirement. The requirement for unit responsibility

shall in no way relieve the Contractor of his responsibility to the County for performance of all systems.

The Contractor shall ensure that all equipment assemblies provided for the project are products for which unit responsibility has been accepted by the unit responsibility manufacturer(s), where specified. Unit responsibility for related components in a mechanical equipment assembly does not require or obligate the unit responsibility manufacturer to warranty the workmanship or quality of component products not manufactured by them. Where an individual specification requires the Contractor to furnish a certificate from a unit responsibility manufacturer, such certificate shall conform to the content, form and style of Form 11000-C specified in Section 01999, shall be signed by an officer of the unit responsibility manufacturer's corporation and shall be notarized. No other submittal material will be processed until a Certificate of Unit Responsibility has been received and has been found to be satisfactory. Failure to provide acceptable proof that the unit responsibility requirement has been satisfied will result in withholding approval of progress payments for the subject equipment even though the equipment may have been installed in the work.

D. BALANCE

Unless specified otherwise, for all machines 10 HP and greater, all rotating elements in motors, pumps, blowers and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. All rotating elements shall be balanced to the following criteria:

$$U_{per} = 6.015 \frac{GW}{N}$$

Where:

U_{per}	=	permissible imbalance, ounce-inches, maximum
G	=	Balance quality grade, millimeters per second
W	=	Weight of the balanced assembly, pounds mass
N	=	Maximum operational speed, rpm

Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data. Equipment balance quality grade shall be *G* 2.5 (*G* = 2.5 mm/sec) or better in accordance with ANSI S2.19.

PART 2 – PRODUCTS

2.01 FLANGES AND PIPE THREADS

Flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125. Pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.

Threaded flanges shall have a standard taper pipe thread conforming to ANSI B1.20.1. Unless otherwise specified, flanges shall be flat faced.

Flange assembly bolts shall be heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

2.02 BEARINGS

Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of ABMA Methods of Evaluating Load Ratings of Ball and Roller Bearings. Unless otherwise specified, equipment bearings shall have a minimum L-10 rating life of 50,000 hours. The rating life shall be determined using the maximum equipment operating speed.

Grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic alemite type.

Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60 degrees C and shall be equipped with a filler pipe and an external level indicator gage.

All bearings accessible to touch, and located within 7 feet measured vertically from floor or working level or within 15 inches measured horizontally from stairways, ramps, fixed ladders or other access structures, shall either incorporate bearing housings with sufficient cooling to maintain surface temperature at 65 degrees C or less for continuous operation at bearing rated load and a 50 degrees C ambient temperature or shall be provided with appropriate shielding shall be provided that will prevent inadvertent human contact.

2.03 V-BELT ASSEMBLIES

Unless otherwise specified, V-belt assemblies shall be Dodge Dyna-V belts with matching Dyna-V sheaves and Dodge Taper-lock bushings, Wood's Ultra V-belts with matching Ultra-V sheaves and Wood's Sure-Grip bushings, or equal.

Sheaves and bushings shall be statically balanced. Additionally, sheaves and bushings which operate at a peripheral speed of more than 5500 feet per minute shall be dynamically balanced. Sheaves shall be separately mounted on their bushings by means of three pull-up grub or cap tightening screws. Bushings shall be key seated to the drive shaft.

Belts shall be selected for not less than 150 percent of rated driver horsepower and, where two sheaves sizes are specified, shall be capable of operating with either set of sheaves. Belts shall be of the antistatic type where explosion proof equipment is specified.

2.04 PUMP SHAFT SEALS

A. GENERAL

Seals for water and wastewater pump shafts shall be mechanical seals.

B. MECHANICAL SEALS

Unless otherwise specified in the detailed pump specifications, mechanical seals shall be split mechanical seals requiring no field assembly, other than assembly around the shaft and insertion into the pump. They shall be self-aligning, and self-centering, single seals. They shall be of a nondestructive (nonfretting) type requiring no wearing sleeve for the shaft. Shafts for pumps specified with mechanical seals shall be furnished with no reduction in size through the seal area (no shaft sleeve). Where the detailed specifications call for cartridge instead of split seals, all other requirements of this paragraph apply.

Metal parts shall be Type 316 or 316L stainless steel. Springs shall be Hastelloy C, Elgiloy, or other Duplex SS selected for resistance to chloride attack. Rotary faces shall be silicon carbide or chrome oxide. Stationary faces shall be silicon carbide for solids bearing fluid service and carbon for clean water service. Elastomers shall be ethylene propylene or fluorocarbon. Mechanical seals shall be suitable for operation between full vacuum (0 psia) up to 200 percent of the maximum specified operating pressure, but in any event not less than 200 psig.

Seal chambers shall be provided with vented solids removal restriction bushings except for enclosed line shaft pumps where the seal barrier fluid is used for line shaft bearing lubrication. The bushing shall both control the amount of flushing water flow and restrict solids and gas accumulation from the seal face area.

Candidate seals include:

1. Chesterton 442 seals provided with Chesterton/SpiralTrac solids removal restriction bushings Version N or D, as recommended by EnviroSeal Engineering Products, Ltd, Nova Scotia, Canada.

2. AESSEAL RDS seals with Cyclops bushing.

3. John Crane 3710 seals with Type 24SL bushing.

4. John Crane 5610 seals

Seals on pumps for contaminated water service (sludge or polymer) shall be drilled and tapped for connection of a clean water flushing supply.

C. SHAFT PACKING

Where shaft packing is specified, stuffing boxes shall be tapped to permit introduction of seal liquid and shall hold a minimum of five (5) rows of packing. Stuffing boxes shall be face attached. Stuffing box and shaft shall be suitable for field installation, without machining or other modifications, of the mechanical seal specified in paragraph 11000-2.04.B for the applicable pump and operating conditions.

Unless otherwise specified, lantern rings shall be bronze or Teflon, packing shall be die-molded packing rings of non-asbestos material suitable for the intended service and as recommended by the manufacturer, and glands shall be bronze, two piece split construction. Lantern rings shall be of two-piece construction and shall be provided with tapped holes to facilitate removal. Lantern rings shall be drilled and tapped 1/4 NC-20. The impeller end of the packing on all but line shaft pumps with external source water lubricated bearings shall be fitted with a SpiralTrac, Version P packing protection system as manufactured by EnviroSeal Engineering Products, Ltd, Nova Scotia, Canada.

The section of each shaft or impeller hub that extends through or into the stuffing box shall be fitted with a replaceable stainless steel sleeve with a Brinell hardness of not less than 500. The sleeve shall be held to the shaft to prevent rotation and shall be gasketed to prevent leakage between the shaft and the sleeve. Minimum shaft sleeve thickness shall be 3/8 inch.

2.05 COUPLINGS

Unless otherwise specified in the particular equipment sections, equipment with a driver greater than 1/2 HP, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taper lock bushings which shall give the equivalent of a shrunk-on fit. There shall be no metal-to-metal contact between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the

coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.

Where torque or horsepower capacities of couplings of the foregoing type is exceeded, Thomas-Rex, Falk Steel Flex, or equal, couplings will be acceptable provided they are sized in accordance with the equipment manufacturer's recommendations and sizing data are submitted. They shall be installed in conformance to the coupling manufacturer's instructions.

2.06 GUARDS

Exposed moving parts shall be provided with guards which meet all applicable OSHA requirements. Guards shall be fabricated of 14-gage steel, 1/2-13-15 expanded metal screen to provide visual inspection of moving parts without removal of the guard. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided. Lube fittings shall be extended through guards.

2.07 CAUTION SIGNS

Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading "CAUTION - AUTOMATIC EQUIPMENT MAY START AT ANY TIME". Signs shall be constructed of fiberglass material, minimum 1/8 inch thick, rigid, suitable for post mounting. Letters shall be white on a red background. The sign size and pattern shall be as shown on the drawings. Signs shall be installed near guarded moving parts.

2.08 GAGE TAPS, TEST PLUGS AND GAGES

Gage taps shall be provided on the suction and discharge sides of pumps, blowers and compressors. Pressure and vacuum gages shall be provided where specified. Gage taps, test plugs, and gages shall be as specified in Divisions 15 and 17, respectively.

2.09 NAMEPLATES

Nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation and equipment number. Equipment nameplates shall be engraved or stamped stainless steel and fastened to the equipment in an accessible and visible location with stainless steel screws or drive pins.

2.10 LUBRICANTS

The Contractor shall provide for each item of mechanical equipment a supply of the required lubricant adequate to last through the specified commissioning period. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the County's current lubricant supplier. The Contractor shall limit the various types of

lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule for starting, testing and adjusting equipment (Section 01660), the Contractor shall provide the County with three copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

2.11 ANCHOR BOLTS

Anchor bolts shall be designed for lateral forces for both pullout and shear in accordance with the provisions of Section 05501. Unless otherwise stated in the individual equipment specifications, anchor bolt materials shall conform to the provisions of Section 05501.

2.12 SPARE PARTS

Spare parts, wherever required by detailed specification sections, shall be stored in accordance with the provisions of this paragraph. Spare parts shall be tagged by project equipment number and identified by part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration, such as ferrous metal items and electrical components, shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with a hinged wooden cover and locking hasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.

PART 3 – EXECUTION

Installation of equipment accessories included in this section shall be as recommended by the equipment manufacturer unless otherwise specified in the individual equipment specification section.

END OF SECTION

SECTION 11002

RIGID EQUIPMENT MOUNTS

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies minimum requirements for rigid equipment mounts (baseplates, , and mounting blocks) and their installation on equipment pads. Completed equipment supports shall consist of equipment pads, equipment anchors, and rigid equipment mounts (baseplates, , or mounting blocks) set in grout.

Unless alternate requirements for equipment mounts are specified in the applicable equipment specification, the requirements of this section shall be applied to rigid mounts for all rotating or reciprocating equipment that is used to mix, convey, or pressurize fluids (gases and liquids). The requirements of this section shall also apply whenever referenced in specifications for other types of equipment. If conflict exists between this section and requirements of individual equipment manufacturers, the more restrictive requirements shall prevail.

B. DEFINITIONS:

Specific equipment mounting terminology used in this section conforms to the following definitions:

1. Baseplate: Fabricated (welded structural steel elements), cast, or plate steel base providing a common mounting element on which the legs, feet, or mounting surfaces of equipment are mounted by means of bolted connections.

2. Mounting Blocks: Multiple smaller baseplates on which individual legs, feet or equipment supports are mounted when equipment or drivers are not fastened to a common baseplate or sole plate.

3. Equipment Pad: Concrete foundation (block or slab) supporting and elevating equipment mounts above the supporting structural floor slab or local grade.

4. Mounting Pads: Thickened or raised areas of baseplates where the feet or mounting surfaces of mounted equipment and drivers are bolted and/or doweled to the baseplate or soleplate.

5. Leveling Blocks: Temporary steel blocks placed under baseplates, , or a mounting block at leveling positions (at equipment anchors) for the purpose of leveling baseplates, , or mounting blocks prior to grouting.

6. Shims: Thin stainless-steel plates of a uniform thickness installed on top of Leveling Blocks for fine adjustment of level. Shims may also be used between equipment or drivers and baseplates, , or mounting blocks for equipment alignment purposes.

7. Wedges: Pairs of uniformly tapered metal blocks that are stacked with the tapered surfaces reversed (relative to the other wedge) so that the top and bottom surfaces of the wedges are parallel. Wedges are used between equipment pads and baseplates, , or mounting blocks for the purpose of leveling baseplates, , or mounting blocks.

8. Mounting Stud: Threaded rod or bolts anchored to baseplates, , or mounting blocks for the purpose of mounting equipment or ancillary devices onto baseplates, , or mounting blocks.

9. Reinforcement Dowels: Steel reinforcement rods embedded in concrete,
10. across a cold joint, for the purpose of transferring loads or force across the
11. joint.

12. Machine Alignment Dowels: Tapered diameter rods inserted in tapered diameter holes for the purpose of aligning machinery. The practice of drilling tapered diameter holes through machinery and baseplates so that Machine Alignment Dowels may be inserted to facilitate alignment of machinery is known as Doweling.

13. Leveling Position: A location on the top of a concrete equipment pad where leveling tools and equipment will be temporarily installed or used for the purpose of leveling baseplates, , and mounting blocks prior to grouting.

13. Grout Manufacturer: Refers to the manufacturer of the epoxy grout system used for installation of rigid equipment mounts.

14. Grout Manufacturer's Technical Representative(s): Refers to the technical representative(s) of the Grout Manufacturer.

C. EQUIPMENT MOUNTING REQUIREMENTS:

Unless otherwise specified, equipment and drivers shall be rigidly mounted on a common cast iron or fabricated steel baseplate or soleplate grouted into place on a concrete equipment pad. Under no circumstances shall baseplates , or mounting blocks be grouted directly to concrete slabs or floors. Equipment that uses an interdependent equipment and driver mounting configuration (equipment that is bolted onto the driver frame and equipment that supports the driver entirely from the equipment frame) may be bolted directly on concrete or grout surfaces of equipment pads if the driver is less than five horsepower. Bolting equipment directly on concrete or grout surfaces of equipment pads is not acceptable for equipment and drivers that do not have an interdependent equipment and driver mounting configuration.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. It is a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed document, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/HI 1.4	Centrifugal Pumps – Installation, Operation and Maintenance
ANSI/HI 2.4	Vertical Pumps – Installation, Operation and Maintenance
API RECOMMENDED PRACTICE 686	Recommended Practices for Machinery Installation and Installation Design
ASTM E329	Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
MIL-PRF-907E	Anti-Seize Thread Compound, High Temperature
SSPC	Society for Protective Coatings Specifications, Vol. 2

IBC	2001 International Building Code (including local amendments)

B. QUALITY CONTROL BY CONTRACTOR:

To demonstrate conformance with the specified requirements for rigid equipment mounts, the Contractor shall provide the services of an independent testing laboratory that complies with the requirements of ASTM E329. The testing laboratory shall sample and test equipment mount related materials as indicated in this Section (11002). Costs of testing laboratory services shall be borne by the Contractor.

1.03 SUBMITTALS

The following information shall be provided in accordance with the submittal requirements specified in Section 01300.

1. A copy of this specification section, with addendum updates included, (referenced sections need not be included for Section 11002) with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The County shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration. Copies of this specification section shall be numbered and marked (specification number and equipment number) for inclusion (filing) with the associated equipment submittal requirements.

2. Schedule of rigid equipment mount installations specified in paragraph 11002-2.01.

3. Name, employer and certificates or other information documenting compliance with the journeyman qualifications requirements for millwrights who will install rigid equipment mounts, as specified in paragraph 11002-3.03. C.

4. Shop drawings for all equipment pads, equipment anchors, and baseplate, soleplate or mounting block details. Shop drawings shall depict size and location of equipment pads and reinforcement; equipment drains; equipment anchor, size, location, and projection; expansion joint locations; elevation of top of grout and grout thickness; elevation of top of baseplate; soleplate; or mounting block; size and location of electrical conduits; and any other equipment mounting features embedded in equipment pads. Shop drawings for equipment pads, equipment anchors, and baseplate, soleplate, or mounting blocks shall be numbered and marked (specification number and equipment number) for inclusion (filing) with the associated equipment submittal requirements.

PART 2 – PRODUCTS

2.01 GENERAL

Prior to initiating any installation efforts, the Contractor shall produce a rigid equipment mount installation schedule containing the expected dates for installing equipment anchors and preparation of equipment pads for leveling, grouting, and final equipment anchor clamping for each item of equipment. The schedule shall list the equipment, by equipment tag number, and shall list applicable equipment specification section, motor horsepower, and name of the Contractor's representative responsible for quality control during installation of rigid equipment mounts. The schedule shall be accompanied by written verification of equipment anchor clamping torque from the manufacturer of each item of equipment to be installed with rigid equipment mounts.

2.02 CONCRETE EQUIPMENT PADS

Concrete equipment pads shall be as shown in the structural details for equipment pads and equipment anchors for rigid mounted equipment.

The Contractor shall submit equipment anchor calculations for all equipment with drivers 20 horsepower and greater. Equipment anchor calculations shall demonstrate that equipment anchor size, embedment, and edge distance comply with the Florida Building Code and are sufficient to resist the maximum lateral and vertical forces specified in paragraph 11000-2.11. Equipment anchor calculations shall be sealed by a registered structural or civil engineer licensed in the State of Florida.

2.03 BASEPLATES , AND MOUNTING BLOCKS

A. GENERAL

Unless otherwise specified, Type I baseplates , and mounting blocks shall be a minimum of 1 inch thick for equipment with drivers 20 horsepower and larger. All

Type I baseplates and mounting blocks shall have edges of surfaces bearing on grout rounded to a radius of not less than 0.25 inch. Horizontal corners of Type I baseplates or mounting blocks shall be rounded to a radius of not less than two inches to avoid producing stress risers on the grouted foundation. Grout pouring holes (minimum 4 inches in diameter for epoxy grout, minimum 2 ½ inches in diameter for cementitious nonshrink grout) shall be provided in all baseplates and all baseplates and shall have grout release holes. Mounting blocks may be grouted without grout pouring holes provided that no dimension of the mounting block (width or length) exceeds 18 inches. Grout relief or vent holes (minimum 1 inch in diameter) shall be provided in all baseplates , and mounting blocks. Internal stiffeners shall be provided on all cast and fabricated baseplates and shall be designed to allow free flow of grout from one section of the baseplate to another. The minimum acceptable opening in cross bracing and stiffeners shall be 2-inches high by 6-inches in width. All welds shall be continuous and free from skips, blowholes, laps and pockets.

Mounting holes for equipment anchors shall be drilled through baseplates, and mounting blocks. Mounting holes for equipment anchors shall not be burned out and they shall not be open slots. All mounting studs shall be Type 316 stainless steel. An anti-seize or anti-galling compound, as specified in paragraph 11002-2.06, shall be applied to all mounting stud threads prior to installing nuts on mounting studs. Terminations requiring connections to baseplates , or mounting blocks shall be acorn nuts welded to the under side of the baseplate or nuts welded to the underside of the baseplate and plugged with cork, plastic plugs or grease. In no case shall the fastener terminate only into the metal base. Where baseplates or mounting blocks are leveled using jackscrews, jackscrew threads shall be tapped in thickened pads or otherwise in sufficient metal to provide ease in adjusting level.

Mounting pads for equipment shall be machined after all welding and stress relieving and shall be coplanar within 0.002 inch per foot in all directions. Mounting pads shall extend not less than 0.5 inch beyond the perimeter of the foot or mounting surface of the mounted equipment, in any direction.

Equipment baseplates shall provide common support for the equipment and driver (and flywheel, if one is specified). Baseplates for equipment with drivers 20 horsepower and greater shall be furnished with eight transverse alignment (horizontal) positioning jackscrews for alignment of equipment drivers on horizontal surfaces of baseplates. Two of the eight transverse alignment/positioning jackscrews shall be installed in perpendicular directions in a horizontal plane at the mounting position for each corner or foot of the equipment driver. (Eight additional jackscrews shall be provided for transverse

alignment of the flywheel, if flywheels are specified.)

B. TYPE I BASEPLATES

Type I baseplates shall be plate or fabricated structural steel baseplates with thickened steel mounting pads for doweling and bolting equipment to the baseplate. The baseplates shall be rectangular in shape for equipment other than centrifugal refrigeration machines and pump baseplates, which may be "T" or "L" shaped to accommodate the equipment drive and accessories. Baseplates for split case pumps shall include supports for suction and discharge elbows, if required by the specified configuration. Perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the baseplate. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.

C. TYPE II/III BASEPLATES

Type II and Type III baseplates, which are applicable for vibration isolation mounting, are not applicable to this project.

D. TYPE IV BASEPLATES

Type IV baseplates shall be cast iron with thickened mounting pads for doweling and bolting equipment to the baseplate. Cast iron baseplates shall be sealed in accordance with the requirements for bleeding surfaces specified in prior to grouting.

F. MOUNTING BLOCKS

Where equipment is fabricated or cast with feet or mounting surfaces that are not fastened to a common baseplate or soleplate, as in dry-pit bottom suction pumps, the equipment may be supported on individual concrete piers or equipment pads in lieu of a common baseplate or soleplate and equipment pad. In such instances, the equipment shall be supported at the feet or mounting surfaces on individual mounting blocks, which shall be leveled and grouted into place on the individual piers or equipment pads as specified in this section. All mounting blocks shall be furnished with jackscrew threads (three locations, minimum) tapped in the mounting block for the purpose of leveling mounting blocks with jackscrews.

2.04 GROUT FOR EQUIPMENT PADS

A. EPOXY GROUT FOR EQUIPMENT MOUNTING:

Unless otherwise specified, grout for setting bearing surfaces of baseplates and mounting blocks on equipment pads shall be Epoxy Grout for Equipment Mounting as specified in Section 03600. Where the term epoxy grout is used in

the context of details and specifications for equipment mounting it shall mean Epoxy Grout for Equipment Mounting.

B. CEMENTITIOUS NONSHRINK GROUT:

Cementitious Nonshrink Grout, specified in Section 03600, may be used for setting bearing surfaces of baseplates or mounting blocks on equipment pads where equipment drivers are 20 horsepower and smaller and the combined weight of equipment and driver is less than 1000 pounds. Where the term nonshrink grout or cementitious grout is used in the context of details and specifications for equipment mounting it shall mean Cementitious Nonshrink Grout. Training and quality control by the grout manufacturer's technical representative is not required for rigid equipment mounts installed with cementitious non-shrink grout.

2.05 EPOXY PRIMER

Epoxy primer shall be a lead free, chrome free, rust inhibitive, two-component epoxy primer specifically designed for use on metal substrates and in conjunction with epoxy grout. The epoxy primer shall be a product of the epoxy grout manufacturer.

2.06 ANTI-SEIZE/ANTI-GALLING COMPOUND

Anti-seize or anti-galling compound shall be a molybdenum disulfide and graphite combination in an aluminum complex base grease conforming to MIL-PRF-907E. Acceptable products include Jet Lube 550 by Jet Lube, Inc., E-Z Break by LA-CO, or equal.

2.07 PRODUCT DATA

The following information shall be provided in accordance with the product data requirements specified in Section 01300:

1. Equipment anchor calculations specified in paragraph 11002-2.02.

2. Results of grout strength tests, as specified in paragraph 11002-3.03 D.

3. Completed Rigid Equipment Mount Installation Inspection Checklist Forms (11002-A), as specified in paragraph 11002-3.02 B.

4. List of Contractor's equipment installation staff that has completed epoxy grout manufacturer's grout installation training specified in paragraph 11002-3.02 A.

PART 3 – EXECUTION

3.01 GENERAL

Grouting for installation of equipment on equipment pads shall take place prior to connecting any field piping or electrical and instrumentation systems. Unless the County accepts an alternate installation procedure in writing, baseplates and mounting blocks shall be leveled and grouted with the equipment removed. Pumps shall be installed in accordance with this section and ANSI/HI 1.4 or ANSI/HI 2.4, as appropriate for the type of pumping equipment installed.

Connecting piping with flexible connections and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the piping system without imposing strain on the equipment connections.

Where an equipment manufacturer's installation requirements include a rigid connection between the machine and connecting piping systems, the Contractor shall delete any flexible coupling (including equipment connection fittings) shown on the drawings and install the equipment in the following manner, in lieu of installing the flexible coupling:

1. The equipment pad shall be prepared as shown on the details for rigid equipment mounts

2. The baseplate or mounting blocks supporting the equipment shall be installed, leveled, and grouted in place as specified in this section.

3. The equipment shall be installed, aligned and doweled in place.

4. The piping shall be installed and aligned to the equipment connections and the field piping connections without welding one of the joints for one section of pipe between the equipment connection and the field piping and all valving. All flanged joints shall be bolted up and pressure tested.

5. All piping shall be fully supported by supports designed to accept their full weight and thrust forces.

6. The final sections of piping shall be aligned with the equipment and field connections without the use of jacks, chain falls or other devices to force it into alignment.

7. The final piping joints shall be welded only after the previous steps have been completed and accepted by the County.

3.02 EPOXY GROUT TRAINING AND QUALITY CONTROL

A. EPOXY GROUT TRAINING

Prior to commencing rigid equipment mount installation work on equipment pads, the Contractor shall furnish the services of a grout manufacturer's technical representative to conduct a training school for the workers that will be using the epoxy grout for rigid equipment mount installations. The school shall be not less than 4 hours in length and shall cover all aspects of using the products, from mixing to application. This requirement, however, shall not be construed as relieving the Contractor of overall responsibility for this portion of the work. The epoxy grout manufacturer shall furnish a list of school attendees that have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

B. EPOXY GROUT QUALITY CONTROL

For equipment with drivers 20 horsepower and greater, the epoxy grout manufacturer's technical representative shall provide quality control services for epoxy grout installation in rigid equipment mounts. The epoxy grout manufacturer's technical representative shall be on site to inspect and verify that the application personnel have successfully performed surface preparation, epoxy grout application, and Quality Control Inspection in accordance with these specifications for a representative portion of the epoxy grout installation work.

Specifically, the epoxy grout manufacturer's technical representative shall perform the following services for at least one rigid equipment mount installation for each equipment type and size:

1. Inspect ambient conditions during various phases of epoxy grouting installation for conformance with the epoxy grout manufacturer's requirements.

2. Inspect the surface preparation of concrete substrates onto which epoxy grout materials are to be applied, for conformance to the specified application criteria, including but not limited to substrate profile, degree of cleanliness, and moisture.

3. Inspect the surface preparation of the metallic substrates onto which the epoxy primer is to be applied.

4. Inspect the epoxy-primed metallic substrate for coverage and adhesion.

5. Inspect preparation and application of epoxy grout form work for conformance to the specifications.

6. Inspect and record that the "pot life" of epoxy grout materials is not exceeded during installation.

7. Inspect epoxy grout for cure.

8. Inspect and record that localized repairs made to grout voids are in conformance with the specification requirements.

9. Conduct a final review of completed epoxy grout installation for conformance to these specifications.

10. Attest to conformance of the Contractor's work by signing appropriate entries in the "Rigid Equipment Mount Inspection Checklist," form 11002-A in Section 01999.

3.03 INSTALLATION

A. CONCRETE EQUIPMENT PAD PREPARATION

After the concrete is fully cured, the top of the equipment pad shall be roughened by chipping the surface. Chipping shall remove all laitance and defective or weak concrete and result in a rough surface profile with a 0.25 inch minimum amplitude. Chipping shall expose broken aggregate without dislodging unbroken aggregate from the cement matrix and shall not cause fractures below the concrete surface. Leveling surfaces of the concrete that have been finished smooth and level for baseplate, soleplate, or mounting block leveling at equipment anchors shall be protected from damage during chipping. A light duty, hand held pneumatic chipper with a chisel type tool shall be used for chipping the equipment pad concrete surface. Abrasive blast, bush-hammer, jack hammers with sharp chisels, heavy chipping tools, or needle gun preparation of concrete surfaces to be grouted is not acceptable.

Prior to leveling activities, satisfactory removal of defective or weak concrete shall be demonstrated in the presence of the County by operating the chipper on the chipped concrete surface at locations identified by the County. The chipped surface of the concrete shall be such that the final baseplate or mounting block elevation results in the grout manufacturer's recommended grout thickness between the surface of the equipment pad and the lower baseplate flange or underside of mounting block.

All dust, dirt, chips, oil, water, and any other contaminants shall be removed and the surface protected with plastic sheeting until grout is installed.

Concrete equipment pad surfaces that have been finished smooth and level for use as leveling positions shall be protected from damage during chipping activities. Alternatively, leveling positions may be restored on chipped surfaces. Leveling positions shall be restored by installing leveling blocks or leveling plates for jackscrews on a high compressive strength epoxy putty (Philadelphia Resins, Phillybond Blue 6A, or equal). Leveling blocks and leveling plates shall be installed level on the epoxy putty.

B. BASEPLATES AND MOUNTING BLOCKS

All surfaces of baseplates and mounting blocks to be in contact with epoxy grout shall be cleaned to SSPC SP-6 and shall be primed with epoxy primer within 8 hours of cleaning.

C. LEVELING

All machinery shall be mounted and leveled by journeyman millwrights. Precision surveying equipment shall be used for leveling. Machinists' spirit levels will not be permitted for leveling purposes for any baseplate or mounting block with a plan dimension greater than 4 feet. Baseplates and mounting blocks shall be leveled to a maximum tolerance of 0.002 inch per foot or as otherwise required by the equipment manufacturer, if more stringent. An anti-seize or anti-galling compound specified in paragraph 11002-2.06 shall be applied to all equipment anchor threads prior to beginning baseplate or mounting block leveling.

All baseplates and mounting blocks shall be leveled against steel surfaces (jackscrew plates, leveling blocks, leveling nuts, support plates, or other steel surfaces). Use of other materials for leveling purposes is strictly and specifically prohibited. Unless otherwise specified, baseplates, mounting blocks, and shall be leveled as indicated in the leveling details. Leveling equipment and tools shall be stainless steel leveling blocks and shims, steel wedges, or jackscrews bearing on leveling plates. Leveling nuts may be used for leveling baseplates and weighing less than 200 pounds. The use of leveling nuts for leveling mounting blocks is not permitted.

After baseplates or mounting blocks have been leveled on the leveling equipment, the Contractor shall clamp the baseplates or mounting blocks in position by installing the equipment anchor nuts and washers. Clamping torque shall be less than the final clamping torque specified in paragraph 11002-2.01, but sufficient to hold the baseplate or mounting block in position. The Contractor shall verify that the correct level and position of the baseplate or mounting block has been maintained after clamping on the leveling equipment.

Leveling blocks shall be stainless steel, four inches square and 1-1/2 inches thick with an open-ended slot terminating in the center for the equipment anchor. Leveling blocks shall be machined flat on all horizontal surfaces and placed under the baseplate or soleplate at each equipment anchor. Shims shall be pre-cut stainless steel, slotted for removal after grouting, and shall extend not less than three inches beyond the baseplate, soleplate or mounting block. Leveling blocks and shims shall be coated with a light oil just prior to beginning the leveling and grouting work. Shims shall be placed so the tabs on the shims are easily accessible.

D. GROUTING

Grout forms shall be built of minimum 0.75-inch-thick waterproof plywood and shall be securely braced (minimum brace size shall be two-by-four lumber). Forms shall be designed for a minimum of 6 inches hydrostatic head above the final elevation of the grout, to assist in flow during installation. Equipment mounting grout shall be furnished with expansion joints installed at four to six foot intervals, perpendicular to the centerline of baseplates.

Forms shall be coated with three coats of paste wax on all areas that will come in contact with the grout to prevent the grout from bonding to the forms. Forms shall be waxed before assembly to prevent accidental application of wax to surfaces where the grout is to bond. Before any forms are installed, all concrete surfaces that will contact epoxy grout shall be free from any foreign material, such as oil, sand, water, wax, grease, etc. Forms shall be liquid-tight. Any open spaces or cracks in forms, or at the joint between forms and the foundation, shall be sealed off, using sealant, putty, or caulking compound. All outside vertical and horizontal edges of the grout shall have 45-degree chamfers as indicated in the equipment anchor details for rigid equipment mounts. Match chamfers in concrete portions of the equipment pad. Block outs shall be provided at all shimming and leveling positions to allow removal of leveling equipment and tools after the grout has cured. Jackscrews shall be coated with a light oil or other acceptable bond-breaking compound prior to grouting.

The 45-degree perimeter chamfer strip shall be located at the final elevation of the grout. The final elevation of the grout on baseplates with exposed I-beam or C-channel supports shall be at the top of the lower support flange. The top of the grout, on all other baseplates and mounting blocks, shall be at least 1.0 inch above the bottom or underside of the baseplate or mounting block and shall not be higher than the top of the baseplate or mounting block. The grout's final elevation shall not be so high as to bond the equipment anchor nut and washer.

The resin and hardener for epoxy grout for equipment mounting shall be mixed in accordance with the epoxy grout manufacturer's recommendations. Epoxy grout shall be placed at the center of one end of the baseplate and worked toward the ends in such a manner as to force the air out from beneath the baseplate and out the vent holes, to eliminate voids. Epoxy grout shall be placed in a manner that avoids air entrapment, using a head box to pour grout into the grout holes. When the head box is moved to the next grout hole, a 6-inch high standpipe shall be placed over the grout hole and filled with grout. Use of vibrating tools and/or jarring (rapping or tapping) forms to facilitate grout flow is not permitted during placement of epoxy grout.

The Contractor shall exercise care to never allow the grout to fall below the

baseplate level once the grout has made contact with the baseplate. Grout placement shall be continuous until all portions of the space beneath the baseplate or mounting block have been filled. Subsequent batches of grout shall be prepared so as to be ready when the preceding batch has been placed. Under no circumstances shall the grouting operation be halted because of lack of grout mix. After the entire baseplate is full, 6-inch high standpipes shall be maintained over each grout hole, to continue purging of air. When the grout has started to take an initial set (typically this is determined by a noticeable increase in temperature and no flow of grout at the vent holes) the standpipes shall be removed and excess grout cleaned from all surfaces.

Where the cavity under a baseplate or mounting block extends above the elevation of the top of the bolting flange for the baseplate or mounting block, grouting may be completed in two pours. Under these circumstances, the first grout pour shall be continuous until the lower face of the bolting flange for the baseplate or mounting block is submerged in grout a minimum of one inch. The second grout pour shall be completed with standpipes and air purges as specified in the previous paragraph.

Grout forms shall be checked for leaks throughout grout pours. Leaks shall be repaired immediately to prevent formation of voids. A final check of baseplate or mounting block level and elevation shall be performed before the grout sets.

A grout sample shall be taken for each equipment pad that has a baseplate or mounting block set in grout. The sample shall be placed in a cylinder of sufficient size to yield three two-inch cubes as test samples. The samples shall be tagged with project name, date, time, the equipment number and ambient temperature at the time of placement. Once the epoxy grout cylinder has been completely filled, it shall be placed next to the foundation of the equipment being grouted and allowed to cure for 48 hours. After 48 hours, the test cylinder shall be tested in accordance with the grout manufacturer's recommendations by the independent testing laboratory specified in paragraph 11002-1.02 B. The results shall be reported directly to the County. Forms shall be removed only after the grout has cured sufficiently and upon specific permission from the County.

E. COMPLETION

Upon acceptance by the County and the equipment manufacturer's representative and after the grout has reached sufficient strength, grout forms and block outs at leveling positions shall be removed. Leveling blocks and shims or wedges and support plates shall be removed, leveling nuts and jack screws shall be backed off to allow the grout to fully support the baseplate, mounting block, or soleplate. Take care not to damage the grout during removal of extended shimming material or leveling equipment and tools.

The equipment anchor nuts shall be tightened, using calibrated indicating

torque wrenches, to develop the full clamping force required by the equipment manufacturer.

Equipment anchor nuts shall be tightened in increments of not more than 25 percent of the final torque value in an alternating pattern to avoid stress concentration on the grout surface. After tightening equipment anchor nuts to final values, apply additional wax, grease, or mastic to all exposed portions of the equipment anchor beneath the baseplate, soleplate, or mounting block.

After applying additional wax or mastic to exposed portions of equipment anchors, block outs (pockets) for access to leveling nuts, leveling blocks and shims, or wedges shall be filled with the grout material installed under baseplates or mounting blocks and pointed after the equipment anchor nuts have been tightened to final values. Jackscrews shall be removed and holes in the baseplate or mounting blocks filled with a flexible sealant (silicone rubber) or a short cap screw.

Check for baseplate or mounting block movement (soft foot) by individually loosening and re-tightening each equipment anchor. Vertical movement at each equipment anchor shall be measured and recorded during loosening and retightening and shall not exceed 20 micrometers (0.001 inch). Vertical movement shall be measured using a magnetic-based dial indicator on the baseplate or mounting block referenced to the epoxy grout surface of the equipment pad or other approved method. Soft foot conditions shall be sufficient cause for removal and reinstallation of grout and baseplates or mounting blocks.

Check for grout voids by tapping along the upper surfaces of the baseplate or mounting block. Grout voids shall be sufficient cause for removal and reinstallation of grout and baseplates or mounting blocks. Grout voids shall be marked. At the discretion of the County, grout voids may be repaired as specified in Chapter 5, Section 3.16 of API 686.

3.04 FINAL INSPECTION

The County will conduct a final inspection with the Contractor for conformance to requirements of the contract documents.

END OF SECTION

SECTION 11025

BELT FILTER PRESS REFURBISHMENT

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies rehabilitation of two (2) existing Ashbrook belt filter press (BFP) at the North Wastewater Reclamation Facility (Manatee NWRF).

NWRF: Two (2) Alfa Laval Inc. Klampress BFPs 2.0 meter Type 809- 85

The scope of the work for the units scheduled for rehabilitation includes dismantling, transportation to the manufacturer's facilities, complete mechanical and electrical rehabilitation including instrumentation and controls, transportation back to the NWRF, installation and startup. The belt filter press manufacturer shall also design and provide three (3) washwater booster pump suitable for the belt filter press operation.

The manufacturer shall review the mechanical layout drawings and visit the plant facilities to familiarize themselves with the location and the set-up of the equipment specified and shall assure themselves that the specified scope of the work is appropriate for and coordinated with what is shown on the contract drawings. The manufacturer shall also review the relevant electrical plan and one-line diagram and the relevant process and instrumentation diagram drawings to ensure that the contract drawings are appropriate and coordinated with the equipment and controls specified.

B. EQUIPMENT LIST:

Description	Equipment No.
BFP 1 refurbished	NR85-BFP-101
BFP 3 refurbished	NR85-BFP-103

C. PERFORMANCE REQUIREMENTS:

The equipment supplied shall be capable of operating under the following operating conditions after refurbishment and as such replacement parts during refurbishment shall be carefully selected such that these operating conditions may be met.

After the refurbishment, the BFPs shall dewater waste activated sludge with a solids concentration between 1 to 3% solids by weight. The solids concentration in the dewatered cake coming from the BFP's shall be a minimum of 15% by weight.

At minimum, the specified equipment shall be able to perform thickening and dewatering operations at the above stated input conditions and output conditions and the following loading rates.

Equipment	Hydraulic Loading Rate (gpm/m)		Solids Loading Rate (lb/hr/m)	
	Average	Peak	Average	Peak
Belt Filter Presses	100	250	500	800

D. CHARACTERISTICS:

The existing equipment shall be refurbished with the following mechanical and electrical characteristics.

Drive Motor Data:	
Quantity per Machine	1
Maximum Horsepower, HP	3
Power Requirements, Vac/phase/frequency	460/ 3/ 60
Rated Speed, rpm	1740
NEMA Design	B
Insulation Class	F
Enclosure (Motor Section 11060)	Type 2 (TEFC)
Service Factor	1.15

E. SERVICE CONDITIONS AND ENVIRONMENT:

F. SERVICE CONDITIONS:

1. ENVIRONMENTAL CONDITIONS: The sludge belt filter presses will be located in the NWRF dewatering building. The press will be mounted on an existing raised concrete curb arranged to form a drainage sump directly beneath the press. The press will be subjected to frequent hose down for cleaning purposes. The temperatures within the press room may be expected to range between 15- and 110-degrees F; relative humidity will range between 50 and 100 percent.

   It may be expected the material discharged to each press will be in an actively digesting state, and small quantities of digester gas may be present. The gas is expected to contain methane in concentrations of up to 70 percent, with the remainder comprised of principally carbon dioxide with up to 2000

parts per million hydrogen sulfide and trace quantities of nitrogen. While it is very unlikely explosive concentrations of methane will be present in the room atmosphere, the Contractor is advised that corrosive agents (moisture, hydrogen sulfide gas, sulfuric acid, etc.) will be present at all times. Accordingly, materials shall be selected to provide appropriate resistance to corrosion and every effort shall be exercised in the manufacture of the equipment to eliminate crevices, unsealed overlapping plates and similar inaccessible areas where corrosion can take place without allowing access for application of preventive measures.

2. CONTROLS: The press, along with the associated sludge and polymer pumps, will be operated at a variable rate to optimize combinations of feed rate, polymer addition and belt speed for various conditions of sludge concentration, organic/inorganic solids percentage and other characteristics. Control of individual operational speeds for the press and pumps shall be through master/slave speed adjustment devices located on the press control panel.

3. UTILITY SERVICES: Each belt filter press shall be equipped with individual belt wash stations for both the upper and lower belts. Each station shall consist of a spray pipe, fitted with spray nozzles, contained within a fabricated housing which encapsulates a section of each belt. The housing and nozzle assembly shall be readily removable.

   Nozzle spacing, and spray pattern shall be such that the sprays from adjacent nozzles overlap one another at the belt surface. Individual spray nozzles shall be replaceable.

   The housing shall be sealed against the belt with rubber seals. The spacing between the upper and lower housing shall be adjustable to insure continuous contact between the seals and belt. The seals shall be replaceable without disassembly of the wash station.

   Each belt wash station shall be furnished with a drain valve having an external handwheel to which is mounted a stainless-steel cleaning brush located inside the spray pipe. One full turn of the handwheel shall cause the brush bristles to enter each spray nozzle, and dislodge any solid particles which have accumulated, open the valve and allow the solids particles to be flushed into the drainage system.

   Each belt filter press shall be provided with a 1 1/2 inch female pvc connection for belt wash water with a motor operated valve to control the flow of the washwater between the washwater booster pump and spray system of the belt filter press. The cost of all appurtenances required to conform the booster pump motor operated valve installation to the standards for this project shall be considered unit responsibility required by the

Manufacturer of the belt filter press and borne by the Contractor. Water consumption shall not exceed 90 gallons per minute. Water for cleaning sprays will be strained plant effluent, which is expected to contain up to 10 mg/l chlorine, small quantities of biological floc and dilute concentrations of industrial solvents.

Polymer, in diluted solution form, will be pumped to the press polymer/sludge mixing section by a variable speed, positive displacement pump located as specified, and enter downstream of the Klampress.

Power for motors 1/2 horsepower and larger will be provided at 480 volts AC, 60 Hz, 3 phase. The maximum recommended belt speed for performance in accordance with paragraphs 11622-1.02 C and 1.02 D shall correspond to operation of the drive motor at 480 volts AC, 60 Hz.

4. APPLIED SOLIDS: Waste sludge from the treatment process will be pumped to the press by a dedicated, variable speed positive displacement feedstock pump located as specified. The sludge is expected to contain quantities of industrial wastes including solvents, petroleum products, grit, hair, rags, grease, rubber goods, and organic solids in concentrations ranging from 0.5 to 5 percent.

   Sludge delivered to the press will have a temperature of 55 to 95 degrees F and will have a pH which may range from 5 to 8.

F. RELATED SECTIONS AND PARAGRAPHS:

The equipment specified in this section shall be provided in accordance with the following additional sections and paragraphs. This is not a comprehensive list of related and referenced sections and paragraphs and additional related and referenced sections and paragraphs requiring compliance may be specified throughout this section and within other sections. This list is provided as a convenience for the Contractor. Related and referenced sections shall be reviewed and submittal information provided as required in paragraph 1.03 of this section.

- 11000 General Requirements for Equipment
- 16176 Control Panels
- 17010 Control Specifications

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ISO 9001: 2000	Industrial Quality Standards
ASTM A36-77a	Structural Steel
ASTM A48-76	Gray Iron Casting
ASTM A123	Hot Dip Galvanizing
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D2240	Standard Test Method for Rubber Property—Durometer Hardness
ASTM D2794	Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D789	Standard Test Method for Determination of Relative Viscosity of Polyamide (PA)
ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
ASTM D624	Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D676	Standard Test Methods for Film-Insulated Magnet Wire
AFBMA std 11-1978	Anti Friction Bearing Manufacturers Association (AFBMA) standards the standard for load ratings and fatigue life for roller bearings

Reference	Title
ASTM D1785-04a	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D6712-01	Standard Specification for Ultra-High-Molecular-Weight Polyethylene (UHMW-PE) Solid Plastic Shapes
ASTM A276-04	Standard Specification for Stainless Steel Bars and Shapes
AISI Standards	American Iron and Steel Institute Standards
ASTM A564	Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM 484	Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings

B. UNIT RESPONSIBILITY:

The Contractor shall assign unit responsibility as specified in paragraph 11000-1.02 C to the belt filter press manufacturer for the equipment specified in this section, including the replacement of the washwater booster pumps and associative motor operated valve. A certificate of unit responsibility shall be provided.

C. EXTENDED LIMITED WARRANTY:

The Contractor is not allowed to supply equipment other than the named manufacturer. The warranty shall bind the equipment manufacturer and shall be backed by a performance and maintenance bond in the amount of 150 percent of the cost of the equipment. An irrevocable letter of credit, drawn on a U.S. government-insured banking institution, may be substituted for the specified bond. The warranty must be supplied to the Owner by the Contractor prior to start-up of the equipment and must be in a form acceptable to the Owner. The warranty shall be limited to all direct costs, including labor, and consequential costs relating to any required remedy, including replacement of the equipment, associated with failure of the equipment to perform as specified, a demonstrated belt filter press belt life lower than that specified, consistent failure of bearings, or failure of the structural frame or rollers. Warranty-related costs arising out of premature replacement of components and belts will be calculated upon a present worth basis to derive the additional costs due the Owner because of additional costs for operating the equipment. The present worth calculation will be based upon the Owner's cost of funds at the time the calculation is performed. The warranty shall cover the period during initial start-up and testing and from the date of expiration of the Contractor's guarantee for period of 365 days to allow for evaluation of belt life and structural and roller integrity over a period of 5 years. The direct and consequential costs of reduced belt life will be extended to cover the full 20-year lifetime of the machine; however, such costs will

be reduced to reflect the value of invested monies. All costs of a major failure of structural frame or rollers shall be covered.

1.03 SUBMITTALS

The following information shall be submitted in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked *"no changes required"*. Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

3. Certificate of Unit Responsibility attesting that the Contractor has assigned, and that the manufacturer accepts, unit responsibility in accordance with the requirements of this Section and paragraph 11000-1.02 C. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.

4. Drawings showing the entire belt filter press assembly, including material list and description of all components, structural members, auxiliary items and devices, and anchoring details. Anchoring details shall be submitted and

be signed and sealed by a Professional Engineer licensed in the State of Florida. The seal provided must be from the State of Florida.

5. Detailed installation drawings, showing the size and location of all equipment, piping, electrical, instrumentation and structural connections.

6. Details of any additional equipment, structural items, and devices required to conform to the layout shown on the contract drawings.

7. Motor data as specified in paragraph 11060-1.03.

8. Proposed on-site testing and start-up procedures.

9. Training course outline and proposed class materials per paragraph 11622-3.03.

10. Control panel submittal requirements listed in Section 16176 and 17110.

11. Product information including manufacturer, pump curve, single line diagrams, electrical requirements, and proposed operating points regarding the provided booster pump.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

The supplier of the refurbishment of the belt filter presses shall be Ashbrook, no equals are accepted.

2.02 MATERIALS

A. GENERAL:

The materials used for the specified equipment shall have following characteristics.

Component	Material
Frame	Steel, ASTM A36, hot-dip galvanized or ASTM A320, stainless steel
Splash guard	ASTM A320, stainless steel, Type 316LT
Drum rollers	ASTM A320, stainless steel, Type 316L
Rollers	Steel tube, ASTM A-36, 3/4-inch minimum coated with Buna-N, neoprene, nylon or Teflon

Component	Material
Roller shafts	ASTM A572 Grade 50 Type 2
Hydraulic piping	ASTM A320, stainless steel, Type 316
Plows and sludge distribution equipment	ASTM A123, carbon steel hot dip galvanized,
Belt filter cloth	Monofilament polyester
Belt seam closures (for seamed belts)	ASTM A320, Type 316, stainless steel
Spray headers	ASTM A320, Type 316, stainless steel
Spray nozzles	ASTM 320, Type 316, stainless steel
Drainage pans	ASTM A320, Type, 316L, stainless steel
Internal pressure piping	ASTM A320, stainless steel, Type 316
Drains	Schedule 40 PVC or ASTM 320, Type 316
Anchor bolts and miscel-laneous hardware, including the bolts, nuts and washers	ASTM A320, Type 316 stainless steel

2.03 CORROSION PROTECTION

The mild steel frame members and related components shall be protected by both hot dip galvanizing and a top-coating system of industrial grade epoxy-based paint. Hot-dip galvanizing shall be in accordance with manufacturers recommendations after fabrication. No cutting, welding, drilling, or punching will be permitted on any portion of the frame after galvanizing.

The epoxy coating system shall conform to Coating System E-2 as specified in Section 09900.

Alternatively, the frame may be protected by fusion applied epoxy, AWWA C213. The epoxy system shall be applied after fabrication. Flame-sprayed application of the zinc coating will be permitted as long as the weight of the zinc coating conforms to applicable portions of ASTM A123. No cutting, welding, drilling, or punching will be permitted on any portion of the frame after galvanizing.

2.04 EQUIPMENT FEATURES

A. ASHBROOK KLAMPRESS BFP REFURBISHMENT:

1. SLUDGE CONDITIONING SYSTEM: Each BFP shall be provided with a sludge conditioning system, designed to efficiently mix polymer with the sludge and to adequately condition the sludge, for optimum thickening. The sludge conditioning system shall include the existing polymer injection rings, existing static mixers and new ¼" thickness SS 316 flocculation tanks as shown on the drawings. The polymer injection ring and static mixers shall be installed up stream of the flocculation tank as shown on the drawings.

New flocculation tanks shall be provided as shown on the drawings. The flocculation tanks shall be located and installed per specified manufacturer's recommendations such that it does not obstruct maintenance activities on the BFPs. The structural supports for flocculation tanks shall 316 SS and completely independent of the BFP structural frame or walkways. The structural supports for flocculation tank shall safely secure and support the flocculation tank from the floor in desired location. The flocculation tanks shall be provided with removable 316 SS covers. The covers shall have sufficient cut out opening to mount mixers on the tanks.

2. STRUCTURAL MAIN FRAME AND STAINLESS STEEL COMPONENTS: The structural main frame and all other galvanized structural components and all carbon steel painted components shall be cleaned and hot dipped galvanized to a 4-7 mills minimum thickness. No welding shall be done after the frame and components have been galvanized.

The galvanized coating shall be warranted for a period of three years from the date of start-up, not to exceed three and a half years from date of delivery. The frame shall not require preventive maintenance during the warranty period. Any defects or corrosion occurring within the warranty period shall be repaired or replaced at no additional cost to the Owner.

All existing stainless-steel machine components, which are not being replaced, shall be cleaned to remove any impurities.

3. GRAVITY DRAINAGE SECTION: New poly wear bars shall be installed in the existing gravity drainage grid. New chicane blades and 316 stainless steel locking collars shall be installed in the gravity section. All hardware shall be 316 stainless steel. New chicane rods, chicane rod support castings and side supports shall be fabricated from A36 carbon steel then hot dipped galvanized. New rubber seal material shall be installed on the sludge restrainers in the gravity section.

New 316 stainless steel level baffle shall be installed which meets the latest original manufacturer equipment design. Assembly shall improve sludge distribution and increase belt life.

Existing wedge plate assembly shall be reconditioned and updated to the latest original equipment manufacturer design standards. All existing nylon coated wedge plate components shall be recoated. Existing cross adjusting bars shall be replaced with the latest O.E.M. design standards.

4. ROLLERS: Rollers shall be reconditioned by complete removal of existing coating and providing recoating as specified per Section 2.02. The existing coating shall be machined off to true roller diameter prior to applying new coating.

All solids rollers except drive rollers shall be recoated with 25 mils of Thermoplastic nylon, as specified per Section 2.02. The rollers shall be coated up to the point of insertion into the bearing block. The drive roller shall be recoated with 1/4" Buna-N rubber, as specified per Section 2.02. Perforated dandy roller shall be sandblasted, cleaned and shall have a new improved thicker design outer skin meeting the latest O.E.M. design standards.

5. BEARINGS: The existing bearing assemblies shall be reconditioned as follows:

a. The bearing housing shall be cleaned and recoated. Bearing housings shall be coated with 8-12 mils of thermoplastic nylon (Rilsan), as specified per Section 2.02.

b. New bearing shall be installed with machined brass retainer

c. All bearing internal components ie., seals, spacers, taper lock nut assembly, etc. shall be replaced. All new internal bearing components must meet the original design specifications.

Bearings supporting the steering rollers shall be non-self aligning cylindrical roller bearings in pivot mounted pillow block housings. All other rollers shall be supported by self-aligning spherical roller bearings mounted in fixed pillow block housings.

All bearings shall have a minimum L10 bearing life of 500,000 hours, calculated by using the ANSI/AFBMA, Std 11-1978, standard with 1.15 capacity modification factor per ISO recommendation. The L10 life shall be based on the summation of forces applied to the bearings from roller mass forces and belt tension on the rollers. The belt tension forces exerted on the pressure zone rollers shall include a minimum load of 200 pounds per lineal inch of belt width, which equates to a belt tension of 50 psi. Certified calculations, based on the AFBMA/ISO capacity formula, showing that all bearings comply with the specified requirements for minimum L10 bearing life, at maximum loadings, shall be submitted per Paragraph 1.03.

Recoated bearing housings shall be class 30 cast iron with four mounting bolts and four cap bolts. The outer side of the housing shall be solid, without end caps or filler plugs. The housings shall be designed with an integrally cast water trough which, when shrouded by a shaft mounted water flinger, shall divert water from the bearing seal area. The housings shall be cleaned, iron phosphate treated, and coated as specified per Section 2.02.

The bearing seal in the pillow block housing shall be of nonmetallic construction with a carrier/flinger which rotates with the roller shaft. A static sealing arrangement between the carrier/flinger and the shaft shall be a triple rubber seal, constructed in a manner that prevents relative rotation between the seal and the shaft. A dynamic sealing arrangement between the carrier/flinger and the bearing housing shall consist of a primary dynamic contact seal of ozone resistant rubber which shall seal by rotational contact with a machined housing surface. A secondary dynamic seal shall be a labyrinth seal between the carrier/flinger and the bearing housing

which utilizes a nonmetallic retaining ring to hold the seal assembly in position within the housing.

Bearing lubrication shall be performed through a monel or type 316 stainless steel button head grease fitting mounted on the bearing housing. All bearings shall be outboard (externally mounted) and shall be greaseable while the unit is in operation. Lubrication shall not be required more often than once every six months.

The specified manufacturer of the BFPs shall warrant the complete bearing assembly, as specified herein, for a period of five years from the date of start-up, or acceptance of the equipment, whichever occurs first. The warranty shall include all parts for repairing or replacing any bearing assembly part that fails during the warranty period.

The worn tensioning yoke bearings sleeves shall be replaced with new teflon sleeves meeting the latest original equipment Manufacturer's maintenance free design. No greasing of sleeves shall be required.

6. BELT WASH SYSTEM: The existing upper and lower washtube shall be replaced. The new washtube shall consist of new 316 stainless steel inner cleaning brush, new 316 stainless steel spray nozzles and retainers. The inner brushes shall be replaced with the latest original equipment manufacture design brushes with replaceable brush segments for ease of maintenance. New 316 stainless steel spray nozzles and retainers shall be installed on the new washtubes.

The existing upper and lower washbox shall be replaced with new O.E.M. latest design washboxes. New washbox shall have removable sides for ease of replacement of rubber seal material. New washbox shall be fabricated from 10-gauge, 316 stainless steel. New carbon steel galvanized mounting brackets shall be provided to mount washbox to existing mounting holes.

7. HYDRAULIC SYSTEM: The existing hydraulic system shall be replaced. New hydraulic system shall be with 316 stainless steel steering valve assembly, tensioning valve, rigid tubing, fittings, flexible hoses, tensioning and steering cylinders..

The steering valve shall be provided with a 316 stainless steel paddle weldment with ceramic wear pad which rides on the edge of the belts to detect their position.

The existing hydraulic cylinders shall be replaced with the latest O.E.M. fiberglass steering and tensioning cylinders. New hydraulic cylinders shall have fiberglass outer casing, laminated phenolic heads, stainless steel tie rods and 316 stainless steel piston rods. Operating pressure of fiberglass cylinders shall be rated at 750psi.

The new steering valves and tensioning valve shall be warranted for a period of 5 years against defects in workmanship and operations but not due to damage resulting from neglect or misuse.

8. ELECTRICAL SYSTEM: The worn electrical system shall be replaced with new electrical system. New electrical system to consist of belt limit switch, belt breakage

proximity switches, no-cake proximity switch, emergency trip cord switch, 316 stainless steel junction box and wiring/fittings. All items on the electrical system shall be corrosion area rated with NEMA-4X enclosures.

9. DISCHARGE BLADES: New discharge blades shall be provided to scrape the thickened sludge from the belt at the final discharge rollers. The blades shall be of UHMW polyethylene construction and shall be readily removable.

10. DRAINAGE PANS: The existing 316 stainless steel drainage pans shall be cleaned and sandblasted. New drainage piping (SCH40 PVC) shall be furnished, adequately sized for the intended service, and rigidly attached to the press frame. The collected water in the drainage pans shall discharge directly into the sump via the drainage piping. There shall not be any dripping or splattering of water from the drainage pans. The drainage piping shall be provided with blind flanged T-connections at every bend to allow for cleaning. Drainage piping shall terminate inside the structural frame at the bottom of the press. Drain connection shall be self-venting to prevent overflow. Drainage pans shall be located such that the moving belts do not come into contact with the pans under any conditions.

11. BELT DRIVE GEAR SYSTEM: Existing platform mount belt drive gears shall be replaced meeting the latest O.E.M. design standards. New belt drive gear system shall consist of (2) two bull gears, (2) two bushings and (1) one pinion gear.

12. DISCHARGE CHUTES: Existing cake discharge chutes shall be replaced with new ¼" thick 316 stainless steel discharge chutes. Chutes shall have at least 12-inch high side walls to prevent cake splatter on the side. The chutes shall be bolted on the BFP unit and shall be independent of the receiving belt conveyor frame. All mounting hardware shall be 316 stainless steel. The chutes shall be installed at an angle such that it facilitates the movement of cake and the cake is discharged in the middle of the receiving conveyor belt trough. The chute shall have rigid support system and the discharge angle shall not change due to cake loading. The final angle of discharge shall be field adjusted per manufacturer's recommendations to discharge cake in the belt conveyor.

13. DEWATERING BELTS: Each BFP shall be supplied with a new set of dewatering belts. Belts shall be fabricated of monofilament polyester and shall have 316 stainless steel seams. The mesh design shall be selected for optimum dewatering of the sludge to be processed.

Belt selection shall be based on the manufacturers experience obtained from testing the sludge during start-up of the belt filter press and at other installations dewatering similar anaerobically digested sludge with similar polyelectrolyte (polymer) conditioning chemicals.

Each belt and connecting seam shall be designed for a minimum tensile strength equal to five times the normal maximum dynamic tension to which the belt shall be subjected. The seam shall be designed to fail before the belt.

Belts shall have a width as hereinbefore specified and shall have a minimum life

warranty of 2,000 hours operation at the rated design conditions. The Manufacturer shall prorate the charge for replacement belts, based on the total number of hours of operation since the belt filter press was placed into useful service.

Belts shall be designed for ease of replacement with a minimum of belt filter down time. Belt replacement shall be such that disassembly of the equipment is not required.

14. HYDRAULIC POWER UNIT: The existing free-standing 20 gallon hydraulic power unit shall be upgraded with the latest original equipment Manufacturer (O.E.M.) press mount hydraulic unit.

Each belt filter press shall be provided with a dedicated hydraulic power system to provide pressurized oil for the steering and tensioning. The unit shall consist of a one-gallon reservoir; variable-displacement pressure compensated hydraulic oil pump and drive motor, hydraulic oil filter (reusable), pressure gauges, piping and valves to make a complete operational system.

The pump, motor, reservoir, oil filter and valves shall be mounted directly to the belt press frame to minimize excess piping runs, fittings and hoses. All hydraulic lines shall be properly sized for the pressure and flow of the unit. Pressurized hydraulic lines shall be 316 stainless steel tubing and shall be rigidly supported on the structural frame of the press. The hydraulic reservoir shall be made of high-density polyethylene (HDPE) and shall be translucent to allow visual inspection of the oil level.

The pump motor shall be a 460Vac, 1-horsepower and shall not exceed a noise level of 70 DbA. The motor shall be a cast iron TEFC 1,200 rpm, NEMA B design with a "C" face mounting for the hydraulic pump adapter.

Maximum system pressure shall be set equal to the highest pressure required to obtain the desired operating belt tension. The maximum system operating pressure is 1,000 psi.

Hydraulic system controls shall be grouped for easy access and ease of operation. There shall be means provided to retract the belt tension cylinders for service. The valves, fittings, manifold and associated parts shall be of non-corroding materials such as FRP, glass filled Nylon and stainless steel.

The oil pressure gauges, one for each belt tension cylinders (upper & lower belt) shall indicate oil pressure in PSI and the belt tension in PLI. Normal operating limits shall be indicated on the face of each gauge. Low-pressure switches shall be provided to sense the absence of belt tension pressure.

15. BELT DRIVE UNIT: The existing DC belt drive system shall be upgraded with a new AC belt drive system meeting the following requirements.

Input power to the drive roller shaft shall be supplied through an A.C., adjustable frequency drive (AFD) unit. The AFD will be located in the Belt Press Main Control Panel. Speed

shall be controlled through cyclical variation in motor current which is operator set at the Belt Press Control Panel. The drive roller speed reduction is obtained through a helical gear reducer.

Drive Motor Data:	
Quantity per Machine	1
Maximum Horsepower	5 horsepower
Power Requirements	460 Vac, 3 phase, 60 cycle.
Rated Speed	1740 r.p.m.
NEMA Design	B
Insulation Class	F
Enclosure	TEFC
Service Factor	1.15
Special Features	Severe duty rating

The variable input power shall be transmitted through a helical bevel gear reducer connected to the drive roller. Drive unit shall be a SEW Eurodrive model type K87. The drive roller shall be surfaced with a Buna-N rubber coating to permit slip free transmission of driving torque to the belt.

2.05 SPARE PARTS AND SPECIAL TOOLS

A. SPARE PARTS FOR THE BELT FILTER PRESSES:

One set of any tools required for servicing belt filter presses shall be provided. In addition, the following spare parts shall be provided for each pair of presses:

1. Two complete sets, replacement belts

2. Doctor blades for both thickened and dewatered sludge, including all fasteners, brackets and appurtenances necessary for mounting on the press frame

3. Gravity, wedge and shower box seals

4. One complete set, water spray nozzles

5. One bearing of each size and type used on each machine and subassembly

6. One complete set, all belt positioning and tensioning devices

Spare parts shall be protected, labeled, and boxed in accordance with the requirements set forth in paragraph 11000-2.12. Special tools shall be Proto, or equal, with the name of the Owner engraved on each. Tools shall be furnished in a painted metal mechanic's toolbox

fitted with a lock hasp. The words "Belt Filter Press Tools" and the name of the Owner shall be neatly stenciled on the cover.

2.05 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Operation and maintenance information specified in Section 01730.
2. Electric motor manufacturer's standard overhaul instructions.
3. Manufacturer's Installation Certification Form 11000-A as specified in Part 3.
4. Manufacturer's Instruction Certification Form 11000-B as specified in Part 3.
5. Field test results for each equipment verifying specified operation and controls at various flow rates as specified in Part 3.

PART 3 – EXECUTION

3.01 REFURBISHMENT AND INSTALLATION

A. GENERAL:

The specified equipment requiring refurbishment shall be shipped offsite to the specified manufacturer’s facility for complete rehabilitation.

Prior to commencing any work in filter building the Contractor shall receive approval from the Engineer. The scheduling of the scoped work and related filter building shut down shall be approved by the Engineer. Once approved, the Contractor shall dismantle and remove existing access platforms, stairs, process piping, electrical conduits, instrumentation conduits associated with demolition as shown on the contract drawings. The Contractor shall retain the specified manufacturer to dismantle, load, transport, refurbish, reinstall and start up of the specified BFPs. The dismantling and reconstruction of BFP units shall only be done by the specified manufacturer’s authorized personnel.

The manufacturer shall coordinate with the Contractor the schedule of the dismantling, shipment and installation of the units in the filter building before and after the building renovation. The manufacturer shall ship the refurbished units as assembled as possible from the factory ready to be installed at the NWRF. The Contractor shall coordinate with the manufacturer to schedule of work in the filter building to facilitate removal and installation of the refurbished units. The Contractor shall level, anchor and grout all units as per the manufacturer’s recommendations.

Contractor shall coordinate the design and installation of the equipment specified in this section with the new belt conveyor equipment, to ensure smooth cake flow between conveying equipment and minimal splattering or spillage of sludge cake. Contractor is cautioned to take special care during final installation of BFPs since some BFPs may require supports extended out from the containment to discharge cake in the receiving conveyor.

B. REMOVAL OF EQUIPMENT FROM NWRF:

Prior to commencing any work in the solids handling building at the NWRF, the Contractor shall receive approval from the Engineer. The scheduling of the scoped work and related solids handling building shut down shall be approved by the Engineer. Once approved, the Contractor shall dismantle and remove existing access platforms, stairs, process piping, electrical conduits, instrumentation conduits associated with the Ashbrook BFPs to be refurbished and relocated. All conduits shall be demolished to the nearest junction box. All process piping shall be demolished up to an isolation valve as necessary to facilitate removal of the equipment. The Contractor shall retain the specified manufacturer to dismantle, load, transport, of the specified BFPs from NWRF. The dismantling of BFP units shall only be done by the specified manufacturer's authorized personnel.

The manufacturer shall coordinate with the Contractor the schedule of the dismantling and shipment of the units from the solids handling building. The dismantled parts of the BFPs shall be removed out of solids handling building through the sludge hopper opening only. The manufacturer shall ship the refurbished units as assembled as possible from the factory ready to be installed at the NWRF.

The Contractor shall be responsible to repair any damage done to Owner's property during dismantling of ancillary equipment around BFPs. The Contractor shall bear all cost to repair the damage to match previous state.

3.02 SHIPMENT AND STORAGE

Equipment shall be shipped and stored in accordance with Section 01605.

3.03 TESTING

Testing of equipment and systems shall be conducted in accordance with the requirements of Section 01660.

3.04 TRAINING

A minimum of 6 hours of training for the BFPs, as specified in Section 01664, shall be provided. Training shall be certified on Form 11000-B specified in Section 01999.

END OF SECTION

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SECTION 11050

GENERAL REQUIREMENTS FOR CENTRIFUGAL
AND AXIAL FLOW PUMPING EQUIPMENT

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section, when referenced in the detailed specification section, provides minimum requirements applicable to centrifugal and axial flow pumping equipment furnished under this contract. More restrictive requirements, where found in individual pump specifications, shall supersede requirements of this section.

"Detailed pump specification", "detailed specification", "individual pump specification", "referencing section", or words of similar import in this section, shall mean the specification section where the requirements for specific pump performance are presented. "Pumping unit", whenever and wherever used, shall mean the complete pumping assembly, including driver (whether engine, turbine, or motor) and shall include all accessories such as variable speed drives required for motor operation, gear reducers, intermediate shafting and bearings, flywheels, and all supports for all equipment furnished with the pump.

A number of provisions of this section shall be required for a subset of pumps. These requirements (refer to Paragraphs 1.05 and 1.07.A, in this Section) are in addition to requirements applicable to all pumps. The subset of pumps is defined as pumping equipment meeting any of the following criteria:

1. All pumping unit specifications where the words "Custom Engineered" appear in the title of the specification section.

2. Where a particular Section 11050 provision is specifically cited in the detailed section.

B. DEFINITIONS:

The following definitions apply for classifying pumps specified in this and referencing sections:

1. GENERAL: Terminology and definitions in this Section follow those established in ANSI/HI 9.1 - 9.5, unless otherwise noted.

2. SOLIDS BEARING LIQUIDS: Liquids to be pumped containing, or assumed to contain, solids that require appropriate pump design

considerations and/or materials of construction. Solids Bearing Liquids are liquids with settleable solids exceeding 50 mg/L and shall include wastewater, stormwater, primary effluent, return sludge, return activated sludge (RAS), trickling filter circulation, and similar services.

3. CLEAR LIQUIDS: Liquids to be pumped generally free of deleterious solids. Clear Liquids shall include potable water, heat reservoir, raw water, secondary effluent pumping, and similar services.

4. EFFICIENCY: For the purposes of this section and sections referencing this section, efficiency, as related to pumps, shall be the ratio of the pump output power (water horsepower) divided by the pump input power (brake horsepower) required to deliver the total head, with meanings as defined in HI 1.2.3.8 and 2.2.3.8. For column type pumps, it shall be computed inclusive of inlet, bowl, column and discharge head losses.

5. NET POSITIVE SUCTION HEAD – 3 PERCENT REDUCTION (NPSH3): For the purposes of this section and sections referencing this section, NPSH3 shall mean the value of net positive suction head resulting in a reduction of 3 percent in the developed pump discharge head when the pump is tested in accordance with procedures established by the Hydraulic Institute. NPSH3 is the successor designation to NPSHR (net positive suction head required). Where NPSHR is used in the Contract Documents it shall be taken to mean NPSH3.

6. NPSH MARGIN: For the purposes of this section and sections referencing this section, “NPSH Margin” wherever used shall mean Net Positive Suction Head Available (NPSHA) divided by the candidate pump’s Net Positive Suction Head-3 Percent Reduction (NPSH3) for the specific operating condition in question.

7. PACL: For the purpose of this section and sections referencing this section “PACL” Wherever used shall mean Pump Application Capacity Limits and is used in these specifications in lieu of the terms Preferred and Allowable Operating Region. PACL is defined in terms of percentage Best Efficiency Flow (BEPQ) to define the margins (based upon suction specific speed) that respectively identify the minimum and maximum flows defining acceptable performance regions for pumps covered by this specification section and any specification section referencing this section. Refer to paragraph 11050-1.04 B. 4.

1.02 TYPE

Provisions and requirements contained in this section apply specifically to centrifugal and axial flow pumps, both vertical and horizontal, commonly falling into the generic types covered by ANSI/HI 1.1 through 1.4 and 2.1 through 2.4. This section does not apply, except by specific reference, to positive displacement pumps of any type.

1.03 REFERENCES

This section (Section 11050) contains references to the following documents. They are a part of this section and any referencing section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section or any referencing section and those of the listed documents, the following order of precedence shall prevail (in the order of primacy):

1. The referencing section.
2. This section.
3. The referenced document.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
AISC	American Institute of Steel Construction –Manual of Practice
ANSI/API 610	Standard for Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
ANSI/ASME B46.1	Surface Texture, Surface Roughness, Waviness and Lay
ANSI/HI 1.1 – 1.4	Rotodynamic (Centrifugal) Pumps
ANSI/HI 2.1 – 2.4	Rotodynamic (Vertical) Pumps
ANSI/HI 9.1 – 9.5	Pumps – General Guidelines
ANSI/HI 9.6.2	Centrifugal and Vertical Pumps for Allowable Nozzle Loads
ANSI/HI 9.6.4	Centrifugal and Vertical Pumps. Vibration Measurements and Allowable Values
ANSI/HI 9.8	Pump Intake Design
ANSI/HI 11.6	Submersible Pump Tests

Reference	Title
ANSI/HI 14.6	Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
API 686/PIP RElE 686	Recommended Practices for Machinery Installation and Installation Design
ASME B18.8.2	Taper Pins, Dowel Pins, Straight Pins, Grooved Pins, and Spring Pins (Inch Series)
ASME Code	ASME Boiler and Pressure Vessel Code
ASTM A27	Steel Castings, Carbon, for General Application
ASTM A36	Carbon Structural Steel
ASTM A148	Steel Castings, High Strength, for Structural Purposes
ASTM A322	Steel Bars, Alloy, Standard Grades
ASTM A564	Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A571	Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service
ASTM A995	Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts, Grades 2A, 3A, or 6A
ASTM B148	Aluminum-Bronze Sand Castings
AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
AWWA C550	Protective Epoxy Coatings for Valves and Hydrants
NSF/ANSI 61	Drinking Water System Components – Health Effects
IEC 61298-2	Process Measurement and Control Devices. General Methods and Procedures for Evaluating Performance Tests Under Reference Conditions
ISO 9001	Quality Management Systems – Requirements, 3rd Ed. (2000)
ISO 10816-1	Mechanical Vibration—Evaluation of Machine Vibration by Measurement on Non-rotating Parts—Part 1: General Guidelines, Annex B, Table B.1. Zone A, Class I, II or II, as applicable. For the purposes of this specification, Annex B of ISO 10816, Part 1 shall form a part of this specification and ISO 10816, Part 1.
ISO 10816-7	Mechanical Vibration—Evaluation of Machine Vibration by Measurement on Non-rotating Parts—Part 7: Rotordynamic Pumps for Industrial Applications, Including Measurements on Rotating Shafts, Annex A, Tables A-1 and A-2 as applicable. For the purposes of this specification, Annex A of ISO 10816, Part 7 shall form a part of this specification and ISO 10816, Part 7.

Reference	Title
MIL STD 167-2	Mechanical Vibrations of Shipboard Equipment (Reciprocating Machinery and Propulsion System and Shafting)
Corbo and Malanoski, 1996	Practical Design Against Torsional Vibration, 25th Turbomachinery Symposium, Turbomachinery Laboratory, Texas A & M University, p. 186 – 222
Corbo and Malanoski, 1998	Pump Rotordynamics Made Simple, Pumping Technology, June 1998, p. 202 – 236

1.04 DESIGN REQUIREMENTS – ALL PUMPS:

A. GENERAL

Equipment furnished under all sections referencing this section shall conform to the requirements and objectives of paragraph 6.1, ANSI/API 610, unless specifically stated in this and the detailed specification section. All components associated with the rotating elements in the drive train, including equipment supports and supports for rotating elements, shall be selected and designed to function without damage or disassembly at reverse rotational speeds up to 150 percent of maximum operational speed during flow reversals through the pump. The complete pumping unit shall operate without overload on any component at any point along the pump's entire full-speed operating curve. Pumps required by virtue of the specified operating conditions to operate against a closed valve or throttled for any period of time exceeding five seconds shall be furnished with drivers sized to operate continuously at the power requirement for that condition even though the power requirements at the rated condition may be less.

With the exception of submersible pumps and the inlet connection for pumps designed to operate in open forebays or wet wells, pump connection nozzles shall be designed for the loads and moments stipulated in ANSI/HI 9.6.2. Where ANSI/HI 9.6.2 does not cover a specific pump type or category, or where that document is silent on allowable nozzle loads or a particular type of nozzle load (e.g. thermal pipe strain), the Contractor shall furnish documentation from the manufacturer attesting to the limitations on loads and moment forces that can be tolerated on each connection and recommended connection details to be used.

B. PUMP SELECTION

1. PROVEN DESIGNS: Pumps furnished under all sections referencing this section shall be proven designs that shall have been in service under similar conditions of service with no objectionable performance characteristics for a period of not less than five years. The Contractor shall furnish a detailed list, duly signed by an officer of the pump

manufacturer's corporation and notarized, of installations with contact information supporting qualification under this requirement with the information required under paragraph 11050-1.08. In order to satisfy this requirement, listed pump shall be of the same size volute or bowl, discharge case and nozzle size, impeller design (including number of vanes) and shall be operating under similar conditions of pumped fluid, head, capacity, speed, rotation, and Net Positive Suction Head Available (NPSHA).

The Contractor may propose equipment that cannot meet this requirement only under the following conditions:

a. The proposed design has been in successful operation under similar conditions of volute or bowl, discharge case and nozzle size, impeller design (including number of vanes), pumped fluid, head, capacity, rotation and NPSHA, but at a higher speed for a period of not less than three years;

or

b. The proposed design has been in operation in designs where both larger and smaller nozzle size pumps have been in service for a period of not less than five years, and impeller design (including number of vanes), pumped fluid, head, capacity, speed and NPSHA are similar to that for the proposed installation. Under no circumstances will an existing pump design operating at a higher speed than those currently in service in similar applications be considered.

If the proposed pump qualifies under either exception (a. or b.), the Contractor shall demonstrate, by operation of a test pump in a fully equipped hydraulic test facility, that the proposed pump in the size and at the speed proposed, with the proposed impeller design will have acceptable operating characteristics under the conditions specified for the proposed installation. The test pump shall be set up and a witnessed demonstration shall be performed prior to designing, fabrication and testing any of the equipment proposed for the specific installation.

2. GENERAL PERFORMANCE CRITERIA: Pumps furnished under this section and any referencing section shall operate without loss of head due to cavitation or vibration over the entire specified range of flow and head conditions and shall be specifically selected for NPSH margin requirements detailed in paragraph 11050-1.04.F. Pump selections which do not provide the specified margin will be rejected.

3. GENERAL DESIGN CRITERIA: All pumps furnished under sections referencing this section shall be designed in accordance with applicable

portions of ANSI/HI 1.1 – 1.4, 2.1 – 2.4 and ANSI/HI 9.6.2 – 9.6.6 and the requirements of this section. The pumps shall be specifically designed to pump the fluid described in the detailed specification and shall operate without clogging or fouling caused by material in the pumped fluid at any operating condition within the range of service specified.

Unless otherwise noted or specified, pump head capacity curves shall slope in one continuous curve within the specified operating conditions. No points of reverse slope inflection capable of causing unstable operation will be permitted within the specified zone of continuous duty operation. Pumps with head/capacity curves with a reverse inflection are specifically prohibited if these characteristics will cause unstable operation within the specified range of operating conditions and where startup/shutdown conditions entail operation against a slow opening/closing valve.

Column type (vertical turbine, vertical column solids handling, and axial flow propeller and mixed flow) pumps shall have bells selected to provide an intake velocity of not less than 3.5 feet/second nor more than 4.0 feet/second when operating at the maximum specified flow or the flow resulting from the lowest specified operating head at maximum speed, whichever is the greatest ("peak flow"). Pump discharge column sizes shall be selected to limit the calculated average velocity at peak flow to no more than 12 feet/second. Pump discharge column sizes shall be selected to limit the calculated average velocity at peak flow (Condition Point B, as defined previously) to no more than 12 feet/second.

Pumps specified to operate at variable speed shall function without loss of head due to cavitation or excessive vibration over the entire specified range of flow and head conditions defined by the region bounded by Condition Points A, B and C and any other continuous duty operating condition specified in the detailed specification referencing this section. The region shall be displayed as a cross-hatched area on a linear X-Y plot of the selected pump's variable speed performance curves plotted in 10 percent increments for the proposed maximum speed to the speed required to meet Operating Condition Point C or any other specified reduced speed operating condition, whichever is less. Unless otherwise specified in the section referencing this section, acceptance criteria shall include the following:

a. Operating Condition Points B and C shall reside within the region defined by the PACL limits set forth in this section for the proposed pump selection, based upon the pump's suction specific speed.
b. No more than 10 percent of the cross-hatched zone noted above shall reside outside the PACL limits set forth in this section for the proposed pump selection, based upon the pump's suction specific speed. Operating Condition A may reside in the area outside the PACL limits.

Pumps shall be shall be specifically selected for NPSH margin requirements detailed in paragraph 11050 1.04.F. Pump selections which do not provide the specified margin will be rejected.

4. PUMP APPLICATION CAPACITY LIMITS: (PACL): Pump selection for a given application shall be predicated on locating the specified most frequent operating condition(s) in the PACL. These points will always include Condition Points A and B and additionally will include any other Condition Points indicated in the detailed specification as continuous duty conditions, or any additionally specified for inclusion in the PACL. Condition Point A shall be the pump's rated condition and shall be guaranteed to meet both specified head and flow within the limit established in ANSI/HI 14.6, acceptance grade 1U.

A given pump's PACL shall be determined as a percentage of Best Efficiency Flow (BEPQ) at the given speed, the pump's suction specific speed as determined in accordance with ANSI/HI 1.3, paragraph 1.3.2.2 and the relationships presented in the following table.

Limiting Flow, percent Best Efficiency Point Flow (BEPQ)*

Suction Specific Speed, less than but not greater than:	Clear Liquid pumps, minimum limit	Clear Liquid Pumps, maximum limit	Solids Bearing Liquids Pumps, minimum limit	Solids Bearing Liquids Pumps, maximum limit
7000	50	125	70	125
8000	57	122	75	122
9000	60	120	80	120
10000	65	120	83	117
11000	68	110	85	112
12000	72	112	88	110
13000	78	110	91	110

* Straight line interpolation may be used for intermediate values of suction specific speed

Exceptions to the foregoing will be considered by the Construction Manager only when the Contractor can provide certified test data demonstrating conclusively a wider region of stable pump performance. The test data shall include suction pressure pulse information as well as actual service information for the same impeller design and trim, operating at the same speed, capacities and head for the same size pump as required for the specified application.

C. CRITICAL SPEEDS AND NATURAL FREQUENCIES

1. GENERAL: The criteria of this paragraph, 11050-1.04.C., apply to all pumps. Pumps exhibiting adverse field behavior from resonance, vibration or fatigue shall be repaired or replaced at no cost to the Owner.

The criteria shall apply to the equipment in like new condition as well as the as worn condition (i.e., when all parts, individually and as a composite, reach the manufacturers' maximum tolerances). Critical speed and natural frequency data submittal requirements depend upon the pump:

a. For the more critical pumps that are covered under paragraph 11050-1.05 the Contractor is required to submit analytical reports confirming requirements on critical speeds and natural frequencies prior to pump fabrication as specified in that paragraph.

b. Unless otherwise specified constant speed pumps and variable speed pumps with suction size less than 6-inch diameter – no critical speed submittal is required.

2. LATERAL ROTOR DYNAMICS: The complete pumping unit, including all related frames, supports, enclosures, and casings, shall be free from dangerous critical speeds from 20 percent below to 30 percent above the operating speeds required to achieve the specified performance characteristics. The logarithmic decrement for each damped natural frequency (forward or backward) shall be greater than +0.3, and the amplitude magnification factor shall not exceed 3, for any natural frequency within this range.

Process sensitivities are such that operation at infinitely variable speed within the specified operational conditions is an absolute requirement. Any remedy imposing a locked-out speed interval or intervals will not be considered an acceptable remedy for identified critical speeds. Acceptable remedies include combinations of adjustments in rotor geometry or materials, and the substitution of energy absorbing couplings. Other remedies may be considered so long as they are justified in writing and the proposal sealed and signed by the design professional retained by the manufacturer to perform the system mass elastic system analyses.

3. TORSIONAL AND COMBINED SHAFT STRESS: For constant torque applications, the pump rotor shall be free from torsional response which produces combined (steady plus alternating torque induced) stresses exceeding 30 percent of the material's elastic limit (but no more than 18 percent of the material's ultimate tensile strength) at any speed from 10 percent below to 20 percent above that required by the specified operating conditions, or during startup, shutdown or motor control transients.

For variable torque applications (including variable speed pumps, vertical pumps and pumps with large overhung loads) the pump rotor and any intermediate shafting shall be free from torsional responses which, in accordance with MIL STD 167-2, produce combined (torsional steady and alternating) peak shear stresses at points of stress concentration (calculated in accordance with the requirements of this section) that exceed 4 percent

of the material's ultimate tensile strength, nor more than 50 percent of the material's fatigue limit, whichever is less.

D. IMPELLER CLEARANCES, VANE PASSING FREQUENCY AND IMPELLER KEYWAYS

The radial clearance between the tip of the impeller vane and diffuser or volute vanes shall be not less than 3 percent and 6 percent, respectively, of impeller diameter. The ratio of liquid channel widths (diffuser or volute/impeller) shall be not less than 1.15 nor more than 1.3 for diffuser pumps and 1.4 – 1.5 for volute-type pumps. The pump shall be designed so that internal geometry shall not cause uneven flow distribution at impeller vane inlets.

Impeller vane combinations shall not be an even multiple of diffuser vanes in column type pumps.

Impeller keyways for multistage column type pumps shall be cut at differing positions and equal angular spacing on the impeller shaft to avoid multiple simultaneous vane passing pulses.

E. COMPONENT DESIGN CRITERIA

1. GENERAL: Unless otherwise specified, combined stresses in steel frames and supports shall not exceed those permitted by the AISC Manual of Practice. Combined stresses in cast, forged, rolled, or fabricated pressure retaining components, frames and supports shall not exceed that allowed for the given material in Section VIII, Division 1 of the ASME Code. Design pressures for pressure-retaining parts shall be not less than twice the pump's shutoff head at the manufacturer's listed maximum operating speed. Pump casing strain at any head on the full speed operating curve (including allowances for increases caused by specified multi-stage applications) shall not result in distortions at the bearing housings greater than the maximum allowable by the bearing manufacturer to provide the specified bearing life.

   The term "combined stresses" in this section shall mean the sum of all operating stresses, including stresses induced by dynamic and static forces as developed via the analysis procedures stipulated in this section. Static forces (x, y, z, and moments in all planes) shall include the relevant maximum nozzle loads specified in ANSI/HI 9.6.2 or as stipulated by the pump manufacturer. Dynamic forces shall include both steady state and transient stresses induced by operating conditions within the zone of operation established by the specified operating conditions.

2. ANCHORAGE AND EQUIPMENT MOUNTS: The Contractor shall cause the pump manufacturer to be responsible for the design of the

anchor bolting system and equipment supports for each separately mounted component furnished under the detailed specification. Anchorage and equipment support requirements for pumps shall conform to the requirements of Section 11002 and the standards of the Hydraulic Institute.

Anchor bolts and connecting bolts for all pumps and assemblies supported by other assemblies furnished under this section, or sections referencing this section, shall be designed in accordance with Section 01900. All operation and maintenance manuals for all pumps and assemblies shall contain criteria for anchor and baseplate bolt torque values.

Unless otherwise recommended by the equipment manufacturer, all pump discharge nozzles shall be restrained using the equipment connection fitting specified in Section 15085.

Equipment mounts for vertical (column and volute type) pumps weighing more than 1000 pounds, with discharge nozzles 6 inches in diameter and greater, shall employ soleplates conforming to the requirements of Section 11002. Soleplate mounting conforming to Section 11002 shall also be provided for all separately supported components in the pump drive system. Fabricated steel supports regardless of design and the nature of the structural shapes used for such proposed supports, will not be accepted.

Soleplates shall be designed to span openings for equipment connections and provide access to maintenance points. Soleplates shall be of sufficient section to key, not less than 1 inch, into the supporting grout provided for bonding the soleplate to the structure. Soleplates shall be of sufficient size to bolt the pump base to the soleplate and allow dowelling the pump base to the soleplate without encumbering the anchor bolts required for clamping the soleplate to the structure.

Equipment mounts for horizontal pumps shall be designed in accordance with Section 11002 and paragraph 7.3, ANSI/API 610 and shall provide common support for the pump and motor (and flywheel, if one is specified). Baseplate bolting shall conform to assumptions contained in ANSI/HI 9.6.2. Pump base shall be drilled and dowel pinned to the base plate in addition to bolting.

Tapered dowel pins shall be used to record the final position of all machine bases on soleplates or pump baseplates. Dowel pins shall be hardened and machine-ground conforming to the requirements of ANSI/ASME B18.8.2. Holes for tapered dowels shall conform to the requirements set forth in Appendix A of ANSI/HI B18.8.2.

3. TORSIONAL AND COMBINED SHAFT STRESSES: Shaft stresses shall be calculated using the following equation and the stress concentration factors in the table below.

$$S = S_{cf} \times \frac{G \times D \times \Delta_{\Theta}}{2 \times L}$$

where:

S = stress, psi

S_{cf} = stress concentration factor, dimensionless

D = minimum shaft diameter at point of concentration, inches

Δ_{Θ} = twist in shaft between adjacent masses, radians

L = effective length between masses, inches

G = shear modulus of shaft material, lb/in^2

The S_{cf}, to be applied at all the roots of all keyways and changes in shaft diameter shall be as follows:

S_{cf}	Ratio of fillet radius to shaft diameter
4.3	0.0025
3.7	0.01
3.05	0.02
2.75	0.03
2.6	0.04
2.55	0.05 and greater

Values of S_{cf} between data points in the table above shall be based upon a straight line interpolation.

4. SHAFT DEFLECTION: Pump shafts on volute type pumps shall be designed to provide sufficient stiffness to operate without distortion or damaging vibration throughout the range of service specified. Shaft deflection at the face (impeller side) of the shaft seal shall be limited to no more than 1.5 mils at any operating condition within the zone described by the specified continuous duty operating conditions. Deflection at the shaft seal shall be calculated as required by provisions set forth in paragraph 11050-1.05.B.5.c.

5. BEARINGS: Unless otherwise specified, anti-friction bearings for pumps shall be selected for a minimum L–10 life of 50,000 hours in accordance with ABMA 9 or 11. Anti-friction bearings for Custom Engineered pumps shall have bearings selected for an L–10 life of 100,000 hours in accordance with ABMA 9 or 11. Bearings for other elements in the rotating system such as motors, intermediate shaft bearings, and flywheel bearings shall be selected using the same criteria as specified for the pump. Bearing selection shall be based upon the worst combination of continuous duty operating conditions specified and shall include both steady state and transient loads. Calculations supporting the selection of bearing sizes shall be provided as Product Data.

6. BEARING ISOLATORS: Unless otherwise specified, all pump and motor bearings shall be fitted with bearing isolators, specifically selected for the size and type bearing. Bearing isolators shall be labyrinth, non-fretting type designed to expel contaminants by centrifugal force and prevent escape of lubricants. Vapor block capability shall be provided. Bearing seals shall be Inpro/Seal or approved equal.

7. PUMP SHAFT SEALS: Unless otherwise specified in the detailed specification, pump shaft seals shall be packing as specified in Section 11000.

F. NET POSITIVE SUCTION HEAD MARGIN LIMITATIONS

1. GENERAL: Pumps furnished under this section and sections referencing this section shall be selected for NPSH (Net Positive Suction Head) margin limitations using the criteria set forth in this section. Net Positive Suction Head Required - 3 Percent Reduction (NPSH3) characteristics for the candidate pump shall be based upon documented test data not more than five years old, performed on a pump not more than two nominal pump diameters larger or smaller than the proposed pump with an impeller of the same geometry as that proposed for the pump to be used for the subject application, and operating at the same speed as the pump for the proposed application. The Contractor shall document the basis for pump selection based upon NPSH margin limitations as set forth in this paragraph.

   The detailed specification sections provide NPSHA (Net Positive Suction Head Available) information for anticipated operating conditions for each application. This information is generally referenced to a specific elevation, stated in terms of project datum. It shall be the Contractor's responsibility to cause the pump manufacturer to adjust the NPSHA information in the specification section to the elevation of the pump impeller eye for the specific pump model and size proposed for the application. NPSH3, as used in the following paragraphs, shall mean the

NPSH3 at the impeller eye, determined in accordance with ANSI/HI 11.6 or 14.6, as applicable for the proposed pump. The Contractor shall cause the pump manufacturer to document the method used to determine NPSH3 for the proposed pump and justifying compliance with the NPSH margin limitations established under this paragraph for each specified operating condition in material submitted under paragraph 11050-1.08. The documentation shall include justification of the NPSH3 tests used to develop NPSH3 characteristics, including the following:

a. Date, test procedure, and test logs of original NPSH3 information used to project requirements for pump selected for the application.

b. Test pump size, impeller diameter, impeller model, eye diameter, and speed.

c. Calculations projecting NPSH3 test information to NPSH3 curve information for the pump proposed for the application.

d. Calculations demonstrating compliance with the NPSH margin requirements established in this paragraph.

The Contractor shall submit the manufacturer's margin calculations justifying the proposed pump selection with the material required under paragraph 11050-1.08. The NPSH margin ratios specified in this paragraph shall be the minimum acceptable margin ratios. If the proposed pump requires greater margin ratios to operate within the specified operating conditions without loss of head due to cavitation, then it shall be the responsibility of the Contractor to bear all costs associated with achieving the required margin ratio by lowering the elevation of the pump setting, lowering the elevation of the structure or other means. Any such adjustments shall be subject to review and acceptance by the Construction Manager.

Individual restrictions that apply to NPSH margin shall be as set forth below, depending upon the type of pumping equipment and the fluid to be pumped.

2. CENTRIFUGAL PUMPS – WASTEWATER SERVICE: The following restrictions shall apply to pumps for wastewater and all solids bearing liquids applications including storm water.

a. Pumps classified as centrifugal pumps under ANSI/HI 1.1 – 1.2 with suction specific speeds less than 8500 with cast duplex stainless steel impellers and to vertical column-type sewage pumps with cast duplex stainless steel impellers and specific speeds less than 5000, a minimum NPSHA/NPSH3 margin ratio of 1.1 shall

apply to pumps at any operating condition within 85 percent and 115 percent of best efficiency capacity. The minimum acceptable NPSH margin ratio at any other location on the pump's head/capacity curve shall be 1.2.

b. Pumps with suction specific speeds greater than the above limitations shall have NPSH margins of 1.5 and 2 applicable to the capacity envelope limitations defined previously. Under no circumstances shall the absolute value of the margin above NPSH3 be less than 3.5 feet.

c. Pumps with suction specific speeds greater than the above limitations and pumps with impeller materials that do not meet the requirement for duplex cast stainless steel set forth in this section, and all pumps with suction specific speeds greater than 10,000 shall have NPSH margins not less than 2.5 at operating conditions within ±15 percent of best efficiency capacity and not less than 3.5 for all operating conditions falling outside the ±15 percent of best efficiency capacity envelope. Under no circumstances shall the absolute value of the margin for pumps qualifying with the foregoing restrictions, be less than 3.5 feet greater than NPSH3.

3. CENTRIFUGAL PUMPS - CLEAR LIQUID SERVICE

a. The minimum NPSH margin requirements set forth in the table below shall apply to water and all non-solids bearing liquid pumps classified as centrifugal pumps under ANSI/HI 1.1 – 1.2 with specific speeds less than 7000 fitted with cast duplex stainless steel or aluminum bronze impellers and to vertical column-type pumps with cast duplex stainless steel impellers or aluminum bronze impellers and specific speeds less than 4000. Under no circumstances shall the absolute value of the margin above NPSH3 be less than 3.5 feet.

Power per stage, Kw	Operating Condition Within PACL	Operating Conditions Outside PACL
< 75	1.1	1.2
≥ 75 but ≤ 225	1.05	1.1
>225	1.2	1.3

b. Pumps with specific speeds greater than the above limitations, pumps with impeller materials that do not meet the requirement for duplex cast stainless steel set forth in this section, and all pumps with suction specific speeds greater than 10,000 shall have NPSHA margins not less than 3.0 at operating conditions within

±15 percent of the best efficiency capacity and not less than 4.0 for all operating conditions falling outside the ±15 percent of best efficiency envelope. Under no circumstances shall the absolute value of the margin above NPSH3 be less than 3.5 feet.

G. ELECTRIC MOTORS

1. GENERAL: Unless otherwise specified, pumps shall be electric motor driven. All motors shall be selected to be non-overloading at any operating point along the pump's full speed operating curve, including all points located beyond specified operating conditions. All vertical motors shall be solid shaft construction. Hollowshaft motors will not be accepted. Motors furnished with pumps specified for operation at variable speed shall be inverter duty types conforming to the requirements of Section 11060 and shall be compatible with the variable speed equipment furnished with the pump.

   Motor bearings shall be protected with bearing isolators as specified in paragraph 11050-1.04.E.

2. MOTORS FOR CUSTOM ENGINEERED PUMPS: In addition to the information submitted under the requirements of Section 11060, the Contractor shall provide certified reed frequency calculations for both the motor rotor and frame for vertical motors driving custom engineered pumps with the data to be submitted under paragraph 11050-1.08. Upon completion of construction of motors for custom engineered pumps, each rotor and frame and the completed assembly shall be given a bump test to confirm reed frequency calculations in the dynamic analysis modeling work performed under paragraph 11050-1.05.B. The results of the bump test, certified by an officer of the manufacturing corporation and notarized, shall be submitted as Product Data under paragraph 11050-2.09.

   All vertical motors shall meet motor face dimension tolerances as follows:

Motor face bolt circle diameter, inches	Motor face runout, inches
12	0.002
16.5 through 24.5	0.002
30 through 42	0.003
42 and larger	0.005

   Motor face register concentricity, referenced to the shaft centerline, shall be not greater than 0.002 inches, if the motor is furnished without jack screws. Motor shaft total indicated runout (TIR) shall not exceed 0.002 inches.

3. BALANCE: Motors rated 50 horsepower and greater, all motors driving custom engineered pumps and all motors operating at less than 1200 rpm shall be precision balanced motors conforming to the requirement set forth in the table below.

Speed, rpm	Mils displacement (peak to peak)
3000 and above	0.5
1500 - 2999	1.0
1000 - 1499	1.0
<1000	1.5

The Contractor shall provide certified balance logs attesting to achieving these requirements, as Product Data under paragraph 11050-2.09. Displacement readings shall be taken at the shaft with an FFT analyzer at 1X speed. Balance logs shall be notarized and signed

1.05 ADDITIONAL DESIGN REQUIREMENTS

A. SCOPE

The following paragraphs present requirements that apply to only some pumps on the project. The first sub-paragraph titled GENERAL explains when the paragraph applies.

B. ROTOR CRITICAL SPEED ANALYSIS AND SYSTEM DESIGN:

1. GENERAL: The requirements of this paragraph shall apply to all pumping equipment in detailed specifications where the words “Custom Engineered” appear in the title of the specification section, and elsewhere when the referencing specification section stipulates. The analyses shall be applied to the equipment in like new condition as well as the as worn condition (i.e., when all parts, individually and as a composite, reach the manufacturers’ maximum tolerances).

2. REQUIREMENTS: The complete pumping unit, including rotating elements, frames, supports, and all related structural elements, including pump, motor and bearing supports, shall be subjected to a lateral rotordynamic analysis, including a rotordynamic critical speed analysis, to identify and eliminate harmful resonant conditions.

The complete pumping unit rotating element including pump, motor, intermediate shafting and flywheel rotors (if specified), and all other elements in the power train (or powered via the power train) shall be designed and manufactured to limit torsional stresses.

Overhung shaft pumps and between bearings pumps operating in single volute casings shall be subject to analysis for shaft deflection in accordance with the terms of this section.

The torsional and rotordynamic analyses shall together be termed the pumping equipment's "mass elastic design". No fabrication work on any component for the equipment specified under this section and any referencing section shall be started until the mass elastic design has been completed and has been reviewed by the Construction Manager.

If the Contractor proposes the use of alternative methods for the required analyses, documentation shall be submitted justifying the substitution. The documentation shall include justification that product results will be equivalent to that specified and with an equivalent level of accuracy. The location and description of projects of an equivalent size where the procedure has been employed and the length of time these projects have been in actual service shall also be included.

3. PROFESSIONAL QUALIFICATIONS: The Contractor shall cause the manufacturer of the pumping equipment to retain the services of an independent professional engineering firm, employing a qualified design professional, which has been engaged in performance of the required, mass elastic design analyses for not less than ten years on equipment of similar size and complexity. The design professional shall not have been in the employ of any pump manufacturer, for a period of not less than 10 years from the date of the request for proposals for this project. The design professional's firm shall submit a notarized certification attesting to having no contractual arrangements with the proposed pump manufacturer. The pump manufacturer's internal engineering organizations, regardless of qualifications, are specifically prohibited from doing this work. This provision, however, shall not be construed as relieving the Contractor of overall responsibility for this portion of the work.

   The mass elastic design shall be the product of a registered design professional who has been responsible for the design of not less than five systems similar to that specified in the detailed specification section. The design professional shall have been engaged in this type of analysis for not less than 10 years and shall directly supervise the performance of the work and be responsible for analysis of results and recommendations for any corrections to the specific rotating system and the associated frames and supports. The Contractor shall submit the design professional's qualifications as a part of the initial submittal information required under this section.

The Owner and Construction Manager believe the following firms are capable of providing services which will satisfy the requirements of this paragraph. This statement, however, shall not be construed as an endorsement of a particular firm, nor shall it be construed that a named firm's standard service will comply with the requirements of this Section. Candidate firms performing these analyses satisfactorily in the past include:

a. DynaTech , Roseville, California

b. Engineering Dynamics Incorporated, Houston, Texas

c. No Bull Engineering (Corbo, Malanoski & Associates), Brandon, Vermont

The Contractor may propose a firm other than those listed. However, before a substitute firm can perform the analyses, the proposed firm's qualifications, the qualifications of personnel proposed for assignment to this project, along with examples of analyses performed on similar pumping equipment using the Corbo and Malanoski procedures specified in this section shall be submitted for review by the Construction Manager. Examples shall include the types of graphical displays required under this section as well as a complete report describing the analyses performed and the recommendations arising out of the analysis results. Construction Manager retains the right to reject any proposed firm with justification.

4. REPORTS, CALCULATIONS AND RECOMMENDATIONS: All reports, calculations and recommendations resulting from the required analyses shall bear the design professional's original signature and professional registration seal. All reports, recommendations and calculations produced under this paragraph shall be submitted under the requirements of this section, as follows:

a. Following completion of the pumping equipment's mass elastic design, Contractor shall cause the design professional to prepare a plain-English "Executive Summary" report with a narrative including: a description and assumptions about proposed operating system; detailed description of the analysis process; results of analyses and findings; detailed recommendations for modification of the Pumping Unit (defined in paragraph 11050-1.01.A), if any; and sufficient graphical depictions to describe the information to a lay reader. Detailed calculations and extensive data reports are not to be submitted at this time and will cause the entire report to be rejected, if included. This Executive Summary shall be submitted for review and acceptance prior to pump or component fabrication. The Executive Summary report shall state that analysis procedures

have complied fully with the requirements of this section and that the proposed system will meet all of the requirements set forth herein for limitations in stresses, deflection and fatigue limits. The design professional shall affirm in writing that all requirements of this section have been achieved or shall specifically state where exceptions have been taken, with justification citing recognized authorities for taking such exceptions. The reports shall be signed and sealed by the design professional, as specified, and shall be notarized.

b. Following review and approval of the Executive Summary, the Contractor shall cause the design professional to review and address any comments from the Construction Manager and incorporate all changes that may be required. Subsequently, Contractor shall direct the design professional to issue a complete, "Final Report" with a revised Executive Summary, recommendations binding on the manufacturer, calculations, data and other supporting information. The format and documentation for this report shall follow the requirements of ANSI/HI 9.6.4. The Contractor shall submit this report as Product Data.

c. Upon completion and receipt of certified results of the bump tests required for the motor rotor, frame and assembly specified under paragraph 11050-1.04.G., the design professional shall review the data and submit a "Supplemental Report", as Product Data, either accepting the test results or recommending alterations to assembly structures to adjust for differences between calculated values used for the original analyses and actual values determined subsequent to motor fabrication.

d. Upon completion of installation and as a part of the initial test procedures specified under Section 01660, the design professional responsible for the mass elastic design shall visit the site and inspect the installed equipment. Prior to the initiation of any field tests, the design professional shall issue a report bearing the design professional's original signature and original registration seal attesting that the equipment, as installed, conforms to the recommendations contained in the report setting forth the results of the mass elastic system design.

e. During initial testing of the equipment, the design professional shall be prepared with all necessary monitors, instruments and recorders, and shall conduct an in-situ torsional vibration test on one of the installed pumping units, to be selected by the Construction Manager, to confirm the torsional natural frequency results of the original mass elastic system design. The torsional

vibration test shall be conducted with transducers suitable for narrow band spectrum analysis, including strain gauges, magnetic or optical pulse demodulation, or shaft position encoders. If the torsional vibration test should reveal any anomalies that cause the equipment to be out of compliance with the requirements of this section, the design professional shall conduct torsional vibration tests on all other like pumping units and submit a comprehensive report, sealed and signed as specified above, detailing the reasons for failure to comply with these specifications and recommendations for attaining compliance. The design professional shall consider all feasible options for compliance and shall provide detailed descriptions of the modifications required to achieve the required performance. Those recommendations accepted by the Construction Manager shall be implemented by the Contractor at no cost to the Owner.

5. METHODOLOGY

a. LATERAL ROTOR DYNAMIC ANALYSIS: The rotor dynamic analysis shall follow the procedure prescribed in Corbo and Malanoski, 1998, and shall include the following features:

1) The procedure shall consider all speeds required to operate the equipment within the envelope of specified continuous operating conditions specified.

2) The procedure shall produce Campbell diagrams for the proposed operating conditions depicting all potential sources of excitation to check interference with all relevant frequencies up to, and including, not less than 6 times (6X) operating speed.

3) For all pumps, the analysis shall also consider vane pass excitation at rev/2.

For column type pumps only, the procedure shall consider variations in assumed coefficients for seal and wearing ring clearances (Lomakin effect), bearing stiffness and damping, rotor imbalance (up to 10 percent of rotor disc weight at each disc position), impeller destabilizing forces, rotor shaft bending, hydraulic imbalance at not less than five operating conditions within the envelope of continuous operating conditions specified in addition to the specified continuous operating conditions.

Unless specifically accepted by the Construction Manager, the range in variation of component characteristics shall comply with the ranges recommended in Corbo and Malanoski, 1998.

4) The mathematical modeling tools to be employed for the analyses and the procedure to be used shall be as described in the references specified in paragraph 11050-1.05.B.5.a, Item 3) with the following modifications:

   a) The mathematical model of the rotating element shall be built on a rotordynamics code such as FEATURE or DYROBES. Use of a finite element modeling program for this purpose will be unacceptable. The model shall specifically be constructed to contain axisymmetrical models of the rotor and casing. This model shall be used to determine the natural frequencies of the rotating elements.

   b) A finite element code such as NASTRAN or ANSYS shall be used to construct three dimensional models of the casing and support structures for the equipment furnished under this contract. This model shall be used to determine the natural frequencies of the support structures and casing as well as the pump bearing frames.

   c) The axisymmetrical model shall then be adjusted, preferably by changing component materials or sizes, or by changing component type, until its output frequencies agree with the models constructed under b).

5) Physical adjustments to provide the required characteristics shall be preferably by changes in component dimensions and secondarily by providing torsionally resilient dampening devices such as fluid-damped couplings or all metallic couplings such as manufactured by Bibby and Holset. Couplings or dampeners using rubber or similar elastic materials shall not be used.

6) The final report shall include three-dimensional graphic presentation of frame and shaft distortion and rotor element performance at identified critical speeds within the pump's operating range.

b. TORSIONAL DYNAMIC ANALYSIS: The methodology used for evaluation of the mass elastic system and shaft combined stresses shall follow the approach prescribed in Corbo and Malanoski, 1996, using either the Matrix-Eigenvalue or Holzer methods for determining natural frequencies. The computer analysis results shall be verified by hand calculations for the fundamental frequency and for mode shapes. Exciting frequencies to be considered during the analysis shall be 0.5, 1, and 2 times running speed, vane passing frequencies and twice vane passing frequencies for the pump impeller/cutwater-diffuser vane combinations, line and twice line frequency, motor pole frequency and motor starting transients. Forcing function magnitudes used for the analysis shall be not less than 10 percent of the maximum transmitted torque. The analysis shall also include evaluation of control pulse frequencies induced by variable frequency drives or engine power stroke frequencies, if provided as part of the specified system. The analysis report shall include a statement produced by the variable frequency drive manufacturer detailing all control pulse frequencies generated by the equipment between 1/4 and 18 times motor running speed.

Unless otherwise justified by documentation supported by independent studies, the analysis procedure shall use the range of factors recommended in Corbo and Malanoski, 1996. The Contractor shall produce a Campbell-type interference diagram showing the relationship between operating range, natural frequencies and exciting frequencies with all relevant frequencies up to, and including, not less than 6 times (6X) operating speed. The stress analysis procedure shall be based upon a finite element analysis technique using a digital computer program that has been field calibrated with not less than five similar installations

The analysis shall include a time-integration study showing transient peak stresses resulting from startup, shutdown and motor control transients if synchronous drives are specified. The diagrams shall include calculated stresses throughout the range of frequencies considered in the analysis. Tomographic diagrams, displaying colorimetrically stresses at all positions in the pump shaft and all frames, including roots at changes in section and keyways or other stress concentrating locations, shall be provided with the analysis report. The diagram shall indicate operating speeds identified that produce the peak stresses and shall be specific for speeds inducing identified peak stresses at keyways, changes in section and at connections to other components. The

reported stresses shall be combined stresses incorporating all identified loads from torsional, lateral and hydraulic sources.

c. SHAFT RADIAL LOAD AND DEFLECTION: Calculation of radial thrust loads shall be performed in accordance with the methodology set forth in ANSI/HI 1.3, paragraph 1.3.5.1. Shaft deflection calculations shall be performed in accordance with ANSI/HI 1.3.5.4. Shaft deflection criteria and limits shall be as required by API 610 (ISO 13709). Calculations justifying the shaft and bearing sizes (selected in accordance with the requirements of this Section, performed at 0%, 20%, 40% 60%, 80% 100% and 120% of BEP Flow and head shall be submitted with the information specified under paragraph 11050-1.08.

C. SUCTION WELLS FOR COLUMN PUMPS

1. GENERAL: This paragraph applies where the detailed specification requires a column type pump to be installed in a suction or inlet well.

2. REQUIREMENTS: Where the detailed specification requires a column type pump to be installed in a suction or inlet well, the Contractor shall cause the well to be designed and provided by the pump manufacturer. The design shall include an arrangement that results in acceleration of flow down the suction well and into the cone. These provisions, however, shall not be construed as relieving the Contractor of responsibility for this portion of the work. Inlet wells shall be designed in accordance with the requirements of ANSI/HI 9.8 and design documentation shall be provided as a part of the information to be submitted under paragraph 11050-1.08.

3. MODEL TESTING: The Contractor shall cause the pump manufacturer to verify the design of suction or inlet wells for pumps specified in detailed sections with “Custom Engineered” in the section title by physical model tests conducted in accordance with ANSI/HI 9.8. Acceptance criteria for design confirmation and final report of the model study shall be as set forth in ANSI/HI 9.8.

The physical model shall include the pump, inlet well, upstream inlet piping, and any valving or piping appurtenances within the 10 D upstream reach preceding the inlet well.

The physical modeling effort shall be the product of a commercial hydraulics laboratory specializing in physical model studies of this type. Hydraulics laboratories associated with colleges or universities and pump manufacturer's hydraulics laboratories are specifically prohibited from providing this service. All development work required for the conduct of the study shall be under the direct supervision of an engineer licensed to practice in at least one of the states comprising the United States of

America, hereinafter called 'the design professional' for the purposes of this paragraph. The design professional shall have not less than 10 years' experience in hydraulic modeling of pump intake designs of at least the magnitude required by these specifications, using physical modeling techniques. Computation Fluid Dynamics (CFD) modeling techniques are not an acceptable substitute for the requirements of this paragraph. The final report, describing the work performed and the results and recommendations arising out of the study, shall bear the original seal and signature of the design professional.

1.06 QUALITY ASSURANCE – ALL PUMPS

A. QUALITY CERTIFICATION

All manufacturers and manufacturing sites proposed by the Contractor for supply of equipment furnished under this section and sections referencing this section shall hold current certification under ISO 9001. Application for certification under ISO 9001 shall not be deemed as an acceptable substitute for current certification. Documentation attesting to current certification shall be signed by an officer of the manufacturer's corporation and shall be notarized. The documentation shall also include the manufacturer's written Quality Assurance/Quality Confirmation (QA/QC) program and the documentation plan necessary for ISO 9001 certification.

B. UNIT RESPONSIBILITY

The Contractor shall assign Unit Responsibility to the pump manufacturer in conformance with the requirements of Section 11000.

C. PERFORMANCE CONFIRMATION

1. HYDROSTATIC TESTS: All pressure sustaining parts shall be subjected to factory hydrostatic tests. Hydrostatic tests shall conform to the requirements of paragraph 8.3.2 of ANSI/ ANSI/API 610. Castings shall be held at the test pressure for 30 minutes for all pumps with discharge nozzles 14 inches in diameter and less and for 60 minutes for pumps with discharge nozzles 16 inches in diameter and greater. Test results shall be certified correct by an officer of the pump manufacturer's corporation, and shall be notarized.

2. PERFORMANCE GUARANTEE: Unless specified otherwise in the detailed specification, pump performance (flow and head, efficiency and NPSH3) shall be guaranteed by the pump manufacturer to the criteria specified under this paragraph.

Equipment performance documentation, including test data, where tests are specified, shall include sufficient test points (not less than 8) to

document hydraulic performance along the complete head/capacity curve from shutoff to maximum capacity and shall cover all full speed operating points specified in the detailed specification section referencing this Section. Tests conducted at specified operating conditions shall be the inlet throttled to product the NPSHA indicated for that specific condition in the detailed specification. NPSH3 tests shall be performed for not less than four full speed operating conditions, but not less than all specified operating conditions and at Best Efficiency.

Test procedures shall conform to those set forth in ANSI/HI 14.6 acceptance grade 1U, and as specifically detailed in these specifications. Performance tests shall be conducted at the specified maximum speed. Affinity relationship-predicted test results will not be accepted. For column type pumps, performance documentation shall include curves showing both bowl efficiency and overall efficiency (including inlet, bowl, column and discharge head losses) at maximum operating speed for the application.

Acceptance criteria for head and capacity test results, based upon the rated condition specified in the detailed specification shall be as required in ANSI/HI 11.6 and 14.6, acceptance grade 1U.

Acceptance criteria for NPSH3 at any specified operating condition shall be the values proposed by the Contractor in the submittal curves submitted under paragraph 11050-1.08 and duly accepted by the Construction Manager, with a tolerance of plus 0, minus unlimited, with the exception that suction specific speed, as calculated for the specific pump, shall not exceed the limitation established under paragraph 11050-1.04.B.

The guarantee shall include a statement to the effect that the pump will operate within the operating regions specified in the detailed specification. The guarantee shall be in writing, shall be signed by an officer of the manufacturing corporation, and shall be notarized. Under no circumstances shall deviations from specified operating conditions result in overload of the driver furnished with the equipment, nor shall such deviations result in power requirements greater than the driver's nameplate (1.0 service factor) rating.

3. NON-WITNESSED TESTS: Unless specified otherwise, all pumps shall be performance tested in accordance with ANSI/HI 14.6, Acceptance Grade 1E. The factory tests shall include test data for each full speed performance requirement (Condition Points A and B specified in the detailed specification) and any other points stipulated for this test procedure in the detailed specification. These tests shall be conducted with the pump inlet throttled to provide the specified NPSHA. For large column pumps, model performance testing with reduced NPSHA,

pursuant to paragraph 11050-1.07.B.2, may be used. If specified in the detailed specification, test data at the full speed operating conditions shall include shaft vibration and case noise.

The test setup in the manufacturer's test facility shall duplicate as closely as possible the inlet conditions in the proposed installation, using temporary baffles and other means. Where centrifugal pumps are furnished with inlet elbows, inlet adapters or inlet reducers, the pumps shall be tested with the elbow, adapter or reducer fitted to the pump and specified performance criteria shall apply to the complete pump assembly, including losses through any elbow, adapter or reducer. Where submersible pumps are to be furnished with inlet nozzles and/or discharge elbows or adapters, the pumps shall be tested with these components fitted to the pumps. The specified performance requirements shall apply to the complete pumping assembly including any inlet nozzles, and discharge elbows or adapters. Certified test data shall include separate readings for inlet and discharge head for each data point.

Not less than eight test points shall be taken, including not less than three within ± eight percent (in terms of rated flow) of the rated condition (Condition Point A) and not less than two test points within ±4 percent of the pump's best efficiency point at the test speed. In addition, one test point shall be sufficient to define head and power requirements at shutoff head.

NPSH3 tests shall be performed to confirm the data used to establish NPSHA margin for each specified operating condition as specified in paragraph 11050-1.04.F. NPSH3 tests for column type (axial and mixed flow and vertical turbine) pumps shall be performed using the method described for Figure 2.74 or Figure 2.75 in ANSI/HI 2.6. NPSH3 tests for submersible wastewater pumps shall be performed using the method described in Figure 11.6.8 in ANSI/HI 11.6. All NPSH3 tests shall extend from 30 percent to 140 percent of Best Efficiency Flow at full speed, or to not less than 10 percent (in terms of flow) past the flow at Operating Condition B, whichever is greater. Failure to achieve specified performance or performance proposed in accepted submittal documents (capacity and head, efficiency or NPSH3), whichever is more restrictive, shall be cause for rejection. Acceptance tolerances shall be as set forth in paragraph 11050-1.06.C.2.

All test procedures shall be in strict conformance with the referenced standards, except prediction of performance of a trimmed impeller from test data of the larger impeller will not be permitted. If trimming is required, the pump shall be retested. Under no circumstances shall deviations from specified operating conditions, though allowed by the referenced standards, result in overload of the driver furnished with the

equipment, nor shall such deviations result in power requirements greater than the driver's nameplate (1.0 service factor) rating.

The Contractor shall furnish the Construction Manager with not less than two weeks' advance written notice of the date and place of the non-witnessed tests.

All test results, including test logs and generated curves, shall be certified correct by an officer of the pump manufacturer's corporation and shall be notarized. Contractor shall submit test results as Product Data.

1.07 QUALITY ASSURANCE – ADDITIONAL REQUIREMENTS

A. SCOPE

In addition to the requirements under Section 11050-1.06 applicable to all pumps, the following are required for the subset of larger and custom engineered pumps defined in Section 11050-1.01.A. Contractors are advised that the results of NPSH3 and pressure pulse tests will be used by the Construction Manager to determine if the tested pumps conform to the PACL requirements set forth in paragraph 11050-1.04 B. Failure to meet these requirements will likely require remanufacture of the pumps or rework of one or more of the pump components to achieve the required and necessary pump stability characteristics. All costs associated with such remanufacture or rework shall be borne by the Contractor.

B. PERFORMANCE TESTING

1. WITNESSED TESTS: All custom engineered pumps, and other pumps where required by the detailed specification, shall be subject to a witnessed factory performance, NPSH3 and pressure pulse tests in accordance with the provisions of this portion of the specifications. The Contractor shall furnish the Construction Manager with not less than two weeks' advance written notice of the date and place of the witnessed tests.

2. PERFORMANCE TESTS: Factory performance tests shall conform to the requirements of ANSI/HI 14.6, Acceptance Grade 1U. The factory tests shall include test data for each full speed performance requirement (Condition Points A and B specified in the detailed specification) and any other points stipulated for this test procedure in the detailed specification. These tests shall be conducted with the pump inlet throttled to provide the specified NPSHA. For large column pumps, model performance testing with reduced NPSHA, pursuant to 11050-1.07.B.5, may be used. Test data shall also include suction and discharge pressure pulse, shaft vibration and case noise at full speed.

The test setup in the manufacturer's test facility shall duplicate as closely as possible the inlet conditions in the proposed installation, using temporary baffles and other means. Where centrifugal pumps are furnished with inlet elbows, inlet adapters or inlet reducers, the pumps shall be tested with the elbow, adapter or reducer fitted to the pump and specified performance criteria shall apply to the complete pump assembly, including losses through any elbow, adapter or reducer. Where submersible pumps are to be furnished with inlet nozzles and/or discharge elbows or adapters, the pumps shall be tested with the inlet nozzles or adapters and the specified performance requirements shall apply to the complete pumping assembly including any inlet nozzles, and discharge elbows or adapters. Under no circumstances shall NPSHA exceed that specified in the detailed specification during any performance test. Certified test data shall include separate readings for inlet and discharge head for each data point.

Not less than eight test points shall be taken, including not less than four within ±8 percent (on the basis of rated flow) of the rated condition (Condition Point A) and not less than two test points within ±4 percent of the pump's best efficiency point at the test speed. In addition, one test point shall be sufficient to define head and power requirements at shutoff head.

3. NPSH3 TESTS: NPSH3 tests shall also be performed to confirm the data used to establish NPSHA margin for each specified operating condition as specified in paragraph 11050-1.04.F. NPSH3 tests for submersible wastewater pumps shall be performed using the method described in Figure 11.6.8 in ANSI/HI 11.6. All NPSH3 tests shall extend from 30 percent to 140 percent of Best Efficiency Flow at full speed, or to not less than 10 percent (in terms of flow) past the flow at Operating Condition B, whichever is greater. Failure to achieve guaranteed performance or performance proposed in accepted submittal documents, whichever is the more restrictive (capacity and head, efficiency or NPSH3) shall be cause for rejection. Tolerances and restrictions shall be as set forth in paragraph 11050-1.06.C.3, above, for non-witnessed tests.

4. PRESSURE PULSE TESTS: Pressure pulse testing shall be performed on all dry pit centrifugal pumps provided under specifications containing the term 'Custom Engineered' in the specification section title or where specified in individual pump specification sections. Pressure pulse testing equipment shall include sufficient calibrated transducers to measure both static and dynamic pressures simultaneously at the pump discharge and suction; the latter if a centrifugal pump. The transducers shall be suitable for narrow band spectrum analysis and shall be mounted less than one pipe diameter away from the pipe wall, with suction and discharge gauge taps at acceptable mounting locations. Operating pressure capability of the

sensors shall selected on the basis that the peak rating shall be less than four times the expected maximum pressure at the measurement location, with total accuracy (combined non-linearity, non-repeatability, and hysteresis as defined by IEC 61298-2) less than one percent of full scale. Sensors at pump inlets shall be capable of compound pressure output. Output from the sensors shall be recorded by vibration data acquisition equipment, with manual notation of either static or dynamic pressure unacceptable. A frequency range from DC to 20 times the maximum operating speed of the pump shall be used for dynamic pressure measurements. A lower frequency range for static measurements may be used if desired. Pressure data shall be obtained from steady operating conditions during testing, and for presentation purposes shall be the result of 16 full averages at the maximum frequency range. Static pressures must be corrected for elevation and velocity head.

Pressure pulse test procedures shall consist of operating the pump at full speed and manipulating the position of the discharge valve to record simultaneous flow, head, vibration and pressure pulse data beginning with the discharge valve positioned to achieve flow and head at Condition Point B and increasing head by 5 percent increments until the magnitude of the pressure pulses at the pump inlet and discharge increase by not less than 20 percent at which time the test run for that speed shall be terminated.

Reporting shall consist of description of the measurement system and must include both frequency and pressure range of the sensors. A National Institute of Standards of Technology-traceable calibration curve for each sensor, obtained in the last calendar year, shall be provided as part of the report appendix. Dynamic pressures shall be displayed in a spectral format, with any discrete peaks identified with harmonic order relative to pump speed and flow. Any significant non-integer dynamic pressure peak, defined as a peak with amplitude equal to or greater than 25% of the largest discrete peak, shall be marked in the spectrum and a source

5. MODEL TESTS: Where allowed in the detailed specification or upon specific application with adequate justification by the manufacturer, confirmation of performance of large pumps may be demonstrated by testing the prototype at reduced speed or by testing a model of the prototype pump. NPSH3 tests shall also be performed to confirm the data used to establish NPSHA margin for each specified operating condition as specified in paragraph 11050-1.04.F. Failure to achieve guaranteed performance (capacity and head, efficiency or NPSH3) shall be cause for rejection. Physical model testing shall be performed at qualified, commercial facilities, with at least 10 years of continuous operation. All tests shall be conducted in accordance with ANSI/HI 1.6 or 2.6. with the following restrictions:

a. If the prototype is tested at reduced speed the ratio of test speed to prototype speed shall not be less than 0.66:1.

b. Model test ratios shall not be less than 0.33:1, model to prototype.

c. Impellers for model tests shall be not less than 12 inches in diameter.

d. Impellers for prototype pumps shall be subject to a model-to-prototype profile comparison using templates ratioed from the impeller used for the completed and accepted model test. Impeller profiles shall be compared for the x, y and z planes. If model testing is proposed for any or all of the specified tests, the Contractor shall include the proposed methodology for profile confirmation as a part of the submittal material required under paragraph 11050-1.08. Impeller profile comparison shall be performed with a representative of the Construction Manager present. All costs associated with travel and subsistence of the Construction Manager's representative shall be borne by the Contractor.

e. Acceptance criteria, based upon projected prototype performance from model test results using Hydraulic Institute approved affinity relationships, shall be as set forth above under paragraph 11050-1.06.C. 3.

f. Restrictions set forth above for witnessed tests shall apply.

The Contractor shall furnish the Construction Manager with not less than two weeks' advance written notice of the date and place of the model tests.

6. TEST CERTIFICATION AND REPORTING: All test results, including test logs and generated curves, shall be certified correct by an officer of the pump manufacturer's corporation and shall be notarized. Contractor shall submit test results as Product Data.

C. CONFIRMATION OF PASSAGE GEOMETRY

For solids handling pumps, the design waterway passages and mating passages between rotating and stationary portions of such passages shall be subjected to confirmation that no mismatch of exiting and entering angles or angular discontinuities exist in all pumps furnished under specification sections containing the words 'Custom Engineered' in the title. The confirmation process shall employ Computational Fluid Dynamics (CFD) modeling techniques in which mesh generation is optimized and mesh size reduce in the regions of flow

attachment, detachment and separation regions of the impeller and cutwater to detect angular mismatches of 0.25 degrees or greater.

A number of different convergence criteria shall be used to assess whether or not a solution is converged. These criteria may include, the residuals given by the software, global imbalances in momentum, energy etc., whether key global quantities have reached an equilibrium value, and whether information from various solution monitoring points have stabilized. Note that these monitoring points should be in areas where the flow could be much weaker, and not where the flow could be converged easily. High convergence criteria shall be utilized and runs shall be repeated with different monitoring points to assure proper convergence.

The modeling software shall be one that is professionally customized and optimized for the determination pump fluid dynamics especially flow attachment, detachment and separation. The mathematical model and software accuracy shall be verified by experimental data from test cases including similar dynamics. The individual conducting the modeling effort shall be a computational fluid dynamics specialist with graduate level education in the subject and over 5 years of relevant experience. The model graphic outputs, signed and notarized by the pump manufacturer's officer in charge of engineering, shall be submitted as a part of the documentation required under paragraph 11050-1.08.

1.08 SUBMITTALS

In addition to the material listed in the detailed specification, the following submittals shall be provided in accordance with Section 01300:

1. Documentation of successful pump designs as specified under paragraph 11050-1.04.B.1. If included as part of the design, the documentation shall include applications where pump cans of a similar size have been provided as part of the design.

2. Certificate of Unit Responsibility attesting that the Contractor has assigned unit responsibility in accordance with the requirements of this section and paragraph 11000-1.02.C. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.

3. A copy of this specification section and the referencing section and all other applicable specification sections governing the pump, drive and driver, supports and specified appurtenances. The specification copies shall be complete with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check-marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and

denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

4. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

5. Documentation of certification in accordance with ISO 9001 as specified under paragraph 11050-1.06.A.

6. Predicted pump performance curves for each condition point specified showing head, power, efficiency, and NPSH required on the ordinate plotted against capacity (in mgd) on the abscissa. Curves for variable speed pumps shall be provided to demonstrate operation at all speeds required to achieve the specified reduced speed operating conditions. All curves shall clearly display the specified operating conditions and the manufacturer's limits for the POR and AOR, as specified in paragraph 11050-1.04.B. Curves for column type pumps shall show bowl efficiency and allowances for inlet, column and discharge head losses separately.

7. NPSH margin calculations performed for each specified operating condition in accordance with paragraph 11050-1.04.F.2 or .3 as applicable and including the information required under paragraph 11050-1.04.F.1.

8. Motor submittal information as specified in Section 11060. In addition, this information shall include certified calculations for motor rotor and frame reed frequencies, as specified under paragraph 11050-1.04.G.

9. Complete description and sketch of proposed test setup for factory test if a factory test has been required under the detailed specification section. Submittal material shall include sample calculations and proposed test log format. If the Contractor proposes a model test for a part or all of the specified performance tests, the submittal information shall include the proposed model details and a complete description of the proposed method for comparing the model impeller profiles with the impeller profiles for the prototype pumps.

10. Drawings showing general dimensions and confirming the size of pumps, motors, drives and specified appurtenances; piping connections; construction details of equipment (including bearings and bearing isolators); wiring diagrams; and weight of equipment.

11. Variable-speed drive information as required under Section 11069 if the equipment specified includes variable speed capability.

12. Driver unit support calculations and data if the driver is separately supported and if the analysis under the requirements of paragraph 11050-1.05.B. has been required by the terms of these specifications.

13. Shaft deflection calculations for volute type pumps: provide calculations to demonstrate compliance with paragraph 11050-1.04.E, per the methodology set forth as required by Section 11050-1.05.B.5.c.

14. Detail drawings of the pump and driver unit foundation demonstrating conformance to this Section and Section 11002. Submittal shall include drawings depicting type, size, number, projection, and arrangement of anchor bolts, dimensional drawings of the sole and baseplates, dimensional drawings for the concrete supports for both the pump and motor, if applicable. Drawings shall also depict all other pertinent information, including: location of equipment pads and reinforcement; equipment drains; expansion joint locations; elevation of top of grout and grout thickness; elevation of top of baseplate; soleplate; or mounting block; size and location of electrical conduits; and any other equipment mounting features embedded in equipment pads.

15. Limiting nozzle loading criteria, if different from that established by ANSI/HI 9.6.2.

16. The qualifications of the independent testing laboratory and individual personnel proposed by the Contractor to perform field vibration testing, analysis and reporting in accordance with the requirements of paragraph 11050-3.06.

17. The qualifications of the personnel proposed by the Contractor to perform field alignment procedures in accordance with the requirements of paragraph 11050-3.04.

The following are applicable for pumps meeting specified applicability criteria:

1. Qualifications of the design professional, and firm name, proposed to perform the mass elastic design analyses specified under paragraph 11050-1.05.B. if the subject analyses are required by the terms of these specifications.

2. Notarized certification attesting that the firm proposed to perform the mass elastic design analyses specified under paragraph 11050-1.05.B has no contractual arrangements with the proposed pump manufacturer.

3. Descriptive material outlining the methodology and software to be used in the analyses required under paragraph 11050-1.05.B.

4. "Executive Summary" report of the mass elastic design analyses for pumps as specified in paragraph 11050-1.05.B.

5. The proposed instrumentation setup for the in-situ torsional vibration test specified under paragraph 11050-1.05.B.4.d.

6. Suction or inlet well design documentation specified under paragraph 11050-1.05.C.2, including bolt patterns for pump base and soleplate on suction or inlet well.

7. Final report of the model study specified under paragraph 11050-1.05.C.3.

8. Model graphic outputs specified in paragraph 11050-1.07.C.

PART 2 – PRODUCTS

2.01 MATERIALS

A. GENERAL

Where this section and sections referencing this section are silent with respect to materials of construction on any component, material selection shall follow the requirements of Table H.1, ANSI/API 610, Materials Class I-1, with the exception that all shafts for vertical column type pumps shall be 12 percent chromium stainless steel. Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

B. PUMPS

1. FINISH FOR SURFACES IN CONTACT WITH PUMPED FLUID: All pump components in contact with the pumped fluid shall conform to the following requirements.

   Surfaces to be machine-finished shall be indicated on the shop drawings by symbols which conform to ANSI B46.1, Surface Texture, Surface Roughness, Waviness and Lay. Machine surfaces shall be finished to at least the following tolerances (SI units):

Nominal Roughness:

Surface	Grade, Ref: ANSI B46.1 (SI units)
General Machine Work	3.2 or better
Flange Faces	3.2
Journal Surfaces at Sleeve Bearings	0.4
Hydraulic Surfaces	
Impeller	4.5 or better
Impeller Bowl and Diffuser	3.2 or better
All other wetted surfaces	6.3 or better

Flaws such as scratches, ridges, holes, peaks, cracks or checks which will make the part unsuitable will be cause for rejection. Machine finished surfaces shall be thoroughly cleaned and coated with protective layer of rust preventive. Small pieces, unassembled pipe or finished bolts, shall be oiled and wrapped with moisture resistant paper.

2. MATERIALS: Unless otherwise specified, wetted cast iron parts for pumps for solids bearing liquid services shall have 2 to 3 percent nickel added to the cast iron.

Stainless steel impellers shall be provided for the first stage of all custom engineered pumps, pumps intended for pumping screened or unscreened wastewater and elsewhere when specified. Stainless steel impellers shall be cast duplex stainless steel conforming to ASTM A995, Grades 2A, 3A, or 6A, with Charpy impact energies greater than 40 ft-lbs at -40°C per ASTM A923 method B. Where cast nickel aluminum bronze impellers are specified, the material shall conform to ASTM B148, Alloy C95500. Unless otherwise specified, second and successive stage impellers on multistage column pumps may be porcelain coated cast iron.

Materials for all shaft sleeves for packed boxes, fretting seals and interstage seals shall conform to ANSI/API 610, Annex H; 12 percent chromium hardened; or hard-faced 316 austenitic stainless steel. Materials for seal glands for packed boxes and shaft sleeves shall be AISI 316 stainless steel. Fastener parts of all types in wetted areas shall conform to ANSI/API 610, Materials Class S-5 requirements. Regardless of the seal construction, all seal chambers shall be adequately sized to accommodate specified mechanical seals.

C. FLYWHEELS

Where flywheel assemblies are to be provided with the pumping equipment, pump pressure containing parts shall be of ductile iron conforming to ASTM A571. Materials of construction for the flywheels shall be as follows:

Frame:	Steel, ASTM A-36, welded and stress relieved.
Shaft:	Alloy Steel, ASTM A322, Grade 4142 HT, ST, BHN 375-388 for shafts 3.5 inches in diameter and less; Stainless steel, ASTM A564, Type 630 HT, Condition H1150 for shafts larger than 3.5 inches in diameter.
Rotor :	Steel, ASTM A36, or cast steel, ASTM A27 for flywheels 3 feet in diameter or less; Cast steel, ASTM A148 for flywheels greater in diameter than 3 feet. All stress relieved after machining.

2.02 GENERAL QUALITY

Details of manufacture and assembly of equipment furnished under this section and referencing sections shall follow the requirements of ANSI/API 610 with respect to the following features (paragraph references, ANSI/API 610):

1. Alignment aids (paragraph 6.1.24).

2. Removal of rotating element (paragraph 6.1.25).

3. Jackscrews for assistance in alignment on all baseplates and equipment supports (paragraph 9.3.8.3.2).

4. Castings (paragraph 6.12.2).

All components or subassemblies weighing 50 pounds or more shall have at least one lifting eye or a provision for threading in a lifting eye. Components 250 pounds or greater shall have lifting eyes or provisions for at least two lifting eyes. Components 1000 pounds or greater shall have at least 3 lifting eyes or provisions for inserting lifting eyes.

2.03 BASEPLATES AND SOLE PLATES

Unless otherwise noted in the detailed specification, all pumps shall be furnished by the pump manufacturer with baseplates or soleplates conforming to the requirements of Section 11002. Baseplates and sole plates shall be designed to be installed in the housekeeping curb shown and shall be machined flat and co-planar to within 0.002 inch per foot in all directions on the face mating with the pump and motor or driver support. Sole plates shall have the words “THIS SIDE DOWN” permanently affixed to the underside using welding rod material prior to milling. Alternative marking methods,

using heavy scribing or machining, are acceptable provided that they may be observed following blasting in preparation for coating.

2.04 WEARING RINGS

Where specified, pumps shall be fitted with both stationary and rotating wearing rings. Except for the difference in hardness between stationary and rotating rings, wearing rings shall be of stainless steel and shall conform to the requirements of ANSI/API 610, paragraph 6.7 and material class S-8 (Table H.1, Annex H). Maximum wearing ring clearances shall not exceed 150 percent of the values stated in Table 6, ANSI/API 610. Minimum wearing ring hardness on the rotating ring shall be 350 Brinnel Hardness Number (BHN), with the stationary ring not less than 100 hardness points greater.

L-form wearing rings are not acceptable for wastewater, sewage, stormwater, thickener overflow, mixed sludge, digester circulation, digested sludge, waste activated sludge, return activated sludge or primary effluent pumping service.

2.05 BALANCE

Balancing for pumps with suction nozzle sizes 6 inches in diameter and greater and all associated components shall conform to the requirements set forth in ANSI/API 610, paragraph 6.9.4.1 (equivalent to ISO 1940 or ANSI 2.19 Grade 2.5), unless other portions of this project manual impose more restrictive requirements. It is the intent that the components be balanced as an assembly ("rotor") in accordance with ANSI/API 610 definitions. For extended shaft pumps, balance impeller(s) and shaft up to the first coupling with the line-shaft.

For separately balanced components, perform a residual unbalance inspection after rotor assembly per ANSI/API 610 requirements, as described in Annex J of that document. Provide copies of worksheets and demonstrate that tolerances are in compliance (i.e. rotor has passed) in addition to other reporting requirements of this paragraph.

All balance logs, certified correct and signed by an officer of the manufacturing corporation and notarized, shall be furnished as Product Data in accordance with paragraph 11050-2.09.

2.06 DRIVE UNIT SUPPORTS FOR SEPARATELY SUPPORTED MACHINES AND INTERMEDIATE SHAFT SUPPORTS

Supports for separately mounted vertical pump drivers and intermediate shaft bearings shall be composite structures of fabricated steel, ASTM A36. Unless otherwise specified, the supports shall be designed to span an opening in the floor sufficient to allow removal for the complete pump. Rolled steel beams shall be provided to stiffen the support and a fabricated steel driver unit support pedestal shall be mounted on the support plate. The support pedestal top plate and all portions of the support plate assembly intended to join with surfaces in the installation structure shall be milled flat and parallel to 0.002 inches

per foot. Pedestals shall be provided with access provisions to adjust or assemble/disassemble couplings. The support shall be designed to be supported on a sole plate or sole plates embedded in a house keeping pad at the edges of the floor opening or as indicated. Other details for the driver unit support shall be as indicated.

2.07 FLYWHEEL ASSEMBLIES

When a flywheel assembly is specified, the moment of inertia (WR^2) of the rotating element for each complete motor/pump set, including entrained water, pump rotor, shafting, couplings, and motor rotor shall be adjusted to provide the value specified in the detailed specification by providing a flywheel.

The flywheel shall consist of cast or fabricated steel weight in the form of a torus with supporting struts, keyed and locked on a shaft supported by bearings at each end of the shaft. Flywheels with diameters greater than three feet shall be double keyed to the shafts. If cast construction is used, the struts and weight shall be cast as a unit. The flywheel shall be designed and fabricated for a coefficient of fluctuation no larger than 0.05. A factor of safety of 5 shall be used for the ratio of operating speed to maximum safe operating speed. The lateral critical frequency of the flywheel assembly shall be shall be higher than the maximum safe operating speed by a factor of 1.5.

If the weight is to be fabricated steel, it shall be machined from a single billet to the diameter and shape required. All flywheels (cast and fabricated alike) shall be stress relieved before balancing. The size of the weight and the distance of the torus centroid from the center of the shaft shall be sufficient to achieve the overall rotating moment of inertia (WK^2) specified for the pump rotating system. Cantilevered designs employing only one set of bearings will not be permitted in stand-alone flywheel assemblies. Flywheels mounted on the motor shaft and using the bearings of a custom designed drive motor may be of the cantilever type. The flywheel assembly shall be included in the lateral, torsional and rotordynamic analyses specified under paragraph 11050-1.05.B.

Bearings shall be selected in accordance with ABMA 9 or 11 for an L-10 life of not less than 100,000 hours. Input and output bearings shall be held in place by rigid fabricated steel struts. The entire rotating assembly shall be balanced in accordance with paragraph 11050-2.05.

The flywheel assembly shall be furnished with a fabricated steel enclosure designed to provide protection against accidental entry of tools or other objects and to provide enclosure protection in accordance with OSHA requirements. The flywheel enclosure shall have an outside width of at least that of the motor, but not greater than 110 percent of the motor's width. The housing shall match the quality of the motor enclosure and shall be equipped with at least two lifting eyes. A mounting pad shall be located on the upper portion of the flywheel housing to permit installation of the vibration detector specified in Division 17 or the referencing section. The flywheel bearing housings shall be supported independently by a rigid frame to maintain alignment.

Where horizontal flywheels are required, the flywheel assembly shall be mounted on a baseplate common with the pump and motor. Frames for horizontally mounted flywheel assemblies shall be fitted with mounting pads for bolting to the pumping unit baseplate. Sufficient space shall be provided on each pad to permit dowelling to the baseplate after final alignment. End plates shall be similar to those provided for the motor and shall provide complete closure to prevent incidental access to the flywheel. The flywheel input shaft shall be direct connected to the motor output shaft by means of a flexible coupling, and the output shaft shall be designed to accommodate the shaft spacer coupling specified.

Where vertical flywheel assemblies are shown supporting the electric motor, the frame shall be designed to support the weight of the motor in accordance with the design requirements of this section. The flywheel assembly frame shall be extended to carry a support plate which shall be rabbeted to provide self-aligning features with the motor base. The frame extension shall have access openings to permit assembly/disassembly of the motor output shaft coupling. The lower flywheel assembly end plate shall be finished flat for mating with the support pedestal on the driver unit support, if so mounted, or rabbeted for alignment with the pump drive shaft if mounted on a column pump discharge head.

Where vertical flywheel assemblies are mounted separately from the pump and motor, the lower end plate shall be finished flat. The input shaft shall be keyed for the specified flexible coupling and shaft guards shall be provided

2.08 INLET WELLS FOR COLUMN TYPE PUMPS

Unless specified otherwise, suction or inlet wells for column type pumps shall be fabricated from ASTM A36 steel with internal baffles fillet welded to the interior surface of the inlet well. Seal welds all around shall be provided at all welded joints and all welds shall be ground smooth. All internal surfaces shall be prepared and coated after welding with fusion-bonded epoxy conforming to the requirements of AWWA C213 using NSF/ANSI 61-compliant materials (3M Scotchkote 134, or approved equal). Minimum coating thickness shall be 12 mils. External epoxy coating shall be in accordance with Section 09900 requirements.

Where the detailed specification requires an inlet well suitable for service with an upstream hydraulic gradient in excess of the elevation required for the pump discharge head, the flanged connection to the pump discharge head shall be gasketed or fitted with a double O-ring seal designed to withstand not less than twice the pressure specified in the detailed specification

2.09 MACHINING

All machined surfaces shall have a 90 micro inch Ra finish without any grooves, surface imperfections or machining marks of any sort. Mating surfaces shall be coplanar within a maximum of 0.001 inches. Surfaces that are in contact with a gasket such as flanges and

casing joints shall have the customary concentric grooves pattern to increase leak path. Bearing housings and seals shall all have collinear centerlines within less than 0.001 inch total difference. Shafts shall have a 64 micro inch Ra finish.

2.10 PRODUCT DATA

The following information shall be provided in accordance with Section 01300.

1. Performance guarantee as specified in paragraph 11050-1.06.C.

2. Equipment anchor calculations specified in paragraph 11050-1.04 E.2.

3. Operation and maintenance information specified in Section 01730.

4. Motor Product Data as specified in Section 11060.

5. Bearing L-10 life calculations.

6. Critical speed calculations demonstrating compliance with paragraph 11050-1.05.B shall be provided if a lateral rotordynamic analysis is required. Otherwise, critical speed calculations demonstrating compliance with paragraph 11050-1.04.C shall be provided.

7. Nozzle loading information required under paragraph 11050-3.01.

8. Motor balance logs, certified and notarized as specified in paragraph 11050-1.04.G.3.

9. Certified balance logs and worksheets, as specified in paragraph 11050-2.05.

10. Installation Certification Form 11000-A as specified in paragraph 11050-3.01.

11. Training Certification Form 11000-B as specified in paragraph 11050-3.08.

12. If factory tests are specified in the detail specification section, certification of satisfactory testing of each unit as specified. The certified material shall include copies of test logs and resulting performance curves. The results of pressure pulse tests shall also be included.

13. Documentation of field alignment data in accordance with Section 11005.

The following are applicable for pumps meeting specified applicability criteria:

1. Results of model tests for pump inlet wells if model tests are required by the provisions for paragraph 11050-1.05.C.

2. "Final Report" of mass elastic systems analyses for pumps as specified in paragraph 11050-1.05.B.

3. Results of motor rotor, frame and assembly bump tests, certified as specified under paragraph 11050-1.04.G., along with the design professional's "Supplemental Report" as specified under paragraph 11050-1.05 B.2.

4. Pump inlet well installation acceptance certification, as specified in paragraph 11050-3.03, if applicable.

5. Results of field vibration tests as specified under paragraph 11050-3.06.

PART 3 – EXECUTION

3.01 GENERAL

With the exception of submersible pumps and the inlet connection for column type pumps installed in open forebays or wet wells, all pump inlet and discharge nozzles shall be connected to field piping using equipment connection fittings conforming to the requirements of Section 15085. Restraining rods on equipment connection fittings shall be designed specifically to restrain the unbalanced hydraulic thrust developed by the pump when operating at full speed against a closed valve. All restraining rod nuts shall be torqued to assure that any moment or shear transmitted to the pump nozzles is within the values permitted under ANSI/HI 9.6.2 or that permitted by the equipment manufacturer, whichever is greatest. Where ANSI/HI 9.6.2 is silent with respect to any particular aspect of allowable nozzle loads, the Contractor shall follow the written requirements provided by the equipment manufacturer. All pumps furnished under specification sections containing the words 'Custom Engineered' in the title shall be installed under the presence of a factory authorized installation specialist or specialists. Under no circumstances shall any installation procedures take place without the installation specialists present. Equipment installation procedures shall conform to the requirements of Section 11002. Upon completion of installation work, the Contractor shall submit a complete, properly signed certification Form 11000-A as specified in Section 01999.

3.02 SOLE PLATES

Sole plates, if provided as required by this section, or any section referencing this section, or where required by the equipment manufacturer's recommendation, shall be leveled in the presence of a factory authorized installation specialist to a maximum tolerance of 0.002 inches/foot in all directions. Where the equipment manufacturer requires more stringent tolerances, those tolerances shall prevail.

3.03 PUMP INLET WELLS

When specified, pump inlet wells shall be installed as indicated to the following tolerances:

Horizontal position:	± 0.125 inches in all directions
Vertical axis:	within ½ degree from vertical
Level:	0.02 inches per foot of diameter at the pump baseplate bolt circle
Elevation:	± 0.125 inches from planned elevation

Where the equipment manufacturer requires more stringent tolerances, those tolerances shall prevail.

Installation of equipment in pump inlet wells shall not take place until the pump manufacturer's factory trained and authorized installation specialist has furnished the Construction Manager with written and signed certification that the inlet well has been installed satisfactorily and is acceptable for installation of the equipment.

3.04 ALIGNMENT

Journeymen millwrights shall perform alignment of equipment furnished under this section and any referencing section. Carpenters, laborers or any other trades are specifically excluded from performing this work. In locations where such trades are not available, the Contractor shall retain the services of a firm specializing in this type of work to perform the setting and alignment work. The Contractor shall submit the qualifications of the proposed firm to the Construction Manager for acceptance prior to performing the work. The Construction Manager shall personally witness final alignment procedures for each item of equipment as a condition precedent to beginning any work required under Section 01660. Alignment techniques shall conform to the requirements of Section 11005.

3.05 FIELD TESTING

Field testing shall conform to the requirements of Section 01660. For all pumps furnished under specification sections containing the words 'Custom Engineered' in the title , the testing procedure shall be a plan developed jointly by the Contractor and the equipment manufacturer to demonstrate performance of each item of equipment at all specified operating conditions.

Field testing includes lateral and vertical vibration, inlet and discharge pressure pulse and torsional vibration testing, as applicable.

3.06 FIELD VIBRATION AND PRESSURE PULSE TESTS

A. QUALIFICATIONS

The Contractor shall retain the services of an independent testing laboratory to conduct the testing work specified under this paragraph. The work shall be directed by a professional mechanical engineer, registered to practice in any one of the 50 states making up the United States of America. The engineer (hereinafter termed "professional vibration analysis specialist") shall be a graduate of a college holding ABET accreditation in mechanical engineering and shall have been engaged in the practice of providing the type of monitoring services required under this paragraph for rotating machinery for a period of not less than 10 years. The professional vibration analyst's qualifications and references, certified and notarized, shall be submitted for review and acceptance by the Construction Manager not less than 6 weeks prior to the date scheduled for the field vibration test work specified herein. The Construction Manager shall review the required documentation and references and indicate acceptance or rejection of the proposed analyst's qualifications within 14 days of submission. If the analyst proposed by the Contractor is rejected, the Contractor shall propose an alternative choice with appropriate documentation.

The independent testing laboratory's testing team (comprised of the professional vibration analysis specialist and any technicians required to complete the specified tasks) shall be fully equipped to provide continuous pressure, velocity and displacement values for all rotating equipment installed under the requirements of this section. Vibration testing equipment shall include sufficient calibrated pressure and flow monitoring devices to determine pump operating conditions as well as vibration levels. Pressure pulse tests shall be conducted on all pumps where the words "Custom Engineered" appear in the specification title or where specified in the individual pump specification sections. Pressure pulse tests for vertical column type pumps (axial flow and vertical turbine pumps with submerged intakes) shall be limited to the discharge connection only.

B. VIBRATION TESTS

RMS vibration velocity on any component when the pump is operating at any specified continuous duty operating condition shall not exceed the limits established for the appropriate machine by Tables 8 and 9 in ANSI/API 610 when the pump is operating within the PACL. Field vibration for custom engineered column type vertical pumps and motors shall not exceed 2.5 mils peak to peak RMS when the pump is operated at any capacity condition within 85 percent and 115 percent of the pump's Best Efficiency Point capacity at full speed, when measured at the top of the pump motor. When operating at any combination of conditions outside the POR for any pump, regardless of type, limiting values shall be 25 percent greater than the above limits.

Vibration test reports shall be submitted as Product Data, directly to the Construction Manager, and shall bear the signature of the responsible professional vibration analysis specialist. Vibration spectra shall be of sufficient resolution for legibility of magnitude and frequency data to be properly reviewed by the Construction Manager. Cascade diagrams are not sufficient for variable speed drive application unless supported by the required data in a format suitable for more detailed analyses. Separate spectra shall be provided at the maximum and minimum operating speeds and any potential resonant frequencies.

C. PRESSURE PULSE TESTS

Pressure pulse testing shall be performed on all dry pit centrifugal pumps provided under specifications containing the term 'Custom Engineered' in the specification section title or where specified in individual pump specification sections. Pressure pulse testing equipment shall include sufficient calibrated transducers to measure both static and dynamic pressures simultaneously at the pump discharge and suction; the latter if a centrifugal pump. The transducers shall be suitable for narrow band spectrum analysis and shall be mounted less than one pipe diameter away from the pipe wall, with suction and discharge gauge taps at acceptable mounting locations. Operating pressure capability of the sensors shall selected on the basis that the peak rating shall be less than four times the expected maximum pressure at the measurement location, with total accuracy (combined non-linearity, non-repeatability, and hysteresis as defined by IEC 61298-2) less than one percent of full scale. Sensors at pump inlets shall be capable of compound pressure output. Output from the sensors shall be recorded by vibration data acquisition equipment, with manual notation of either static or dynamic pressure unacceptable. A frequency range from DC to 20 times the maximum operating speed of the pump shall be used for dynamic pressure measurements. A lower frequency range for static measurements may be used if desired. Pressure data shall be obtained from steady operating conditions during testing, and for presentation purposes shall be the result of 16 full averages at the maximum frequency range. Static pressures must be corrected for elevation and velocity head.

Pressure pulse test procedures shall consist of operating the pump at the speed required to meet each individual specified operating condition and manipulating the position of the discharge valve to record simultaneous flow, head, vibration and pressure pulse data beginning with a wide open discharge valve at full speed and increasing head by 5 percent increments until the magnitude of the pressure pulses at the pump inlet and discharge increase by not less than 20 percent at which time the test run for that speed shall be terminated. This procedure shall be repeated for each of the operating speeds required for each specified operating condition.

Reporting shall consist of description of the measurement system and must include both frequency and pressure range of the sensors. A National Institute of

Standards of Technology-traceable calibration curve for each sensor, obtained in the last calendar year, shall be provided as part of the report appendix. Dynamic pressures shall be displayed in a spectral format, with any discrete peaks identified with harmonic order relative to pump speed and flow. Any significant non-integer dynamic pressure peak, defined as a peak with amplitude equal to or greater than 25% of the largest discrete peak, shall be marked in the spectrum and a source postulated in the discussion of the data.

3.07 FIELD TORSIONAL VIBRATION TESTING

Where required by these specifications, field torsional vibration tests shall be performed under the direct supervision of the design professional responsible for the mass elastic system design on a pumping unit selected by the Construction Manager.

3.08 TRAINING

Training shall conform to the requirements of Section 01664 and shall include separate training sessions for each operator shift maintained by the Owner and a separate session for maintenance personnel. Unless otherwise specified in the referencing section, the training requirement is waived for constant speed pumping equipment with suction nozzle sizes 6 inches in diameter and smaller and for all pumps with connected power requirements 10 horsepower and less. The training session for maintenance personnel shall include a comprehensive presentation, employing cut-away models or comparable graphics, and documentation on the step-by-step disassembly and subsequent reassembly of a pumping unit. Upon completion of all training requirements, the Contractor shall submit certified Form 11000-B as specified in Section 01999.

END OF SECTION

SECTION 11060

ELECTRIC MOTORS

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies single and three phase, horizontal and vertical, single-speed and two-speed, low-voltage (600 volts and less), energy efficient (900 rpm) and premium efficiency (1200, 1800, and 3600 rpm) alternating current, induction motors, 250 horsepower or less. Standard NEMA MG 1 motors are specified, as modified herein.

This section also specifies IEEE 841 severe-duty, totally enclosed fan-cooled (TEFC Type-2, specified herein) squirrel cage induction motors from 1 to 500 horsepower with voltage ratings of 230V, 460V, 2300V, and 4000V. See Custom Motor criteria within the driven equipment specification for voltages above 600V and for high horsepower.

Motors shall be provided in compliance with these specifications. Ambient conditions for the Project are specified in Section 01800. Provide motors suitable for continuous operation under the ambient conditions:

1. Temperature: 0 degree C to 40 degree C.

2. Altitude: 10 feet above sea level.

Motors shall have aluminum rotor material and copper stator windings with F-insulation without exceeding the B-temperature rise of 80-degree C at rated load and with Design-B torque / current characteristics rated for continuous operation duty.

Two-speed motors shall be two-winding motors. Two-speed, one-winding consequential-pole motors that require special motor starters are prohibited.

Refer to Motor Types-1, 2, and 3 Classification and Inverter Duty variable torque and constant torque specification requirements herein. Motor Types-1, 2, and 3 have the additional requirements of Inverter Duty Motors as specified or scheduled.

Enclosures, as specified elsewhere in the Project Contract Documents:

A. TYPE-1 – OPEN DRIP PROOF (ODP)

B. TYPE-2 – TOTALLY ENCLOSED FAN COOLED (TEFC)

C. TYPE-3 – EXPLOSION PROOF (EP)

D. CUSTOM MOTORS

1. Weather Proof-I (WP-I)

2. Weather Proof-II (WP-II)

3. Totally Enclosed Blower-Over (TEBC) for additional cooling

E. SPECIAL PURPOSE MOTORS: PER DRIVEN EQUIPMENT MANUFACTURER (Not Used)

1.02 QUALITY ASSURANCE

A. GENERAL

Motors shall be built in accordance with UL 674, UL 1004, and NEMA Standard MG 1. Motor nominal and minimal efficiency shall be based on NEMA MG 1, Table 12-10.

Motors shall comply with Energy Policy Act of 1992 (EPAct) with full-load efficiency measurements per IEEE Standard 112, Test Method B, and shall comply with the requirements specified.

IEC Metric Motors and imported EPAct Motors that do not meet the NEMA standards are prohibited.

B. REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).

If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date,

regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
IEEE 112	Standard Test Procedures for Polyphase Induction Motors and Generators
IEEE 841	Standard for Petroleum and Chemical Industry-Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 500 HP
NEMA ICS 2	Industrial Control and Systems Controllers, Contactors and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA 250	Enclosures for Electrical Equipment (1000 volts maximum)
NEMA MG 1	Motors and Generators
NEMA MG1-30	Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable- Frequency Controls or Both. Note: Specifications for Standard TENV Submersible Motors rated 1/2 – 200 HP, 140TY-L360TY Frames, and rated at 200, 230, 460, 575, 600 Volt are available from motor manufactures.
NEMA MG1-31	Definite-Purpose Inverter-Fed Polyphase Motors: Rated 5000 horsepower or less at 7200 volt or less, intended for use with adjustable-voltage and adjustable frequency controls, commonly referred to as inverters.
UL 674	Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 1004	Electric Motors

C. FACTORY TESTS

The manufacturer's factory motor Prototype Tests per IEEE Standard 112 Appendix-A on motors through 250 horsepower shall be submitted. Actual factory tests for these motors are not required. The standard routine factory tests shall be conducted, that may include:

1. Winding resistance in ohms and converted to 25 degree C.

2. Resistive Unbalance and Quarter Voltage Impedance, as applicable.

3. Locked-Rotor current (Single phase).

4. High Potential.

5. No-Load Excitation (volts, amperes, RPM).

6. Bearing vibration check.

7. Efficiency, Power Factor, Current at 115%, 100%, 75%, 50%, and no load.

D. WARRANTY

All motors ½ horsepower and greater shall be warranted against defects in materials and workmanship for a period of 1.5 years.

All motors specified to conform to IEEE 841 shall be warranted against defects in materials and workmanship for a period of five years.

All warranties shall be submitted in writing and shall include as a minimum 100 percent full payment coverage for parts and labor for repair or replacement of the motor during the entire warranty period due to defective workmanship or materials.

1.03 SUBMITTALS

Submittals shall be provided in accordance with Section 01300 and shall include the following:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole.

   If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

   The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

   Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Motor Data Sheets:

   a. For all motors other than those specified to conform to IEEE 841, supplier completed “Form 11060-A” in specification Section 01999 with required factory data.

   b. For all motors specified to conform to IEEE 841, manufacturer completed IEEE Standard 841 Data Sheet for AC Squirrel Cage Induction Motors.

   3. Speed-Torque curve per 1.02 C Factory Tests.

   4. Factory test data for motors required to be subject to manufacturer’s complete factory dynamometer tests as specified in paragraph 11060-1.02 C.

5. Guaranteed vibration level when measured per MG 1, Figure 7-6:

   a. Displacement: 0.0025 inch peak-to-peak.

   b. Velocity: 0.15 inches per second peak.

   c. Acceleration: 1g (gravity) peak.

6. Motor heating curve for motors per 1.02 C Factory Tests.

7. Motor outline, dimensions, and weight.

8. Manufacturer's descriptive information relative to motor features.

9. Response curve where a winding over-temperature device is required.

10. For all inverter duty motors: Manufacturer's certification that the motor is compatible with the adjustable frequency drive to be used and that the motor meets the requirements of NEMA MG1 Part 31 as required herein.

1.04 POWER SUPPLY VARIATIONS

Motors shall operate successfully under running conditions at rated load with +/- 10-percent of rated voltage with rated frequency or +/- 5-percent of rated frequency with rated voltage.

1.05 NEMA WINDING TEMPERATURES

NEMA MG 1 Table 12-7 motors insulation system maximum winding temperatures in degrees-Centigrade (C), with the degrees-Fahrenheit (F) insulation system class specified herein.

1. Forty degree-C ambient (104 degree-F) is the basis for temperature rise.

2. For 50 degree C ambient (122F) and above, refer to the driven equipment specifications for additional requirements.

Insulation System Class	Degrees C / F	Temperature Rise by Resistance
A	140 / 284	NA
B	165 / 329	B-rise: 40 + 80 = 120 Degrees C / 248 F
F	190 / 374	F-rise: 40 + 105 = 145 Degrees C / 293 F
H	215 / 419	H-rise: 40 + 125 = 165 Degrees C / 329 F

1.06 NEMA MOTOR TEMPERATURE PROTECTION TYPES

Refer to Thermal Protection in Part-2 for thermal device requirements. The NEMA design shall limit the temperatures of the windings without using a thermal device:

A. NEMA Type-1: Winding Running and Locked Rotor Over-temperature Protection.

B. NEMA Type-2: Winding Running Over-temperature Protection.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

The following manufacturer's motors generally meet the class and performance requirements of this specification when furnished with appropriate modifications and additional features as specified:

A. HORIZONTAL MOTORS

1. Type 1 - Premium efficiency guarded, open-drip-proof motors manufactured by:

a. Baldor-Reliance:

1) Type ODP

2) Type XEX

b. Emerson US Motor: Type DE or RE

c. General Electric Inc.: Type KS

2. Type 2 - Premium efficiency totally enclosed-fan cooled, Chemical Industry severe duty motors manufactured by:

   a. Baldor-Reliance Electric Co.:

      1) Type IEEE 841 XL Severe Duty

      2) Super-E Severe Duty TEFC IEEE 841

      3) Super-E TEFC for HVAC applications over 2 horsepower

   b. Emerson US Motors: Type CE IEEE 841

   c. General Electric X$D Ultra 841:

      1) TEFC IEEE 841 Severe duty

      2) Inverter rated

   d. Siemens TEFC, Severe Duty

      1) 1 to 400 hp

      2) SD100-IEEE 841: 1-20 hp in Frames 143T – 256T

      3) RGZEESDX: 25-400 hp in Frames 284T to 449T

   e. WEG Electric Corp:

      1) TEFC IEEE 841 NEMA Premium Efficiency

      2) Motors Severe /Chemical Duty

      3) 1 hp NEMA Frame 143T to 500 hp NEMA Frame 586/7

3. Type 3 - Premium efficiency explosion-proof motors manufactured by:

   a. Baldor-Reliance:

      1) XEX-XP, IP 54 with Temperature Code: T3C

      2) Super-E Explosion Proof with Temperature Code: T3C

   b. Emerson US Motor: Type LCE

c. General Electric: Type KS - Explosion Proof
d. Siemens: RGZZESDI with Temperature Code: T3C

B. VERTICAL MOTORS

1. Types 1 and Type 2 - Premium efficiency ODP and TEFC motors manufactured by:

a. Baldor-Reliance:
1) Super-E Severe Duty IEEE 841
2) Super-E TEFC for HVAC applications over 2 horsepower

b. Emerson US Motors:

1) Type TUCE Corroduty
2) Titan Line

c. General Electric:
1) Type KS
2) Value Line WP-1 deep well, hollow-shaft, high-thrust, high-efficiency, inverter duty 4:1 turndown, speeds: 3600, 1800, 1200 rpm, 5-300 horsepower

d. Siemens:

1) RGZVESD: solid shaft, TEFC, severe duty, normal thrust, P-Base: 1-250 hp

2) RGZVILESD: solid shaft, TEFC, severe duty, in-line thrust, P-Base: 1-250 hp

2. Type 3 - Premium efficiency explosion-proof motors manufactured by:

a. Baldor-Reliance: Super-E Explosion Proof

b. Emerson US Motors: Type LUCE

c. General Electric: Type KS, Class I, Group D

d. Siemens:

1) RGZZVESD: solid shaft, EP, hazardous duty, normal thrust, P-Base: 1-250 hp with Temperature Code: T2A
2) RGZZVILESD: solid shaft, EP, hazardous duty, in-line thrust, P-Base: 1-250 hp with Temperature Code: T2A

C. MOTOR TYPES 1, 2 OR 3 RATED FOR INVERTER DUTY SERVICE

1. Baldor-Reliance Electric Inc.:

   a. V*S Master XT:

      1) Variable Torque rated motor

      2) Constant Torque rated motor

2. Baldor-Reliance:

   a. Vertical and horizontal.

   b. TEBC, TENV, and TEFC:

      1) Variable Torque rated motor

      2) Constant Torque rated motor

3. General Electric Inc.:

   a. KAF design for ODP, TEFC, or TEFC Severe Duty enclosures

   b. KAF design in horizontal TEFC Severe Duty and EP enclosures with A$D construction for constant torque: 1000:1

   c. X$D Ultra for Severe Duty IEEE 841

   d. Value Line WP-1 vertical deep well:

      1) hollow-shaft, high-thrust, high-efficiency

      2) inverter duty with 4:1 turndown

      3) 3600, 1800, 1200 rpm

      4) 5-300 horsepower

4. Emerson US Electrical Motors:

   a. VFM - Horizontal (TEFC) IEEE 841 Plus S:

      1) Variable Torque rated motor: 10:1 turndown

      2) Constant Torque rated motor: 4:1 turndown

5. Siemens:

a. TEFC RGZESDI:

1) Variable Torque rated motor

2) Constant Torque rated motor: 10:1 turndown

b. TEBC RGZESDI:

1) Constant Torque: 1000:1 turndown

2) Blower cooled

c. EP RGZZESDI:

1) Variable Torque: 6:1 turndown

2) Constant Torque: 6:1 turndown

2.02 GENERAL

A. NAMEPLATES

Motor nameplates shall be engraved or stamped stainless steel. Information shall include those items enumerated in NEMA Standard MG 1, as applicable. Nameplates shall be permanently fastened to the motor frame and shall be visibly positioned for inspection.

Additionally, provide the following information on nameplates or additional nameplates for:

1. Motors 1/2 horsepower and larger: Indicate the ABMA L-10 rated life for the motor bearings based on load data.

2. Motors 2 to 50 horsepower: Indicate the NEMA nominal efficiency.

3. Explosion-Proof motors: Indicate UL frame temperature limit code.

4. Space heater information.

5. NEMA MG 1 Over Temperature Protection Type Number.

6. Temperature device rating and alarm and shutdown setpoint information.

B. CONSTRUCTION

All motors provided under this specification shall have the following features of construction:

1. Frames:

   a. Cast iron frames for TEFC motors and motors 60 horsepower and larger.

   b. Steel frames for non-TEFC motors smaller than 50 horsepower.

   c. Aluminum frame motors will not be permitted.

2. Stamped steel or cast metal fan shrouds with non-sparking fan blades.

3. Non-hygroscopic motor leads.

4. NEMA Design-B as standard design. NEMA Design-A, C, or D shall be identified as custom design features in the driven equipment specifications.

5. Motor Service Factor (percent of additional horsepower):

   a. SF: 1.15 for Types-1, 2, and 3 Sine-wave motors.

   b. SF: 1.0 for Inverter Duty motors.

   c. SF dual rating: 1.15 Sine-wave and 1.0 Inverter Duty.

6. Grounding terminal in conduit box.

7. Stainless Steel nameplate.

2.03 MOTORS LESS THAN 1/2 HORSEPOWER

A. GENERAL

Motors less than 1/2 horsepower shall be squirrel cage, single phase, capacitor start, and induction run type with Class B or F insulation. Fan motors rated 1/8 horsepower or less may be split-phase or shaded-pole type. Windings shall be copper.

B. RATING

Motors shall be rated 115 volts, single phase, 60 hertz, and shall be continuous-time rated in conformance with NEMA Standard MG 1. Motors shall be non-overloading at all points of the equipment operation.

C. ENCLOSURES

Motor enclosures shall be as defined in NEMA MG 1. Motors shall have totally enclosed fan cooled (TEFC) or totally enclosed non-ventilated (TENV) enclosures, unless specified otherwise in the driven equipment specification.

Explosion-proof (EP or XP) motors shall bear the UL Label for Class I, Division 1, Group D hazardous locations. The nameplate shall indicate the UL frame temperature limit code T2A. The enclosure surface temperature shall not exceed 280 degrees C. Provide self-protected over-temperature device in the motor to detect and automatically de-energize the motor if the frame temperature limit is exceeded and automatically reset.

2.04 MOTORS 1/2 HORSEPOWER THROUGH 250 HORSEPOWER

A. GENERAL

Motors 1/2 horsepower through 250 horsepower shall have copper windings and shall be three phase, squirrel cage, induction type rated for full-voltage start and continuous duty and rated for 460-Vac.

Motors shall have a NEMA MG 1 design for the duty service imposed by the driven equipment such as frequent starting, intermittent overload, high inertia, mounting configuration, or service environment.

B. RATING

Motors shall be rated 460 volts, three-phase, 60-Hertz, and shall be continuous time rated in accordance with NEMA Standard MG 1. Refer to the driven equipment specification for custom motors or special purpose motors with voltage rating above 460 volts.

Unless specified otherwise, motors shall have a service factor of 1.15 with additional 15-percent horsepower. Motors shall not be required to exceed the nameplate rating at service factor 1.00.

C. MOTOR TYPE CLASSIFICATIONS

1. GENERAL

a. Definition of terms shall be in accordance with NEMA MG 1.

2. TYPE 1 MOTORS

a. Enclosure: Open drip-proof, guarded ventilation openings (ODP).

b. Class F insulation and Class B temperature rise at the motor's nominal rating.

3. TYPE 2 MOTORS

a. Enclosure: Totally enclosed, fan cooled (TEFC).

b. Class F insulation and Class B temperature rise at the motor's nominal rating.

c. Conform to IEEE 841 Chemical Industry-Severe Duty rating through 500 Horsepower.

d. Surfaces shall be coated with a corrosion-resistant treatment such as an epoxy paint that passes ASTM B117 for 96-hours.

e. No load airborne sound power level below 90-dBA per MG 1 Part-9.

f. Breather/drain fitting instead of solid drain plug.

g. International Protection Standard IP55 bearing enclosure.

4. TYPE 3 MOTORS

a. Enclosure: Explosion-proof motors (EP or XP).

b. UL listed in accordance with UL 674 for Class I, Group D for Hazardous Atmospheres.

c. Bear UL Label for Class I, Division 1, Group D Hazardous locations.

d. UL-approved breather/drain device in the motor drain hole.

e. Class F insulation.

f. Nameplate: Indicate the UL frame temperature limit code T2A without thermostat and T2D with thermostat.

g. Rated for the UL surface temperature limit codes for Class I Group D for gasoline, petroleum, alcohols, natural gas etc:

1) Motor designed below the UL frame temperature limit code T2A of 280 degrees C or

2) Provide an internal frame temperature thermostat that meets the UL frame temperature limit code T2D of 215 degree C with normally closed contact rated 5-amperes at 115-Vac.

D. THERMAL PROTECTION

Type 1, Type 2 and Type 3 motors that require motor over-temperature protection, as defined in NEMA MG 1-12, with the motor controller interface wiring and devices as indicated on the drawings for the following:

1. Inverter duty motors and totally-enclosed-air-over (TEAO) motors:

   a. NEMA Type-2 motor over-temperature self-protection: Thermal-overload, self-reset bimetallic Klixon switch for motors 5 horsepower and smaller.

   b. Motors larger than 5 horsepower require controller alarm / trip:

      1) Self-powered by motor temperature or by motor voltage: the motor mounted auxiliary device with two Form-C output contacts wired to variable speed or adjustable frequency drive to shut down the motor controller. Both the normally open contact and the normally closed contact shall be available at the motor terminal box for remote alarm and shutdown functions. Indicate the setpoints on the temperature device nameplate.

      2) Non-self-powered power thermal devices are prohibited.

      3) Factory set thermal protection device with alarm and trip setpoints indicated on the motor device nameplate.

      4) Factory wired to separate motor termination box.

2. Motors 300 horsepower and larger and higher voltage. (Not Used)

3. Auxiliary equipment shall have normally closed NEMA ICS 2 B300 contacts and shall be housed in NEMA 250 enclosures as follows:

   a. Type 1 motors NEMA 12.

   b. Type 2 motors NEMA 4.

   c. Type 3 motors NEMA 7D.

E. INVERTER DUTY MOTORS

Motors for use with adjustable frequency controllers shall be inverter duty motors specifically designed for inverter service for the speed range and load torque characteristic required by the associated driven equipment. Inverter duty motors shall be specifically certified compatible with the adjustable frequency controller and driven equipment, as specified in Section 11000-1.02C Unit Responsibility.

Motors for use with adjustable frequency controllers shall not exceed NEMA MG 1, Class B temperature rise when operating over the specified speed range on the adjustable frequency controllers with the specified load speed/torque characteristic.

Inverter duty rated motors shall have 4:1 turndown with variable torque motor controllers or constant torque motor controllers rating designed to operate from 25% of base speed to base speed continuously with full load current and torque without exceeding the Class F insulation with B temperature rise.

Torque requirement for greater turndown and slower speed applications is a custom design; refer to the driven equipment specification for additional requirements. Inverter duty rated motors shall be designed to operate over the speed or frequency range specified.

Motor insulation shall be designed to meet 2000-volt peak at a minimum of 0.1 microsecond rise time which exceeds the NEMA MG 1, Part 31: 1600-volt peak requirement for the 460 volt motors.

Provide inverter duty motors with NEMA Type 2 over-temperature protection as specified in NEMA MG 1-12. Provide motor mounted and motor-powered winding temperature device with a 5-ampere normally open and normally closed output contacts at the motor terminal box for monitoring by the adjustable frequency controller and shutdown where the temperature exceeds 165 degree-Centigrade.

Inverter duty motors shall have electrically insulated bearings or shall be equipped with a shaft-grounding unit mounted on the fan housing with stub shaft extended from the motor shaft. Larger motors, using the shaft-grounding unit, shall be equipped with two brushes, totally enclosed, and sealed against environmental contamination.

F. VERTICAL MOTORS

Vertical motors shall be solid-shaft P-base type specifically designed for vertical installation. Thrust bearing rating shall be compatible with the loads imposed by the driven equipment. Universal position motors are not acceptable.

Vertical motors shall conform to Type 1, Type 2, or Type 3 in accordance with the location and use. Vertical motors specified or indicated as rated for Inverter Duty Motor shall be as specified herein.

G. MOTOR EFFICIENCY

NEMA Premium™ efficiency electric motor, single-speed, polyphase, 1-500 horsepower, 3600-rpm 2-pole, 1800-rpm 4-pole, and 1200-rpm 6-pole, squirrel cage induction motors, NEMA Design A or B, continuous rated. NEMA Standards Publication MG 1 2003, in Tables 12-12 and 12-13, respectively.

Table 1
Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated 600 Volts Or Less (Random Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
1	82.5	85.5	77.0*	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4
250	95.4	95.8	95.0	95.8	96.2	95.8
300	95.4	95.8	95.4	95.8	96.2	95.8
350	95.4	95.8	95.4	95.8	96.2	95.8
400	95.8	95.8	95.8	95.8	96.2	95.8
450	96.2	96.2	95.8	95.8	96.2	95.8
500	96.2	96.2	95.8	95.8	96.2	95.8

Table 2
Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated Medium Volts 5kV or Less (Form Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
250	95.0	95.0	94.5	95.0	95.0	95.0
300	95.0	95.0	94.5	95.0	95.0	95.0
350	95.0	95.0	94.5	95.0	95.0	95.0
400	95.0	95.0	94.5	95.0	95.0	95.0
450	95.0	95.0	94.5	95.0	95.0	95.0
500	95.0	95.0	94.5	95.0	95.0	95.0

Motors in Table 3 shall be in accordance with IEEE 841 minimum nameplate efficiency for energy efficient 900-rpm 8-pole motors determined in accordance with IEEE 112B testing procedures.

Table 3
IEEE STD 841-2001

Horsepower	Guaranteed Motor Minimum Efficiency (percent)
1	70.0
1.5	72.0
2	80.0
3	81.5
5	82.5
7.5	82.5
10	86.5
15	86.5
20	87.5
25	87.5
30	89.5
40	89.5
50	90.2
60	90.2
75	91.7
100	91.7
125	92.4
150	92.4

Table 3
IEEE STD 841-2001

Horsepower	Guaranteed Motor Minimum Efficiency (percent)
200	92.4
250	93.6
300	94.1
350	94.1
400	94.1
450	94.1
500	94.1

H. CONDUIT BOXES

Conduit boxes shall be sized based on the conduit number and conduit size indicated on the drawings. Provide over-sized boxes with the number of openings as required to accommodate the conduits required. Replace undersized conduit boxes.

Conduit boxes shall be split construction with threaded hubs and shall conform to IEEE 841 for Type 2 motors. Motors shall be furnished with petroleum-resistant gaskets at the base of the conduit box and between the halves of the conduit box

Conduit boxes shall be designed to rotate in order to permit installation in any of four positions 90 degrees apart. Motors shall have grounding lug located within the conduit box for the ground connection.

Provide separate conduit boxes for temperature devices and space heaters.

I. BEARINGS

Bearings may be oil or grease lubricated ball bearings, angle contact roller bearings for axial thrust loads, and cylindrical bearings for radial-only loads. Bearings shall be rated for a minimum L-10 life of 100,000 hours in accordance with ABMA 9 or 11 at the ambient temperature specified.

Motor designs employing cartridge type bearings will not be accepted. Bearings shall be fitted with lubricant fill and drain or relief fittings. Belt loads shall not exceed forces calculated from NEMA MG 1 Table 14-1.

J. LIFTING EYES

Provide lifting eyes per NEMA standard with a safety factor of 5. Generally, motors weighing more than 50 pounds shall be fitted with at least one lifting eye and motors over 150 pounds or 150 horsepower shall be fitted with two lifting eyes.

K. SPACE HEATERS

Where shown on the Drawings or Schedules, furnish motors with space heaters to prevent condensation inside the motor enclosure after motor shutdown and maintain the temperature of the winding at not less than 5-degree C above outside ambient temperature.

Heaters shall be flexible wraparound type rated 120 volts, single phase, 60 Hertz. The space heater rating in watts and volts shall be noted on the motor nameplate or on a second nameplate. Space heater leads H1 and H2 shall be brought to a separate terminal block or pigtails in the motor conduit box or separate conduit box with a threaded conduit opening. Provide separate label on small motors.

L. MOTOR SHAFT GROUND RING

Provide shaft ground ring (SGR) kit during factory motor assembly on inverter duty motors with NEMA ODP enclosures and TEFC enclosures operating on AFD motor controllers, including motors with insulated or ceramic bearings.

SGR kits shall be factory install. If not received with the kits installed, then field install the kits: Install the shaft ground ring, adhesive ring, grounding pig tail in accordance with the manufacturer's installation instructions. Ground the motor frame to the ground grid.

Do not provide SGR grounding kit devices on explosion proof motors located in Division 1 or Division 2 hazardous locations, provide alternate factory provided means.

Provide Electro Static Technology's AEGIS Shaft Grounding Ring Pro Series for Bearing Protection http://www.est-aegis.com/index.html or approved equal:

1. Install circumferential ring of conductive micro fibers to reduce the shaft voltage, to divert current away from the bearings, and to protect bearings in attached equipment.

2. Install on either drive-end or non-drive-end of motors less than 100-horsepower.

3. Insulate the one bearing and install Shaft Grounding Ring on the opposite drive-end of motors 100-horsepower and larger.

4. Install with conductive epoxy to ensure ground connection from the SGR to motor frame.

5. Verify the discharge path for shaft voltages to ground.

2.05 PRODUCT DATA

The following product data shall be provided for each motor in accordance with Section 01300:

1. Operating and maintenance information as part of the motor driven equipment O&M manual as specified in Section 01730.

2. Include overhaul instructions in operation and maintenance information for motor driven equipment that is 50 horsepower and above.

3. Factory motor prototype test results specified in paragraph 11060-1.02 C.

4. Written warranty specified in paragraph 11060-1.02 D.

PART 3 – EXECUTION

3.01 GROUNDING AND BONDING

Verify the circuit ground cable (green) is identified and connected to the grounding lug terminal in the conduit box.

Provide supplementary grounding by installing a bond from the motor frame to the grounding electrode system or as indicated on the drawings. Verify Shaft Grounding Rings are installed per manufacturers recommendations and that

3.02 FIELD COATING OF MOTORS

Provide motors with the field applied, Epoxy Coating System E-2 with thickness of 16 mils dry film in accordance with specification Section 09900 – Coating Systems for motors located in corrosive environments.

3.03 FIELD TESTING

Verify breather/drain fittings have been installed as specified herein. Winding insulation resistance for motors shall be not less than 10-megohm measured with a 1000-Vac megohmmeter at 1-minute at or corrected to 40-degree C.

END OF SECTION

SECTION 11069

ADJUSTABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE

This section specifies 480 Vac rated adjustable frequency drive motor controller systems using insulated gate bipolar transistors (IGBT) for pulse width modulation technology (PWM).

The AFDs specified in this section shall be the product of a single vendor and mounted in the specified cabinet enclosure or motor control center when required as shown on the drawings.

The terms AFD (adjustable frequency drive), ASD (adjustable speed drive), VFD (variable frequency drive), and VSD (variable speed drive) are interchangeable for the purposes of this specification.

Refer to the drawings for control and monitoring requirements including special interlocking requirements. Refer to the Control Specification 17010 for the control description for the AFD systems.

B. SYSTEM REQUIREMENTS

The AFD system shall convert 460 volt, 60-Hertz nominal input to a suitable voltage and frequency to cause a premium efficient, inverter duty, squirrel-cage induction motor to run at a speed proportional to an external input analog 4 to 20 ma dc or digital input command as specified for the required AFD speed range.

The AFD system shall include active front end drives, rectifier units, inverter units, control circuitry, protective equipment, input line reactors and output load reactors and other filters and accessories as necessary to provide the specified functions to meet voltage and current harmonics at the specified point of common connection and to mitigate the motor reflected voltage wave. Unless otherwise specified, the point of common connection for AFDs shall be the 480 distribution bus (motor control center, distribution panel, etc.) immediately upstream of the AFD.

The AFD system torque requirement shall match the pump torque requirement. Verify the equipment type and select variable torque (VT) or constant torque

(CT). Select 6-Pulse units for motors less than 100 hp and 18-Pulse units for motors 100 hp and larger.

AFDs shall be provided as shown on the drawings.

C. ENVIRONMENTAL CONDITIONS

Ambient conditions are specified in Section 01800.

D. SEISMIC

Freestanding AFDs shall be braced per Section 01900.

1.02 QUALITY ASSURANCE

A. REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
IEEE 519	IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power System
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 2	Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
NEMA ICS 6	Industrial Control and Systems: Enclosures
NEMA ICS 7	Industrial Control and Systems: Adjustable-Speed Drives

Reference	Title
NEMA ICS 7.1	Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems
NFPA 70	National Electrical Code (NEC)
UL Standard 508	Industrial Control Equipment

B. INDUSTRY STANDARDS

The AFD shall be UL 508 listed and shall conform to the requirements specified in NEMA ICS 2, 6, 7 and 7.1.

C. UNIT RESPONSIBILITY

The Contractor shall assign unit responsibility for the adjustable frequency drives in this section as specified in paragraph 11000-1.02 C. The Contractor shall submit letters of certification with the shop drawings from the AFD manufacturer, the motor manufacturer, and the driven equipment manufacturer stating that they have reviewed each application and that the combination will satisfy the application duties required, for the actual motor sizes required, regardless of deviations from the scheduled "nominal horsepower."

1.03 PRODUCT HANDLING

AFD units shall be shipped in air-cushion vans to ensure against shipping damage and packed in suitable protective containers. The units shall be inspected upon receipt for damage.

1.04 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

   Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

   The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal.

   If no changes are required, the drawing or drawings shall be marked *"no changes required"*. Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

3. Certificate of Unit Responsibility attesting that the Contractor has assigned, and that the manufacturer accepts, unit responsibility in accordance with the requirements of this Section and paragraph 11000-1.02 C. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.

4. Catalog and technical data including outline dimensions, shipping section dimensions, weight, and foundation requirements for all assemblies.

5. Schematic diagrams and wiring connection diagram showing functions and identification of terminals.

6. Voltage and current Total Harmonic Distortion (THD) calculations with line reactors or filter design to mitigate harmonics to meet IEEE-519, if applicable.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

The Owner and Engineer believes the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section. AFDs shall be installed in the custom enclosures as specified and Candidate manufacturers include:

1. ABB ACS-600
2. Toshiba Series:
   a. W7 18-Pulse for centrifugal fan and pump motors
   b. G7 18-Pulse for slow speed and high-torque motors

3. Cutler-Hammer SV9000
4. General Electric AF-300
5. Siemens Model 6SE32
6. Square D Altivar Series
7. Robicon
8. Allen Bradley
9. Or equal

2.02 ENCLOSURES

Enclosures shall be provided as specified in Section 16176 including enclosure types, heating and ventilating.

Provide each indoor mounted AFD in a NEMA 12 ventilated and filtered enclosure with fan cooling and conformal coating protection on circuit boards for corrosive atmosphere protection. The air filters shall be washable type.

Provide outdoor mounted or corrosive area mounted AFD in a NEMA 4X enclosure with dead front enclosure, inner door and panel air conditioning unit for cooling. Enclosures shall be shall meet the requirements of Section 16176.

A. GENERAL

Provide enclosures with AFDs and custom control as required for the project and as indicated on the drawings. Each drive shall be designed for stand-alone operation and multiple drives shall not utilize shared components. Review the project site location, elevation, temperature, humidity, plant atmosphere, and load current-torque requirements to size the AFD and its associated enclosure with requirements specified herein and the control and monitoring devices and interlocks as indicated.

Enclosures shall be designed for indoor service. Each AFD system shall be mounted in a NEMA 250 internally force ventilated enclosure with UL approved Class 1 filters on ventilation openings. Enclosures shall be fabricated from 12-gage minimum thickness sheet steel with an interior frame or formed to provide a rigid structure.

Provide enclosure size to allow entry of power source and motor load cables as indicated on the drawings. Submit drawing of the source and load power cable location within the enclosure and indicated barriers from control and instrument wiring.

Door width shall not exceed 30 inches and shall be hung on removable-pin hinges, with three-point latch hardware, and handle latch for 3/8-inch-shackle padlock.

B. FINISH AND COATINGS

AFD systems enclosures shall be finished with corrosion protection coatings inside and outside for hydrogen sulfide atmospheres. The electrical and electronic assemblies shall have conformal coatings.

2.03 AFD ASSEMBLIES

A. GENERAL

AFDs shall include the following assemblies:

1. Flanged type power disconnect using a thermal magnetic circuit breaker sized for the specific application by the manufacturer.

2. 6 pulse drives shall include a line input reactor or harmonic filter, for harmonic mitigation.. MTE RL reactors, 3-5% impedance open reactor, MTE AP Matrix Filter or approved equal.

3. 6 pulse drives shall include a load harmonic filter with adaptive passive technology for dV/dT mitigation or motor terminator units for addressing dv/dt effects at the motor for all motors 300 feet or more from the AFD. MTE Matrix Series dV or approved equal. For distances between 50 – 300 feet a load reactor shall be provided. MTE RL reactors, 5% impedance open reactor or approved equal.

4. Rectifier, direct current bus filter, and inverter.

5. Control circuitry interface with Operator Interface Unit.

6. Output protection including phase overload.

B. AFD FEATURES

Provided with the following features:

1. Fused control circuit transformer and microprocessor for system logic sequencing functions. Provide fuses with blown fuse indicator lamps.

2. Accept 4 to 20 mAdc speed reference signal.

3. A 4 to 20 mAdc output signal proportional to inverter output frequency for the speed range specified.

4. Adjustable minimum/maximum frequency limits:

   a. Minimum frequency shall be adjustable from 6 to 40 Hertz.

   b. Maximum frequency shall be adjustable from 48 to 90 Hertz.

5. Adjustable and independent timed linear acceleration and deceleration functions, adjustable from 6 to 20 seconds.

6. Current limiting.

7. Automatic restart.

8. Control Wiring:

   a. 600 volt stranded copper

   b. 90 degrees C color-coded insulation

   c. No. 16 AWG

9. Wiring Identification and Termination: Sleeve type markers at each termination point and numbered terminal blocks for external connections.

10. Electrically isolated discrete output contacts for running, remote mode status and trouble alarm.

11. Control Power: Provide a 120 Vac, triple fused, control power transformer for cooling fans and external control circuits when required. Control circuits shall be isolated from power circuits by distance and by insulated barriers.

12. Provide 120 Vac or 24 Vdc as required for Operator Interface Unit.

13. Drives for submersible pump motors shall be furnished with circuitry to interface with the motor leak and temperature protection modules (such as the Flygt CAS module). Coordinate with pump supplier and obtain the pump/motor protection devices for mounting in the VFD enclosure as required. See the pump motor schematic diagram shown on the drawings for additional information.

C. FUNCTIONAL REQUIREMENTS

1. Supply Power: Operate continuously with supply power of 480 volts plus or minus 10 percent, 60 Hertz plus or minus 3 percent and remain on line and operate without damage to the AFD or connected load during a supply

power under-voltage variation to the drive up to 85% of its nominal value for 30 milliseconds at full load.

2. Environmental Conditions

   a. Ambient temperature: refer to Section 01800.

   b. Atmosphere: refer to Contract drawings and Section 16000.

3. Load: Capable of driving the specified maximum motor load continuously and under the following conditions:

   a. Deliver 110 percent of the specified load for up to 60 seconds in variable torque applications.

   b. Deliver 150 percent of the specified load for up to 60 seconds in constant torque applications.

4. Efficiency: Not less than 95 percent at 60 Hertz output driving the specified maximum load at rated torque and speed at 40 degrees C ambient based on measured input power versus output power with all specified components in the system.

5. Frequency And Voltage Regulation: Output frequency regulated to within 0.6 Hertz of the signal/output frequency relationship. Output voltage regulated to within 1.0 percent to produce minimum motor heating at any operating frequency within the specified range.

6. Frequency Range: AFD shall be capable of continuous operation with the specified load at any frequency between 6 and 60 Hertz unless noted otherwise.

7. Space And AFD Access

   a. Enclosure size shall not exceed the size allotments specified on the drawings nor shall any portion of the AFD system exceed a height of 90 inches.

   b. Front accessible only and shall not require rear access.

   c. Mount against the wall without any clearance for ventilation or other purposes.

   d. Submit AFD in the enclosure drawing with the detail of front door and the internal arrangement, including the feeder and motor cables,

and the control cables, and the instrument cable location and terminations.

8. Ambient Noise: Free field noise generated shall not exceed 85 dBA at 3 feet out from any point on the AFD enclosure under any normal operating condition.

9. Motor Coordination: AFDs shall be configured as required to maintain output voltage peaks at the connected motor windings from reaching levels damaging to the motor insulation. Provide protection integral to the AFD or as protective hardware to be installed at the motors.

   Where motor terminator units are provided, they shall be rated for the environment in which they are located. Motor terminator units shall be:

   a. Allen Bradley 1204 Motor Terminator for AFD with the maximum carrier frequency of 6 kilohertz,

   b. Cutler Hammer Reflected Wave Trap (RWT) with the maximum carrier frequency of 12 kilohertz,

   c. Or Equal product.

D. PROTECTION AND ANNUNCIATION

1. Overcurrent Protection: Electronic current limit at 150 percent of motor nameplate current and provide motor running overcurrent protection in compliance with NFPA 70.

2. Short Circuit Protection: Protected against load faults: bolted faults, phase to phase or phase to ground shall not damage the unit. Fault protection based on a power source short circuit capacity of 65,000 amperes RMS symmetrical at the AFD power input terminals with impedance or current limiting device provided.

3. Line Voltage: Protected against high and low line voltage all phases.

4. Internal Faults: Internal fault monitoring system to detect malfunctions to protect from transient and sustained faults and to limit damage that may be caused.

5. Motor Over Temperature: Interface to motor over temperature device 2-ampere output contact to shut down and alarm if the motor becomes overheated.

6. Fault Alarm: Indicates the cause of any shutdown visible on the AFD keypad/display without opening the AFD enclosure. As a minimum, the following faults shall be alarmed:

    a. Motor over-temperature.

    b. Motor overcurrent.

    c. Incoming power line over/under/unbalanced-voltage.

    d. AFD over-temperature.

    e. AFD over-voltage.

    f. AFD control failure.

7. Safety Features: The AFD shall include:

    a. Flanged mounted padlockable main disconnect handle.

    b. Mechanical interlock to prevent opening enclosure door with disconnect in the "ON" position while the unit door is open.

    c. Auxiliary contact on main disconnect to isolate 120Vac control power when fed from external source.

    d. Barriers and warning signs on terminals that are energized with the power disconnect "OFF".

    e. Separation and insulated barriers between the power and control and instrument products.

    f. External emergency stop input.

8. Reverse Direction Protection: Provide protection from inadvertent operation in reverse where reverse rotation can damage the driven equipment.

9. Critical Speed Bypass: Provide capability to program speed bypass for minimum two critical speed points.

10. Transient Voltage Protection: Provide solid state transient voltage protection to meet or exceed ANSI C37.90.

2.04 CONTROL AND MONITORING DEVICES

Front door mounted on the AFD enclosure between 36 and 72 inches above the floor for each unit:

1. Digital Operator keypad/display.

2. Hand/Off/Auto door mounted selector switch.

3. Manual speed control: potentiometer

4. Provide the following local indicators and controls with 30mm NEMA 4 oil tight devices as specified:

    a. Hand/Off/Auto door mounted selector switch.

    b. Status Indicators (ON, OFF, FAULT).

    c. Reset Pushbutton.

    d. Emergency Stop.

    e. Any additional features as shown on the contract drawings; including schematics and P&ID diagrams.

5. Internal terminal strips for remote monitoring:

    a. Run status.

    b. Trouble / Fail alarm.

    c. Auto Mode status.

    d. Motor speed feedback 4-20mA.

    e. Motor Current, 4-20mA.

    f. Additional devices as indicated on the drawings.

A. OPERATOR INTERFACE UNIT

1. Digital keypad/display for monitoring and controlling the drive and to input drive parameter settings with a backlit LCD or equally visible display with a minimum of 16 characters per line.

2. Digital keypad for numerical settings in English engineering units and a guide to parameter settings. Setup operations and adjustments stored in non-volatile EEPROM memory transferable to new and spare boards. Settings shall be protected from unauthorized tampering, revision, or adjustment by a personal lockout code.

3. The digital keypad to provide programming of the drive and include:

a. Up and Down arrow keys: Increase or decrease output frequency or data values.

b. Monitor key: Selection of control mode.

c. Run and Stop keys: Starting and stopping in the manual mode.

d. Fault clear / Enter keys: Reset fault conditions and enter changes.

e. Program key: Enter the program mode and adjust parameters.

f. Remote / Local Location keys: Operation location and local speed control.

g. Auto / Manual Mode keys: Program mode.

h. Number keys: 0 through 9 keys to access specific parameters.

i. Keypad digital illustrations: English and display the last 5 faults.

j. Frequency / Motor Speed Indication: Calibrated in Hertz and RPM.

k. Run Status Indication.

l. Ready Status Indication.

m. Fault Alarm Indication.

B. CONTROL AND MONITORING COMMUNICATION

1. Additional analog I/O as required for the project.

2. Additional discrete I/O as required for the project.

2.05 KEYPAD FUNCTIONS AND OPERATION

Adjustment of the following parameters through the OIU digital keypad:

1. Current limit and torque boost.

2. Maximum voltage level.

3. Minimum/Maximum speed, Volts/Hertz, Upper and Lower limit.

4. Adjustable acceleration rate and deceleration rate.

5. Electronic thermal overload setting.

6. Coast, controlled ramp or DC injection selectable modes of stopping.

7. PID setpoint and time-function selection.

8. Critical frequency avoidance: Three set points selectable from 0 to maximum frequency with set points adjustable from 0-30 Hertz.

2.06 SPARE PARTS

The following spare parts shall be supplied with each type or frame size AFD:

1. Three sets of all replaceable fuses.

2. 10 of each type pilot light lamp.

3. Three of each type relay.

2.07 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Operation and maintenance information as specified in Section 01730, including:

   a. Final reviewed submittal.

   b. As-built drive configuration settings.

2. Installation certification Form 11000-A as specified in paragraph 11069-3.01.

3. Training certification Form 11000-B as specified in paragraph 11069-3.03.

PART 3 – EXECUTION

3.01 FIELD INSTALLATION

Each adjustable speed controller shall be installed and tested by the Contractor with the assistance of factory-trained pump manufacturer engineer/technician and AFD engineer/technician in accordance with the manufacturer's specifications and Section 11069, and witnessed by the Engineer.

Manufacturers' factory representatives shall provide field testing for devices including the setup of the Operator Interface Unit and the setup of the data communication devices, where used. Upon satisfactory completion of the testing, the Contractor shall submit two certified copies of the test report to the Engineer.

Component failure during testing will require repeating any test associated with the failure or modified components to demonstrate proper operation.

The installation shall be certified on Form 11000-A specified in Section 01999.

1. Adjust drive and perform "start-up" tests as recommended by manufacturer. Set parameters and carrier frequency for existing motors to avoid insulation damage.

2. Establish proper direction of rotation for the motor controlled by the drive. Verify that the AFD is precluded from operating in a direction that can damage the driven equipment. Change motor or AFD power lead connection and not the AFD direction, where rotation is incorrect.

3. Verify that the drive will operate properly both in the "manual speed control mode" and in the "remote or automatic mode" from a remote speed signal input.

4. Set the maximum "locked rotor" current drawn during start-up recommended by the manufacturer and approved by the Engineer.

5. Set the minimum and maximum speeds and the acceleration and deceleration "ramps" recommended by the Engineer.

6. Verify the motor high temperature switch contacts are wired into the AFD 120 Vac control circuit and will trip on high winding temperature. Test or simulated the alarm and trip feature at the motor for high temperature and for high vibration, where used.

7. Operate the drive at 100 percent speed for one hour and monitor output current. The output current shall remain below the full load current listed on the motor nameplate.

8. Check for excessive heating of the drive and motor. Report any discrepancies to the Engineer.

3.02 HARMONIC TESTING

The Testing Firm specified in Section 01662 shall perform a harmonics acceptant test with all AFD motor controllers operating to verify compliance with IEEE-519 of less than 5 percent voltage THD and 12 percent current THD at the defined point of common connection when running from Power Utility power source with a BMI-Dranetz or equal harmonic test set that provides a hard-copy record of the test results.

The test shall also be run with power sourced from the standby generator where such a power source is being used at the project site. THD shall be limited to a maximum level of 8 percent voltage THD on standby generator operation.

Submit the test performance to the Engineer per latest version NETA ATS Acceptance Testing Specifications. Refer to the electrical testing specification Section 01662.

3.03 TRAINING

Two hours of onsite AFD operation and maintenance training shall be provided for the Owner's Operation and Maintenance Staff. Manufacturers' factory representative shall conduct the training, upon acceptance of a resume submitted by the trainer. Training shall be certified on Form 11000-B specified in Section 01999.

END OF SECTION

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SECTION 11350

DRY POLYMER ACTIVATION SYSTEM AND APPURTENANCES

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE

This section specifies a packaged polymer system suitable for metering, diluting, mixing, and pumping polymer. The units shall be suitable for the feed of all types of polymers specified in this Section.

B. DRY PREPARATION SYSTEM

1. The automatic polymer preparation/dilution make down system shall be an integrated equipment package capable of automatically preparing a homogenous polymer solution. The system shall be an automatically controlled, sequentially batching unit capable of preparing dry polymers.

2. The system shall incorporate two stage mixing. The first stage shall be a primary wetting bowl and the second stage will be an accelerated mixing zone that sends solution to an external mix tank.

3. System shall continuously supply the resulting polymer solution as controlled by level in external tanks.

C. EQUIPMENT LIST

Item	Value
Dewatering Polymer Blending Unit 1	CFR-7410
Dewatering Polymer Blending Unit 1 LCP	NR85-VCP-302

D. OPERATING CONDITIONS

Refer below for environmental conditions. Dilution water will be filtered plant water and is expected to range between 50 degrees F and 80 degrees F.

The polymer blending unit shall be provided with a local control panel for manual and fully automatic control as described in this specification section.

1.02 QUALITY ASSURANCE

A. REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A276	Stainless Steel Bars and Shapes
ASTM A320/A320M	Alloy/Steel Bolting Materials for Low-Temperature Service
NEMA 250	Enclosures for Electrical Equipment (1,000 Volts Maximum)
NFPA 70	National Electrical Code (NEC)

B. UNIT RESPONSIBILITY

The Contractor shall assign unit responsibility, as specified in Section 11000-1.02-C Unit Responsibility, to the manufacturer of the polymer system provided under this section. This manufacturer is the unit responsibility manufacturer and has unit responsibility, as specified in Section 11000-1.02-C Unit Responsibility, for both the equipment assembly specified in this section and for the Local Control Panel specified in this section and in Section 16176. A completed, signed, and notarized Certificate of Unit Responsibility (Section 11000-Form 11000-C) shall be provided.

C. FACTORY TESTS

The specified equipment with all mechanical and electrical components shall be completely assembled as a skid at the manufacturer's facility. Pump casings shall be hydrostatically tested to twice the discharge head. The skid shall be non-witnessed tested for desired functionality and operation at the manufacturer's facility prior to the shipment.

D. WARRANTY AND PERFORMANCE AFFIDAVIT

The system shall be covered by a conventional one-year limited warranty against defects in materials and workmanship. In addition, system installation shall be subject to the following provisions:

1. Polymer feed system shall be warranted for a period of 12 months from the date of start-up by authorized technician.

2. In addition, supplier shall warrant the system to operate in accordance with owner's expectation and performance. If dissatisfied with system performance for any reason, the owner shall have the right to return the system to vendor for a refund of vendor's sale price any time during the first 30 days following start-up.

1.03 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

A. SHOP DRAWINGS

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

3. Completed Certificate of Unit Responsibility attesting that the Contractor has assigned, and that the manufacturer accepts, unit responsibility in accordance with the requirements of this Section and Section 11000-1.02 Unit Responsibility. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.

4. Motor Data Sheets specified in Section 01999 and 11060.

5. Manufacturer's specifications verifying the equipment performance. Motor data sheet.

6. Dimensional drawings, showing required access and clearances, including any layout requirements of the equipment.

7. Equipment mounting information as specified in Section 11002.

8. Manufacturer's catalog data and shop drawings confirming dimensions, weight, construction, materials, and installation details.

9. Descriptive control sequences of the dryer's manual and automatic operation.

10. Equipment control panels:

    a. Schematic diagrams, including connections to remote equipment.
    b. Drawings showing scaled front and interior views.
    c. Bill of materials of components.
    d. Marked product literature for all components.

11. Marked product literature for all instruments and controls.

12. Installation reference list including contact information as specified in this section.

13. Manufacturer's written certification that the polymer blending unit is suitable for the required polymer being used at the facility. The certification shall state that no additional equipment, such as aging tanks, are necessary and that the available source water is adequate for the application.

14. Predicted performance curves developed for the specific application. Performance curves shall plot speed, capacity, head, horsepower, efficiency, and NPSH required for the specified operating range for the pumps provided on the skid.

15. Shop drawings including location of all piping, electrical, instrumentation, and structural connections.

16. Descriptive control sequences of the polymer blending unit's manual and automatic operation.

17. PLC program listing printout and SCADA Input/Output List with detailed descriptions per paragraph 2.04 Local Alarms to support development of Plant Control System interface. Vendor shall coordinate with Owner and Systems Integrator regarding tagging requirements and I/O list standards. If submittal is electronic, entire submittal electronic file shall be compressed to reduce file size.

18. HMI screen printouts.

B. OPERATION AND MAINTENANCE

1. Applicable operation and maintenance information as specified in Section 01730, including
   a. Final reviewed shop drawing submittal.
   b. As-built drawings, PLC program listing, HMI screen printouts and SCADA Input/Output list.
   c. Range and setting of indicators, instruments, timers, and other related devices.
   d. Equipment Warranty.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

The Owner and Engineer believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. Dry polymer activation system shall be ProMinent, Polyrex 6.6, no equal.

2.02 MANUFACTURED UNITS

ProMinent Polyrex preparation shall have the capability to automatically prepare dry, polymers. The entire system shall be an integrated package pre-piped, prewired, skid-mounted system whose dimensions shall not exceed 138" high X 122" wide X 94" deep.

2.03 MATERIALS

Materials of components shall be as follows:

Component	Material
Mixing chamber	304 Stainless Steel Steel with PVC internal components
Polymer pump suction and bearing housing	Type 316 Stainless Steel
Polymer pump rotor	Type 316 Stainless Steel
Polymer pump drive shaft	Type 316 Stainless Steel
Polymer flow meter wetted parts	Type 316L Stainless Steel
Skid	Type 304 Stainless Steel

2.04 EQUIPMENT

A. POLYREX WETTING ASSEMBLY

1. The Polyrex wetting system uses a step-by-step mixing system to effectively hydrate and mix the polymer. The first stage is the hydration system which utilizes wetting funnel to create a vortex effect. The second step utilizes a water ejector to create an accelerated mixing energy zone. The third stage is achieved in the efficient and gentle agitation achieved in the primary mixing tank.

2. Also included is an outlet valve to prevent moisture from reaching the polymer powder. The wetting system shall be enclosed to prevent any airborne dry polymer particles from escaping.

Each dry polymer activation system unit shall be a complete package that automatically dilutes, activates and feeds dry polymer and water. Blenders shall instantaneously invert polymer into solution, producing a thoroughly diluted and completed activated homogeneous blend, free of “fish-eyes” and unblended polymer. Units shall be capable of delivering a consistent dilute polymer solution at an adjustable rate of flow and concentration. Each unit shall be an integrated package, pre-piped and prewired.

B. OPERATION PROCESS

1. Operation shall be initiated by low level in external mix/hold tank. This shall start the Polyrex wetting assembly, water, and polymer feeder to begin in a timed sequence, preparing a batch of polymer at a preset concentration. Polymer batch concentration is selected via a panel-mounted polymer feed timer. A high level in mix/hold tank shall initiate the shutdown sequence. The shutdown shall turn off polymer feeder (assuming it has not completed timing sequence) while allowing disperser water flow to flush the system and plumbing of activated polymer.

C. WATER FLOW

1. Dilution water flow shall be maintained at a rate of up to 44 gpm at a minimum of 58PSIG and maximum of 87PSIG. Dilution line assembly shall include a pressure reducing valve, pressure switch, solenoid valve and shut-off valve

D. Total electrical service shall be 240/480VAC - 60 Hz - three-phase - 15 amps.

E. Noise level of polymer preparation unit shall be at or below 80 decibels.

F. COMPONENTS

1. Volumetric Feeder

a. The volumetric feeder shall be a multi-screw feeder assembly. The feeder will consist of a minimum of 2 counter turning screws. Single screw feeders shall not be acceptable.

b. Volumetric feeder shall deliver a linear discharge with accuracy of 0.25-0.5%. Feeder screws shall be self cleaning and hollow wound wire or bar stock feeder screws are not acceptable.

c. The feeder screws shall be support by solid shaft and bearings on both the drive and the discharge sides. Freely hanging discharge feeder screws are not acceptable.

d. The discharge port of the multi-screw volumetric feeder shall be completely enclosed to prevent inadvertent drifting of airborne polymer dust and protect feeder discharge from environment.

e. Dry polymer shall rely on gravity to transfer from feed device to wetting device.

f. The volumetric feeder shall include a low-level powder switch to indicate low hopper level

2. Operator Control Panel

a. The system shall have a control panel for fully automatic control. Control panel construction shall be NEMA 4X, door mounted operator interface module, and programmable controller (inside cabinet) for sequencing control.

1) Operator interface shall display messages with LCD, multi-character display and shall function as switches, timers, counter, lights and alarm indication.

2) Operator interface shall clear all PLC faults without use of external programmer.
3) Operator interface shall show status and condition of all monitored parameters, i.e. tanks levels, powder refill levels, pressure switches, heating cones, mixer status
4) Operator interface shall display specific alarm condition in words to facilitate troubleshooting.
5) Operator interface shall contain alarm silence and alarm reset pushbuttons.
6) Operator interface can be programmed with a security passcode.

3. Illuminated emergency stop pushbuttons shall be provided that will disable the system at any point in its cycle and re-start the cycle at the exact point previously disabled. Operator interface module shall remain usable while in an E-stop condition for changing control settings.

4. Panel door shall have "system enabled" and "system not enabled" lights to indicate system readiness for automatic operation. A power light shall indicate power available.

5. Front panel mounted controls shall be industrial duty.

6. Panel shall include an audible alarm for all monitored alarm conditions.

7. Supplier shall prove operation reliability by providing (5) five references for this specific control system, which have been operating successfully for at least (6) six months.

G. OTHER INSTRUMENTS

Provide stainless steel glycerin filled pressure gauges.

H. STAINLESS STEEL SKID

Polymer blending unit components shall be integrally mounted on a frame. All pipe supports shall be stainless steel. No mild steel shall be used. The frame shall be constructed of 3/16-inch angle or structural stainless steel tubing. The panel supporting the control panel shall be a minimum 12 gauge thickness.

Secure piping, valves and other components with rigid clamps. The frame shall be designed for lifting and shall have holes for mounting on concrete pads.

I. MOTORS

Motors shall conform to the requirements of Section 11060. Motor enclosures shall be TEFC and corrosive/washdown rated.

2.05 CONTROLS

A. CONTROL DESCRIPTIONS

1. Operator shall be allowed to start and stop the blending unit, set the polymer flow and dilution water flow using the local control panel's HMI when the HOA is in the Hand position.

2. Operator shall be allowed to enter the following operating parameters through the HMI when the HOA is in the Auto position:

    a. Polymer percent active concentration
    b. Average sludge concentration, percent
    c. Pound of polymer per ton of dry solids
    d. Polymer specific gravity
    e. Diluted polymer concentration, percent.

Prior to starting and stopping the polymer feed pump at the initiation of the remote start/stop signal, the blending unit shall initiate a start-up and shutdown flush in accordance with the operator entered setpoints.

B. CONTROL PANELS

Provide a control panel integral to the system's frame rated NEMA 4X and constructed of fiberglass reinforced plastic (FRP). The control panel shall consist of all switches, relays, indicator lights, digital displays, transformers, and controllers as required herein. The blender components shall be factory wired to the control panel for power supply and control.

An external lockout/disconnect for 480 Vac, 3 phase electric power source shall be provided for each blending unit control panel.

Control Panel Lights:

1. Power ON indicator light.
2. Common alarm light.
3. Panel light colors.

C. CONTROL DEVICES

Provide the following control devices:

1. Programmable Logic Controller (PLC) to control the operation of the blending unit in any mode of operation. PLC shall be Allen-Bradley Compactlogix 1769-L33ER PLC program to be written by Vendor in Ladder Logic or Function Block Diagram using Allen Bradley Studio 5000 Version 24. Vendor shall coordinate with Owner for seamless operation with Plant SCADA.

2. A liquid crystal display (LCD) 10" minimum touchscreen operator interface terminal (OIT) shall be provided for input of operating setpoints, alarm setpoints, monitoring of blending unit operation, and to acknowledge or clear alarm conditions. Provide Allen Bradley Panelview Plus or equal. The polymer dilution and feed unit control panel shall have, as a minimum, the following displays and lights or be integrated into the OIT system:

    a. Actual polymer flow rate,
    b. Actual dilution water flow rate,
    c. Actual diluted polymer (solution) concentration,
    d. Hand-Auto status,
    e. Alarm setpoints and time delays,
    f. Alarm status, and
    g. Diluted polymer pressure.

3. Hand–Off–Auto (HOA) switch.

4. Heavy-duty emergency stop push button with red knob.

5. Polymer pump selector switch.

D. INTERLOCKS

The polymer pump shall be interlocked to shutdown in any mode of operation on the following alarm conditions:

1. Low dilution water flow

2. Low dilution water suction pressure

E. LOCAL ALARMS

Polymer blending unit shall be capable of generating the following alarms with adjustable time delays:

1. Polymer blending unit failure when unit is unable to maintain the setpoint polymer flow rate and setpoint diluted polymer (solution) concentration.

2. Low dilution water flow (operator adjustable)

3. Low dilution water suction pressure

F. REMOTE INPUT AND OUTPUTS

The polymer blending unit control panel shall provide the following alarms, control signals, and status signals to/from Plant Control System. Analog signals shall be 4 to 20 mAdc, discrete inputs and outputs shall be dry contacts. Alarms and status shall be communicated to SCADA over the network. Refer to drawing I-10-604.

1. Control Inputs:
   a. Remote start/stop

2. Status Outputs:
   a. Dilution water pump status (running or stopped)
   b. Polymer blending unit control status (HAND or AUTO)
   c. Equipment Running
   d.

3. Alarm Outputs:
   a. Common alarm
   b. Estop
   c. Equipment Fail

G. SCADA INPUT/OUTPUT LIST

Provide a SCADA I/O list in Microsoft Excel format for each type of polymer blender control panel. Include the following: LCP name (typical). The list shall be used as a check-off during testing. Include the following column headings filled in:

1. Tag name
2. I/O type
3. Communication register number
4. Description
5. P&ID drawing number
6. Register raw data count range (analog)
7. Minimum range value (analog)
8. Maximum range value (analog)
9. Alarm setpoint (digital)

2.06 SPARE PARTS

A. MECHANICAL

The following spare parts shall be provided for each polymer blending unit of each size:

1. Special tools required for operation and maintenance.
2. Two (2) Feeder bearings
3. Tank Level Transmitter
4. Vacuum Conveyor Filter

Spare parts shall be tagged and stored as specified in Section 11000.

B. PLC PROGRAM

Provide separate copies of PLC and HMI programs on CD-ROM. Label with Owner's name, facility name, project name, Owner's project number, LCP name, date, and PLC or HMI manufacturer's programming software used name; model; and revision/version. Programs shall be provided after completion of testing.

2.07 PRODUCT DATA

The following product data shall be provided in accordance with Section 01300:

A. Manufacturer's Installation Certification Section 11000-Form A.

B. Manufacturer's Instruction Certification Section 11000-Form B.

C. Operating and maintenance information specified in Section 01730

D. Motor data specified in Section 11060.

E. Manufacturer's Warranty specified in paragraph 1.02

PART 3 – EXECUTION

3.01 INSTALLATION

The dry polymer activation system shall be installed in accordance with the manufacturer's written recommendations. The Contractor shall coordinate with the manufacturer during installation to ensure correct installation has occurred. The Contractor shall coordinate with the manufacture during installation to ensure correct installation has occurred. The installation and initial operation shall be certified on form specified in Section 01990.

3.02 FIELD TESTING

Each polymer blending unit shall be field tested to ensure compliance with the specified requirements. At minimum, the blending unit will be start up tested and calibrated to set the

dry feeder and polymer feed settings to the desired setpoints. The Contractor shall demonstrate that the blending unit can produce a batch of polymer to the satisfaction of the manufacturer's and owner's representatives.

3.03 TRAINING

A minimum of 4 hours of training conforming to the requirements of Section 01664 shall be provided. Training shall be certified on Form 11000-B specified in Section 01999.

END OF SECTION

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SECTION 11390

PROGRESSING CAVITY POLYMER PUMPS

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies positive displacement progressing cavity pumps, complete with electric motors, and all specified appurtenances. One (1) polymer will be installed and mounted on a common baseplate. Another one (1) polymer pump will be provided and kept on the shelf for use as a spare. For the polymer pump that is kept on the shelf, no spare parts are required. However, a baseplate shall be provided to both pumps provided.

B. TYPE:

The pumping units shall be of the self-priming, positive displacement, progressing cavity type specifically designed for pumping liquid wastewater treatment scum and sludge containing organic solids and small inorganic particles.

C. EQUIPMENT LIST:

Item	Equipment No.
Polymer Feed Pumps	NR85-P-303

*Note as part of the contract, an additional polymer feed pump will be provided and placed on the shelf to serve as a spare pump.

D. GENERAL PERFORMANCE AND DESIGN REQUIREMENTS:

Equipment shall be designed and selected specifically for *continuous* duty pumping of concentrated solids derived from the treatment of wastewater, as well as to serve as a polymer feed. All pumps shall be suitable for exposure to wastewater, byproducts, corrosive environments, polymer, moisture, scum consisting of floatable materials skimmed from the surface of primary sedimentation tanks; and primary and thickened sludge containing grit, small particles of wood, rags and stringy material, industrial solvents, heavy greases, fats, detergents, petroleum products, and organic particles in concentrations as great as 10 percent. The pumped fluids are expected to range in temperature between 40 degrees F and 110 degrees F, and the pH may vary between 4 and 9.

The pumps along with associated drive appurtenances shall be mounted on common fabricated steel baseplate. A new baseplate shall be provided for each pump that is replaced.

E. SERVICE REQUIREMENTS:

Progressing cavity pumps shall provide the following services:

Equipment No / Location	Fluid type	Fluid Temperature Range	Percent Solids	Control
NR85-P-303/NRF Dewatering Building	Polymer Feed Pumps	40°F – 110°F	N/A	VFD

*Note as part of the contract, an additional polymer feed pump will be provided and placed on the shelf to serve as a spare pump.

F. PERFORMANCE REQUIREMENTS:

Progressing cavity pumps shall meet the following performance requirements:

Equipment Nos	Rated capacity, gpm	Rated head, psig[a]	Inlet pressure range, psig[b]	Maximum pump speed, rpm[c]
NR85-P-303	7 gpm	30 psig	0-5	147

*Note as part of the contract, an additional polymer feed pump will be provided and placed on the shelf to serve as a spare pump.

a. Rated head (discharge pressure) is based on pumping clean water at 68 degrees F.
b. Potential range in pressure at the pump inlet (suction). The pump shall be capable of continuous operation over the entire inlet pressure range.
c. Pump speed after fixed reduction and at the highest allowed adjustable frequency drive frequency.

G. DESIGN REQUIREMENTS:

1. PUMPS: Pumps shall meet the following design requirements:

Equipment Nos	Suction and disch port size, in.[a]	Max pump layout dims, in. (L x W x H)[b]	Minimum number of pump stages	Shaft seal type[c]	Configuration[d]
NR85-P-303	2.5” Suction & 2” Discharge		1	Mechanical Seal	Inline direct coupled

*Note as part of the contract, an additional polymer feed pump will be provided and placed on the shelf to serve as a spare pump.

a. If a suction or discharge port size different than the size specified is provided, pipe expansions and contractions required to conform the pump installation to the designed piping shall be supplied at no additional cost to Owner.

b. Maximum pump layout dimension is the largest footprint allowable for the entire pump assembly, including the motor. The pump shall not exceed any one dimension listed.
c. See paragraph 11390-2.03 E.
d. See paragraphs 11390-1.01 C and 11390-2.03 B.

2. MOTORS: Motors shall meet the following design requirements:

Equipment Nos	Maxi-mum motor hp	Motor type[a]	Inverter duty	Motor speed, rpm	Pump (or motor) brake	Adjustable frequency drive?
NR85-P-303	0.83	TEFC	Y	1800	TBD	Yes

*Note as part of the contract, an additional polymer feed pump will be provided and placed on the shelf to serve as a spare pump.

a. See paragraph 11060-2.01 for motor types.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AGMA 6010-E	Spur, Helical, Herringbone, and Bevel Enclosed Drives
AGMA 6019-E	Gear Motors Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears
ASTM A331-90	Standard Specification for Steel Bars, Alloy, Cold-Finished

ASTM A322	Standard Specification for Steel Bars, Alloy, Standard Grades

B. UNIT RESPONSIBILITY:

The Contractor shall assign unit responsibility, as specified in paragraph 11000-1.02 C, to the pump manufacturer for the equipment provided under this section. This manufacturer is the unit responsibility manufacturer and has unit responsibility, as specified in paragraph 11000-1.02 C, for the equipment assembly specified in this section, and the electric motors specified in Section 11060, and the adjustable frequency drives specified in Section 11069 and all other equipment assembly components specified elsewhere but referenced in this section. A completed, signed, and notarized Certificate of Unit Responsibility (Form 11000-C, Section 01999) shall be provided.

C. FACTORY TESTS:

Factory tests shall be performed according to the manufacturer's standard test procedures. Certified test results shall be provided as product data. However, the manufacturer must be prepared to guarantee the pump performance specified in paragraph 11390-1.01 G.

D. WARRANTY:

1. UNIVERSAL JOINTS ONE-YEAR FULL WARRANTY: Provide all warranties as described in the General Conditions, including normal commercial warranties available from equipment manufacturers. The rotor drive trains, consisting of universal joints, connecting rods and related components, furnished with progressive cavity pumps specified in this Section, shall be warranted by the pump manufacturer against defects in materials, workmanship, and wear regardless of the cause or fault of the wear or failure for a period of one (1) years. Rotor drive trains shall be repaired or replaced by the pump manufacturer at no cost to the Owner during the one-year warranty period. The pump manufacturer shall provide the warranty labor for repair or replacement of rotor drive trains. The warranty period shall commence at the date of final acceptance of the equipment specified in this Section.

2. ROTORS AND STATORS WARRANTY: The rotors and stators, furnished with progressive cavity pumps specified in this Section, shall be warranted by the pump manufacturer against defects in materials, workmanship, and wear regardless of the cause or fault of the wear or failure for a period of 10,000 hours of operation or two-years, whichever occurs first. Rotors and stators shall be repaired or replaced by the pump manufacturer at no cost to the Owner during the warranty period. The pump manufacturer shall provide the warranty labor for repair or

replacement of rotors and stators. The warranty period shall commence at the date of final acceptance of the equipment specified in this Section.

1.03 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300

1. Data regarding pump, gear reducer and motor characteristics and performance:

a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate pumps, showing they meet indicated and specified requirements for head, capacity and horsepower.

1) For units of same size and type, provide curves for a single unit only.

b. Provide catalog performance curves at maximum pump speed indicated and specified for each service showing maximum and minimum speeds available, manufacturer's recommended maximum speed for the operating conditions and service specified and indicated.

c. Results of shop performance tests as specified shall be included in the O&M manual.

d. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch (A4) sheets, one curve per sheet.

2. Shop drawing data for accessory items.

3. Contractor to submit certified setting plans, with tolerances, for anchor bolts.

4. Materials listing.

5. Manufacturer's literature as needed to supplement certified data.

6. Operating and maintenance instructions and parts lists.

7. Certified results of hydrostatic testing will be included as part of O&M manual.

8. Bearing temperature operating range for the service conditions specified.

9. List of recommended spare parts other than those specified.

10. Shop and field inspection reports. Field inspection reports shall be supplied after start-up.

11. Bearing Life: Certified by the pump manufacturer. Include design data.

12. Pump shop test results shall be included in the O&M manual.

13. Recommendations for short and long-term storage.

14. Shop and field-testing procedures, pump and piping set up, equipment to be used and testing tolerances to be followed.

15. Special tools (if required).

16. Number of service person-days provided and per diem field service rate.

17. Results of field vibration test data including a vibration signature for each pump and drive assembly. Provide vibration testing procedure for review.

18. Recommended location of suction and discharge pressure gauges.

19. Manufacturer's product data, specifications and color charts for shop painting.

20. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

21. The latest ISO 9001 series certification.

B. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

The County believes the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section. Candidate manufacturers and pump models include Moyno, Seepex Range BN SCT, or equal, modified to meet the requirements of this specification.

2.02 MATERIALS

Materials of construction shall be as follows:

Component	Material
Rotor	ASTM A331-90 Grade 4150 cold finish alloy steel with hard chrome plating, 0.010-inch minimum thickness, 800 Vickers minimum hardness Or Air-hardened C-45 tool steel with a chromium nitride coating, 26 µm minimum thickness, 1750 Vickers minimum hardness
Stator	Buna-N synthetic rubber with a Shore durometer hardness between 50 and 70, and bonded to a steel tube
Pump body	Cast iron

Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose. Mill certifications confirming hardness of rotor and stator shall be provided as product data.

2.03 EQUIPMENT

A. ROTOR AND STATOR

1. Each pump design shall be a minimum one-stage design employing a convoluted rotor operating in a similarly convoluted stator. The convolutions shall be configured to form a cavity between the rotor and stator which shall progress from the pump's inlet to discharge port with the operation of the rotor. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form a good seal and to prevent leakage from the discharge back to the inlet end of the pumping chamber. Stators for pumps shall have Buna elastomer. The stator material hardness shall be suitable for the abrasiveness of the medium to be pumped. The sludge pump rotos shall have a chromium nitride coating (Duktil process) with a minimum thickness of (.0108").
2. Stators shall be replaceable without dismantling the pump suction or discharge flanges or any associated piping. Pumps that require additional space for axial/horizontal removal of the stator shall not be allowed. Stator designs shall additionally incorporate a retensioning feature to compensate for wear in lieu of increasing pump speed. Stators must be split design for east of replacement.
3. Rotors shall be replaceable without dismantling the pump suction or discharge flanges or associated piping. Pumps that require additional space for axial/horizontal removal of the rotors shall not be allowed. The rotor design shall include provisions so that rotor replacement does not require the disassembly of either universal joint.

B. CONNECTING ROD AND GEAR JOINTS

The drive train shall be warranted for one year (1) from acceptance and shall consist of the following: Each pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod. The pin shall be constructed of high speed steel, air hardened to 60-65 HRc. The joint shall be grease lubricated with a high temperature (450° F), PTFE filled synthetic grease, covered with Buna N sleeve and positively sealed with hose clamps constructed of 304 stainless steel.

C. CASING

The pump casing shall be provided with a cleanout opening on each side of inlet fitting. Cleanout opening shall be located immediately opposite the rotor head gear joint to provide access for maintenance. A 150-pound (ANSI B16.5 RF) flanged connection shall be provided at both the inlet port and discharge ports. The suction casing shall employ two opposed cleanout openings to facilitate removal of debris without dismantling the pump or pipework.

E. STUFFING BOX AND BEARINGS

Each pump shall be provided with grease lubricated thrust and radial bearings designed for all loads imposed by the specified service and rated per Section 11000. Direct couple pump shall utilize the bearings in the gear box. The stuffing box shall be of ample depth for 6 rings of packing and be provided with lantern rings. The lantern ring and gland shall be split for convenient removal. Minimum bearing L-10 shall be 50,000 hours.

Shaft shall be sealed using a single internal mechanical seal as specified in Section 2.02. The shaft shall be solids through the sealing area, but of a two part design which allows the rotating unit to be removed from the pump without disassembly of the gearmotor bearings. Seal materials shall be solid silicon carbide faces with 316 stainless steel metal parts and viton elastomers.

F. MOTOR AND DRIVE UNIT

2. Gear motors or gear reducers shall be designed in accordance with AGMA 6019-E (Class II). Unless otherwise noted, motors shall be energy-efficient, TEFC motors.

2. Pumps that require variable frequency drives (VFDs) are noted in paragraph 1.01 E. VFDs shall be constant torque type. For VFD-driven units, the pump supplier shall be responsible for the provision of the fixed reduction between the motor and pump. The reduction ratio shall be that required to operate the pump at its maximum operating speed when the motor is operating at its nominal rated full speed in accordance with the schedule in paragraph 1.01 E. VFD-driven units may be operated at up to 85 Hz at the maximum speed.

G. BASE

1. Mount pump and drive on a common base.

a. Material: ASTM A36 fabricated structural steel.

b. Provide structural steel shape bases, bent form bases are not acceptable.

c. Provide bases with provisions for grouting and for anchor bolts.

d. Design baseplates to support pump and driver.

e. Provide planed surfaces of bearing pads for pumps and drives.

H. OVER PRESSURE PROTECTION

1. Provide each pump with a pressure sensor ring with a dual mounted gauge and single point pressure switch.

I. MOTORS

1. Provide in accordance with Section and as specified and indicated.

2. Horsepower rating of motors: Not less than maximum brake horsepower requirements of pumps under any condition of operation specified and indicated without operating in the motor service factor.

3. Provide motors for horizontal pumps with mounts for bolting to baseplate.

4. In addition to the requirements for bearings specified under Electric Motors in Section , provide pump motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

5. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet (1 meter) from motor.

6. Operate without overheating at the speeds specified and indicated.

7. Service Factor: 1.15, with 1.0 inverter duty rating for pumps equipped with variable frequency motor controllers.

8. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

9. Rating: 115/230V, 3 PH, 60 Hertz.

10. Insulation: Class F with Class B temperature rise, 40 degree C ambient.

11. Site Altitude: Less than 100 feet above sea level.

12. Provide Inpro/Seal bearing isolators.

J. SHOP TESTING

1. Provide motor shop testing in accordance with Section .

K. PUMP TESTS

Note that factory testing is required on both polymer pumps. The pump that shall serve as a spare pump will not be installed nor testing on the site. The pump shall be placed on the shelf, as directed by the County.

1. Provide hydrostatic test of assembled pump at a maximum of 65 psi. Test wet end with pump assembled.

2. Certified performance.

   a. Run pump at full speed rating point for 60 minutes prior to start of any testing.

   b. Full speed tests:

      1) Take readings to determine flow, differential pressure, rpm, horsepower, displacement and efficiency.

   c. Variable speed tests:

      1) Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.

      2) Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.

   d. Factory tests on pumps:

      1) Use tested job motors.

      2) Use factory calibrated test drives.

   e. Provide a minimum of 30 days written notice to the Engineer prior to shop testing.

3. Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.

4. Testing Tolerances: ANSI/HI

5. In the event that specified tests indicate that pump, motor, or variable frequency motor controller will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps, motors, and variable frequency motor controllers at no additional cost to the Owner.

6. Repeat tests until specified results are obtained.

7. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

L. ADJUSTABLE FREQUENCY DRIVES

Pumps that require adjustable frequency drives (AFDs) are listed within this Section. AFDs shall be constant torque type and shall be as specified in Section 11069. For AFD driven units, the pump supplier shall be responsible for the provision of the fixed reduction between the motor and the pump. The reduction ratio shall be that required to operate the pump at its maximum operating speed when the motor is operating at its nominal rated full speed in accordance with the schedule in paragraph 11390-1.01 G. AFD controls shall be such that pumps cannot operate at a speed lower or higher than that which corresponds to the minimum and maximum speed as specified within this Section.

2.04 CONTROLS

Vendor shall provide control strategies for the pumping equipment.

2.05 COATINGS

Painting of equipment shall be in accordance with Section 09900.

All equipment and fabricated surfaces shall be shop primed and finish coated prior to shipment from the factory.

2.06 SPARE PARTS

Note that the spare parts are only for one (1) polymer pump. Only one (1) set of spare parts is required. Furnish one set of packing tools to service the pumps if packing seals are furnished. In addition, furnish the following spare parts for each pump model and size:

1 - stator
1 - rotor
1 - connecting rod
2 - sets of packing rings
1 - gear joint kit including gear joint seals/pin joint kit

Spare parts shall be tagged and stored as specified in Section 11000.

2.07 PRODUCT DATA

The following product data shall be provided in accordance with Section 01300:

1. Mill certifications confirming hardness of rotor and stator specified in paragraph 11390-2.02.

2. Operating and maintenance information specified in Section 01730, including manufacturer's warranties specified in paragraph 11390-1.02 D and Section 01739.

3. Certified factory test results as specified in paragraph 11390-1.02 C.

4. Installation Certification Form 11000-A as specified in paragraph 11390-3.01.

5. Training Certification Form 11000-B as specified in paragraph 11390-3.03.

PART 3 – EXECUTION

3.01 INSTALLATION

The pumping unit shall be aligned, connected and installed in accordance with the manufacturer's recommendations. The installation and trial operation shall be certified by the pump manufacturer's authorized representative on Form 11000-A as specified in Section 01999.

3.02 TESTING

A. Note that only the installed pump will be tested on-site. The spare pump will not be installed nor tested besides factory testing.

B. Comply with the requirements specified in Section 01663 and as specified herein.

C. Test piping connections to prove the pump nozzle are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with pump nozzles. This must be performed and the piping acceptable prior to any field performance testing.

D. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each pump in presence of the Engineer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.

1. During tests, observe and record head, capacity, pump bearing housings and motor bearing temperature, noise and motor inputs.

a. Test Duration: Determined by the Engineer, but not less than three hours of continuous operation at each condition specified and indicated.

2. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

3. Repeat tests until specified results are obtained.

4. Contractor to provide all water labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.

a. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.

b. All calibrations must be within 30 days of the field testing.

c. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.

d. Contractor is responsible for delivery and disposal of water used for testing.

E. Make all adjustments necessary to place equipment in specified working order at time of above tests.

F. Test pump on product only. If product is not available, test with water. Water for testing furnished by Contractor.

G. Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

3.03 TRAINING

A minimum of 4 hours of training shall be provided by the pump manufacturer's service engineer. The 4 hours of training shall be inclusive of all progressive cavity pumps supplied, including the polymer pumps and cake pumps. Training shall conform to Section 01664 and shall be certified on Form 11000-B as specified in Section 01999.

END OF SECTION

SECTION 11391

PROGRESSING CAVITY SLUDGE PUMPS

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies positive displacement progressing cavity pumps, complete with electric motors, and all specified appurtenances, mounted on a common baseplate to be furnished as a spare.

B. TYPE:

The pumping units shall be of the self-priming, positive displacement, progressing cavity type specifically designed for pumping wastewater treatment sludges containing organic solids and small inorganic particles.

C. EQUIPMENT LIST:

Item	Equipment No.
Belt Filter Press Sludge Feed Pumps	Spares

D. PERFORMANCE AND DESIGN REQUIREMENTS:

Equipment shall be specifically designed and selected for continuous duty pumping of concentrated solids derived from the treatment of wastewater. Pumps shall be suitable for exposure to digested sludge containing grit, tramp iron, small particles of wood, industrial solvents, greases, detergents, petroleum products, and organic particles in concentrations as great as 12 percent. The pumped fluids are expected to range in temperature between 40 degrees F and 110 degrees F, and the pH may vary between 4 and 9.

Where indicated, the equipment including the drive train, shall be designed for operation at variable speed, with inline base configuration with coupling and coupling guard.

The pumps, along with associated drive appurtenances, shall be mounted on common fabricated steel baseplates.

E. OPERATING CONDITIONS:

The progressing cavity pumps shall have the following operating characteristics:

Equipment number / Location	Rated capacity, gpm[a]	Rated head, psi[a]	Minimum, maximum pump speed, rpm	Suction and discharge port size, in	Maximum motor HP	Variable speed drive
Spare	100	50	250	8	10	YES

[a] Based on pumping clean water at 68 degrees F.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AGMA 6010-E	Spur, Helical, Herringbone, and Bevel Enclosed Drives
AGMA 6019-E	Gear Motors Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears

1.03 ENVIRONMENTAL CONDITIONS

Pumps to be provided under this section will be installed in the Dewatering Building as shown in the Contract Drawings. The dewatering building is conducive to a corrosive environment. See Section 01800 for design ambient temperatures and conditions.

1.04 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300

1. Data regarding pump, gear reducer and motor characteristics and performance:

    a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate pumps, showing they

meet indicated and specified requirements for head, capacity and horsepower.

(1) For units of same size and type, provide curves for a single unit only.

b. Provide catalog performance curves at maximum pump speed indicated and specified for each service showing maximum and minimum speeds available, manufacturer's recommended maximum speed for the operating conditions and service specified and indicated.

c. Results of shop performance tests as specified.

d. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch (A4) sheets, one curve per sheet.

2. Shop drawing data for accessory items.

3. Contractor to submit certified setting plans, with tolerances, for anchor bolts.

4. Materials listing.

5. Manufacturer's literature as needed to supplement certified data.

6. Operating and maintenance instructions and parts lists.

7. Certified results of hydrostatic testing.

8. Bearing temperature operating range for the service conditions specified.

9. List of recommended spare parts other than those specified.

10. Shop and field inspection reports. Field inspection reports shall be supplied after start-up.

11. Bearing Life: Certified by the pump manufacturer. Include design data.

12. Pump shop test results.

13. Recommendations for short and long-term storage.

14. Shop and field-testing procedures, pump and piping set up, equipment to be used and testing tolerances to be followed.

15. Special tools (if required).

16. Number of service person-days provided and per diem field service rate.

17. Results of field vibration test data including a vibration signature for each pump and drive assembly. Provide vibration testing procedure for review.

18. Recommended location of suction and discharge pressure gauges.

19. Manufacturer's product data, specifications and color charts for shop painting.

20. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

21. The latest ISO 9001 series certification.

B. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

PART 2--PRODUCTS

2.01 ACCEPTABLE PRODUCTS

Progressing cavity pumps shall be Moyno 2000 Series (Model 1G065 CDQ 3SAA), Seepex Series BTHE, or equal, modified to meet the requirements of this specification. Pressure gauge, switch, and seal shall be Ashcroft 5503 Differential Pressure Gauge, B-Series NEMA 4X Pressure Switch, and annular seal.

2.02 MATERIALS

Component	Material

Component	Material
Rotor	ASTM A331-90, grade 4150, yield strength 55,000 psi with 0.010 inches hard chrome plate
Stator	Nitrile with minimum shore A durometer of 71+4
Pump and stator	Pump, thick-walled cast iron. Stator, carbon steel tube.
Pump body	Cast iron

Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

2.03 EQUIPMENT

A. ROTOR AND STATOR:

Each pump shall be two-stage design employing a convoluted rotor operating in a similarly convoluted stator. The convolutions shall be configured to form a cavity between the rotor and stator which shall progress from the pump's inlet to discharge port with the operation of the rotor. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form a good seal and to prevent leakage from the discharge back to the inlet end of the pumping chamber.

B. CONNECTING ROD AND GEAR JOINTS:

Each pump rotor shall be driven through a connecting rod which shall be connected to the rotor and input shaft through precision machined grease lubricated crowned gear type joints. The balls and sockets shall be machined from chrome alloy tool steel and shall be designed to withstand shock and thrust reversal. Each gear joint shall be protected against the entrance of dirt, sludge, and other foreign objects by a wire reinforced elastomeric seal. Gear joint shall be positively secured to the connecting rod to ensure against failure when the pump is in operation. The connecting rod shall pass through the shaft seal area inside the hollow drive shaft quill so that no eccentric loads are imparted on the shaft seal area. The connection rod shall maintain shaft angularity of less than 1.5 degrees.

The drive shaft shall be of two-piece construction through the bearings and shaft seal area. This design shall permit disassembly of the gear type universal joints without affecting the alignment of the shaft in the shaft sealing area.

C. CASING:

The pump casing shall be provided with a cleanout opening on each side of inlet fitting. Cleanout opening shall be located immediately opposite the rotor head gear joint to provide access for maintenance. A 125-pound flanged connection shall be provided at the inlet port. A 125-pound

flanged connection shall be provided at the discharge port. The suction shall be provided with a 1/2-inch tap to permit installation of a water lubrication system.

D. STUFFING BOX AND BEARINGS:

Each pump shall be provided with grease lubricated thrust and radial bearings designed for all loads imposed by the specified service and rated per Section 11000. The stuffing box shall be of ample depth for 6 rings of packing and be provided with lantern rings. The lantern ring and gland shall be split for convenient removal. The stuffing box housing shall be drilled and tapped for water flush connections. The shaft, where inside the stuffing box, shall be fitted with a replaceable sleeve.

E. MOTOR AND DRIVE UNIT:

Gear motors or gear reducers, designed in accordance with AGMA 6019-E (Class II) or AGMA 6010-E (Service Factor 1.25), shall be provided where greater speed reduction is specified. Unless otherwise noted, motors shall be energy-efficient, Type 2 motors in accordance with Section 11060. Pumps that require adjustable speed drive (ASDs) are noted in paragraph 1.01 E ASDs shall be constant torque type as specified in Section 11069. For ASD driven units the pump supplier shall be responsible for the provision of the fixed reduction between the motor and pump. The reduction ratio shall be that required to operate the pump at its maximum operating speed when the motor is operating at its nominal rated full speed in accordance with the schedule in paragraph 1.01 E ASD-driven units may be operated at up to 60 Hz at the maximum speed.

F. BASE:

1. Mount each pump and drive on a common base.

   a. Material: ASTM A36 fabricated structural steel.

   b. Provide structural steel shape bases, bent form bases are not acceptable.

   c. Provide bases with provisions for grouting and for anchor bolts.

   d. Design baseplates to support pump and driver.

   e. Provide planed surfaces of bearing pads for pumps and drives.

G. OVER PRESSURE PROTECTION

1. Provide each pump with a pressure sensor ring with a dual mounted gauge and single point pressure switch.

H. MOTORS:

1. Provide in accordance with Section and as specified and indicated.

2. Horsepower rating of motors: Not less than maximum brake horsepower requirements of pumps under any condition of operation specified and indicated without operating in the motor service factor.

3. Provide motors for horizontal pumps with mounts for bolting to baseplate.

4. In addition to the requirements for bearings specified under Electric Motors in Section , provide pump motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

5. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet (1 meter) from motor.

6. Operate without overheating at the speeds specified and indicated.

7. Service Factor: 1.15, with 1.0 inverter duty rating for pumps equipped with variable frequency motor controllers.

8. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

9. Rating: 460V, 3 PH, 60 Hertz.

10. Insulation: Class F with Class B temperature rise, 40 degree C ambient.

11. Site Altitude: Less than 100 feet above sea level.

12. Provide Inpro/Seal bearing isolators.

I. SHOP TESTING:

1. Provide motor shop testing in accordance with Section .

J. Pump Tests:

1. Provide hydrostatic test of assembled pump at a maximum of 65 psi. Test wet end with pump assembled.

2. Certified performance and witness testing.

a. Run pump at full speed rating point for 60 minutes prior to start of any testing.

b. Full speed tests:

(1) Take readings to determine flow, differential pressure, rpm, horsepower, displacement and efficiency.

c. Variable speed tests:

(1) Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.

(2) Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.

d. Factory tests on pumps:

(1) Use tested job motors.

(2) Use factory calibrated test drives.

e. Provide a minimum of 30 days written notice to the Engineer prior to shop testing.

3. Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.

4. Testing Tolerances: ANSI/HI

5. In the event that specified tests indicate that pump, motor, or variable frequency motor controller will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps, motors, and variable frequency motor controllers at no additional cost to the Owner.

6. Repeat tests until specified results are obtained.

7. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

K. RUN DRY PROTECTION: The stator shall be fitted with a sensor sleeve and thermistor sensor. A controller shall also be provided and shall be installed by the contractor in the motor control center. The controller shall monitor the stator temperature and activate a shutdown and alarm sequence if the stator temperature reaches the adjustable limit on the controller. The controller shall include a manual local and remote reset function. Input to the controller shall be 1x115VAC/60 Hz.

L. OVER PRESSURE PROTECTION: Each pump unit shall be supplied with a silicone-filled isolation ring with a dual mounted gauge and single point pressure switch. The pressure ranges for the switch and gauge shall be selected specifically for each specified service. The isolation ring shall be mounted between ANSI flanges, be sized according to the discharge pipe as shown on the plans, and be constructed with a carbon steel body and fittings with a Buna sleeve. The switch shall be SPDT, NEMA 4.

M. HOPPER EXTENSION WITH LASER MOUNTING BRACKETS: Each pump shall be supplied with a hopper extension that is pre-installed and flange mounted to the pump. The hopper extension shall include the following as a minimum:

1. A maximum overall height of no more than 5-1/4”
2. Shall include a open hopper flange for the integration of the pump with a customer supplied transition hopper that will extend from the dewatering equipment to the extension flange.
3. The integral flanged hopper extension shall integrate a window on the drive end of the hopper extension. This window will be used for level measurement and presence/absence detection of cake.
4. The integral hopper extension shall include a metal fabricated sloped canopy internal to the hopper extension and covering the window. This canopy will eliminate any cake from falling out of the hopper and obstructing the level measurement and presence/absence detectors.
5. The hopper extension shall incorporate a flexible polycarbonate shield that will divert falling cake away from the level measurement equipment signal. This shield will be clear polycarbonate and will be between 1/8” and ¼” thick depending on the application. It will be flexible in order to prevent cake build up and eliminate possibility of bridging.
6. The hopper extension shall include all adjustable brackets to mount all of the presence/absence and level control transmitters and receivers

N. LASER LEVEL TRANSMITTERS: Each pump will be supplied / installed with three (3) pre-programmed laser measurement devices that incorporate the following chararistics:

1. Each laser shall be self-contained and have an IP67 rating for being capable of being fully submersed.
2. Must be able to measure distances ranging from 8”-390” with an overall accuracy of not more ¾” where extraneous light is less than 40klx.
3. The laser level transmitter shall project a dot no larger than 5/8” diameter at the maximum measuring length.
4. The laser measurement system shall be able to operate in environmental temperatures ranging from 15-140° F
5. Each laser transmitter shall utilize sealed M12 connections to prevent any contamination, but easy period maintenance or removal and replacement.
6. Each laser transmitter shall incorporate a discrete output to represent the laser line being broke by falling cake. Additionally, the laser transmitter shall include a analog process signal indicating the proximity of cake from the sensor.
7. Each of the three laser transmitters shall be programmed identically in order to permit them to measure level or indicate presence of cake. The operator shall be able to switch the function of each transmitter only by swapping the M12 quick connector.

O. LEVEL CONTROLLER: The system shall include a level controller to analyze all of the level signals and provide on-the-fly filtering to determine proper operation and speed of the pump to keep the process operating in a continuous manner. The controller shall be as manufactured by the pump manufacturer and include the following features:

1. Minimum of 5 previous installations that incorporate the controller and hardened control algorithms.
2. The controller shall be housed in a non-metallic enclosure that carries a minimum rating of NEMA 4X.
3. The controller shall feature a 5.7" color touch screen, capable of producing a 64,000 color gamut, which will permit operators of selecting or changing parameters of operation. The display shall incorporate a resistive touch display that will permit operation with gloved hands.
4. The control system shall permit the control of boundary layer injection pumps to reduce frictional piping losses pressure in application that may convey for longer distances.
5. The controller shall be capable of accepting/transmitting a minimum of the following control signals:
    a. Qty four (4) analog process inputs.
    b. Qty four (4) analog process outputs.
    c. Qty sixteen (16) discrete inputs that are 24 VDC tolerant
    d. Qty fifteen (15) dry contact relay outputs that are each rated for 10 Amps resistive.

2.04 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Mill certifications confirming hardness of rotor and stator specified in paragraph 11390-2.02.

2. Operating and maintenance information specified in Section 01730.

3. Motor data as specified in paragraph 11060-2.05.

4. Manufacturer's certification that the pumping units will meet the vibration and critical speed limitations as specified in Section 11020.

5. Installation certification Form 11000-A as specified in paragraph 11390-3.01.

6. Training Certification Form 11000-B as specified in paragraph 11390-3.03.

2.05 SPARE PARTS

The following shall be provided for each pump size:

1 - stator
1 - rotor
1 - connecting rod
2 - sets of packing rings
1 - bearing kit
1 - gear joint kit including gear joint seals

Spare parts shall be tagged and stored in accordance with provisions of paragraph 11000-2.12.

PART 3--EXECUTION

3.01 INSTALLATION

The pumps shall be installed as specified and in accordance with manufacturer's written recommendations. The installation and initial operation of all components shall be certified on Form 11000-A as specified in Section 01999.

3.02 TESTING

A. Comply with the requirements specified in Section 01663 and as specified herein.

B. Test piping connections to prove the pump nozzle are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with pump nozzles. This must be performed and the piping acceptable prior to any field performance testing.

C. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each pump in presence of the Engineer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.

1. During tests, observe and record head, capacity, pump bearing housings and motor bearing temperature, noise and motor inputs.

    a. Test Duration: Determined by the Engineer, but not less than three hours of continuous operation at each condition specified and indicated.

2. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

3. Repeat tests until specified results are obtained.

4. Contractor to provide all water labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.

a. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.

b. All calibrations must be within 30 days of the field testing.

c. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.

d. Contractor is responsible for delivery and disposal of water used for testing.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Test pump on product only. If product is not available, test with water. Water for testing furnished by Contractor.

F. Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

3.03 TRAINING

A minimum of 8 hours of training shall be provided by the pump manufacturer's service engineer. Training shall conform to Section 01664 and shall be certified on Form 11000-B as specified in Section 01999.

END OF SECTION

SECTION 11392

PROGRESSING CAVITY DEWATERED SLUDGE PUMPS

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies positive displacement progressing cavity pumps, complete with electric motors, and all specified appurtenances. Two (2) dewatered sludge feed pumps will be installed and mounted on a individual baseplate. Another one (1) dewatered sludge feed pump will be provided and kept on the shelf for use as a spare. For the dewatered sludge feed pump that is kept on the shelf, no spare parts are required. However, a baseplate shall be provided with the spare pump.

B. TYPE:

The pumping units shall be of the self-priming, positive displacement, progressing cavity type specifically designed for pumping wastewater treatment sludges containing organic solids and small inorganic particles.

C. EQUIPMENT LIST:

Item	Equipment No.
Dewatered Sludge Feed Pump 1	NR82-P-101
Dewatered Sludge Feed Pump 2	NR82-P-102

*Note as part of the contract, an additional dewatered sludge feed pump will be provided and placed on the shelf to serve as a spare pump.

D. PERFORMANCE AND DESIGN REQUIREMENTS:

Equipment shall be specifically designed and selected for continuous duty pumping of concentrated solids derived from the treatment of wastewater. More specifically, the pumps shall be capable and designed for pumping dewatered sludge ranging from 12% to 20% cake solids. Pumps shall be suitable for exposure to wastewater **and** dewatered sludge containing grit, tramp iron, small particles of wood, industrial solvents, greases, detergents, petroleum products, and organic particles in concentrations as great as 320 percent. The pumped fluids are expected to range in temperature between 40 degrees F and 110 degrees F, and the pH may vary between 4 and 9.

The pumps, along with associated drive appurtenances, shall be mounted on common fabricated steel baseplates. Each baseplate shall contain and direct excess seal water to a single outlet.

E. OPERATING CONDITIONS:

The progressing cavity pumps shall have the following operating characteristics:

Equipment number	Rated capacity, gpm[a]	Rated head, psi[a]	Minimum, maximum pump speed, rpm	Suction and discharge port size, in	Maximum motor HP	Variable speed drive
NR85-P-401 - NR85-P-402	10 – 40	290	20 – 81	Suction Hooper – 5”	30	Yes

*Note as part of the contract, an additional dewatered sludge feed pump will be provided and placed on the shelf to serve as a spare pump.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AGMA 6010-E	Spur, Helical, Herringbone, and Bevel Enclosed Drives
AGMA 6019-E	Gear Motors Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears

1.02 UNIT RESPONSIBILITY

The Contractor shall assign unit responsibility as specified in paragraph 11000-1.02 C to the dewatered sludge feed pump manufacturer for the equipment specified in this section, including the laser level, receiving hopper, and air assist with compressor. A certificate of unit responsibility shall be provided.

1.03 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AGMA 6010-E	Spur, Helical, Herringbone, and Bevel Enclosed Drives
AGMA 6019-E	Gear Motors Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears
ASTM A331-90	Standard Specification for Steel Bars, Alloy, Cold-Finished
ASTM A322	Standard Specification for Steel Bars, Alloy, Standard Grades

B. UNIT RESPONSIBILITY:

The Contractor shall assign unit responsibility, as specified in paragraph 11000-1.02 C, to the pump manufacturer for the equipment provided under this section. This manufacturer is the unit responsibility manufacturer and has unit responsibility, as specified in paragraph 11000-1.02 C, for the equipment assembly specified in this section, and the electric motors specified in Section 11060 , and the adjustable frequency drives specified in Section 11069 and all

other equipment assembly components specified elsewhere but referenced in this section. A completed, signed, and notarized Certificate of Unit Responsibility (Form 11000-C, Section 01999) shall be provided.

C. FACTORY TESTS:

Factory tests shall be performed according to the manufacturer's standard test procedures. Certified test results shall be provided as product data. However, the manufacturer must be prepared to guarantee the pump performance specified in paragraph 11390-1.01 G.

D. WARRANTY:

1. UNIVERSAL JOINTS ONE-YEAR FULL WARRANTY: Provide all warranties as described in the General Conditions, including normal commercial warranties available from equipment manufacturers. The rotor drive trains, consisting of universal joints, connecting rods and related components, furnished with progressive cavity pumps specified in this Section, shall be warranted by the pump manufacturer against defects in materials, workmanship, and wear regardless of the cause or fault of the wear or failure for a period of one (1) years. Rotor drive trains shall be repaired or replaced by the pump manufacturer at no cost to the Owner during the one-year warranty period. The pump manufacturer shall provide the warranty labor for repair or replacement of rotor drive trains. The warranty period shall commence at the date of final acceptance of the equipment specified in this Section.

2. ROTORS AND STATORS WARRANTY: The rotors and stators, furnished with progressive cavity pumps specified in this Section, shall be warranted by the pump manufacturer against defects in materials, workmanship, and wear regardless of the cause or fault of the wear or failure for a period of 10,000 hours of operation or two-years, whichever occurs first. Rotors and stators shall be repaired or replaced by the pump manufacturer at no cost to the Owner during the warranty period. The pump manufacturer shall provide the warranty labor for repair or replacement of rotors and stators. The warranty period shall commence at the date of final acceptance of the equipment specified in this Section.

1.03 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300

1. Data regarding pump, gear reducer and motor characteristics and performance:

a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate pumps, showing they meet indicated and specified requirements for head, capacity and horsepower.

1) For units of same size and type, provide curves for a single unit only.

b. Provide catalog performance curves at maximum pump speed indicated and specified for each service showing maximum and minimum speeds available, manufacturer's recommended maximum speed for the operating conditions and service specified and indicated.

c. Results of shop performance tests as specified as part of O&M Manual.

d. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch (letter) sheets, one curve per sheet.

2. Shop drawing data for accessory items.

3. Contractor to submit certified setting plans, with tolerances, for anchor bolts.

4. Materials listing.

5. Manufacturer's literature as needed to supplement certified data.

6. Operating and maintenance instructions and parts lists.

7. Certified results of hydrostatic testing as part of O&M Manual.

8. Bearing temperature operating range for the service conditions specified.

9. List of recommended spare parts other than those specified.

10. Shop and field inspection reports. Field inspection reports shall be supplied after start-up and included in O&M Manual.

11. Bearing Life: Certified by the pump manufacturer. Include design data.

12. Pump shop test results shall be included in O&M Manual.

13. Recommendations for short and long-term storage.

14. Shop and field-testing procedures, pump and piping set up, equipment to be used and testing tolerances to be followed.

15. Special tools (if required).

16. Number of service person-days provided and per diem field service rate.

17. Results of field vibration test data including a vibration signature for each pump and drive assembly. Provide vibration testing procedure for review.

18. Recommended location of suction and discharge pressure gauges.

19. Manufacturer's product data, specifications and color charts for shop painting.

20. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

21. The latest ISO 9001 series certification.

B. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

PART 2 – PRODUCTS

2.01 ACCEPTABLE PRODUCTS

Progressing cavity pumps shall be Seepex Series BTHE, or equal, modified to meet the requirements of this specification.

2.02 MATERIALS

Component	Material
Rotor	C45 (AISI 1045) - Ductile chromium coating
Stator	Buna-N synthetic rubber with a minimum shore durometer hardness of 60
Pump and stator	Cast iron
Pump body	Cast iron/ Steel
Shaft Sealing	Packing grease packed with Duktil coated plug-in shaft

Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

2.03 EQUIPMENT

A. ROTOR AND STATOR:

Each pump shall be four-stage design employing a convoluted rotor operating in a similarly convoluted stator. The convolutions shall be configured to form a cavity between the rotor and stator, which shall progress from the pump's inlet to discharge port with the operation of the rotor. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form a seal and to prevent leakage from the discharge back to the inlet end of the pumping chamber. The stator shall be molded with a seal integral to the stator elastomer preventing the metal stator tube and the bonding agent from the elastomer from contacting the pumped liquid. Gaskets or "O" rings may not be used to form this seal. Stators for sludge feed pumps shall have Buna elastomer. The sludge feed pump rotors shall be constructed of 316 SS. Additionally the sludge feed pump rotors shall have a chromium nitride coating (Duktil) with a minimum thickness of 250 µm (.0108"). Hard chrome plating or ceramic coatings are not acceptable due to the ease at which this coating will crack and the lack of diffusion into the rotor base metal.

B. CONNECTING ROD AND PIN JOINTS:

Each pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod. The pin shall be constructed of high speed steel, air hardened to 60-65 HRc. The joint shall be grease lubricated with a high temperature (450° F), PTFE filled synthetic grease, covered with Buna N sleeve and positively sealed with hose clamps constructed of 304 stainless steel.

C. CASING:

The pump casing shall be provided with a cleanout opening on each side of inlet fitting. Cleanout opening shall be located immediately opposite the rotor head gear joint to provide access for maintenance. A rectangle opening connection shall be provided at the inlet port. A 300-pound flanged connection shall be provided at the discharge port.

D. STUFFING BOX AND BEARINGS:

Each pump shall be provided with grease lubricated thrust and radial bearings designed for all loads imposed by the specified service and rated per Section 11000. The stuffing box shall be of ample depth for 6 rings of packing and be provided with lantern rings and a water seal connection. The lantern ring and gland shall be split for convenient removal. The stuffing box housing shall be drilled and tapped for water flush connections.

E. ANTIREVERSAL HOLDBACK:

Each pump shall be equipped with a differential friction-type holdback designed to prevent reversal of flow when the pump is not in operation. Unless otherwise specified the holdback shall act directly on the pump shaft and shall be equipped with a housing to protect the unit against the entrance of dust, dirt, and moisture. Anti-reversal holdbacks shall be adequately sized for the specified service. Shaft extensions shall be provided where required.

Where a gear reducer is direct connected, the holdback shall be incorporated into the gearbox.

In lieu of friction type holdbacks, each pump may be provided with electric brake motors to prevent anti-rotation of the pump. Brake shall release when motor starts and shall engage when motor shuts down or on power failure.

F. MOTOR AND DRIVE UNIT:

1. Gear motors or gear reducers shall be designed in accordance with AGMA 6019-E (Class II). Unless otherwise noted, motors shall be energy-efficient, TEFC motors.

2. Pumps that require variable frequency drives (VFDs) are noted in paragraph 1.01 E. VFDs shall be constant torque type. For VFD-driven units, the pump supplier shall be responsible for the provision of the fixed reduction between the motor and pump. The reduction ratio shall be that required to operate the pump at its maximum operating speed when the motor is operating at its nominal rated full speed in accordance with the schedule in paragraph 1.01 E. VFD-driven units may be operated at up to 85 Hz at the maximum speed.

G. BASE:

Pump base and support shall be Type I as defined in Section 11002 and shall be rigidly mounted. Pumps and drive assemblies shall be supported on common base pads or pedestals, as specified.

H. OVER PRESSURE PROTECTION

1. Provide each pump with a pressure sensor ring with a dual mounted gauge and single point pressure switch.

I. MOTORS

1. Provide in accordance with Section and as specified and indicated.

2. Horsepower rating of motors: Not less than maximum brake horsepower requirements of pumps under any condition of operation specified and indicated without operating in the motor service factor.

3. Provide motors for horizontal pumps with mounts for bolting to baseplate.

4. In addition to the requirements for bearings specified under Electric Motors in Section , provide pump motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

5. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet (1 meter) from motor.

6. Operate without overheating at the speeds specified and indicated.

7. Service Factor: 1.15, with 1.0 inverter duty rating for pumps equipped with variable frequency motor controllers.

8. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

9. Rating: 460V 3 PH, 60 Hertz.

10. Insulation: Class F with Class B temperature rise, 40 degree C ambient.

11. Site Altitude: Less than 100 feet above sea level.

12. Provide Inpro/Seal bearing isolators.

J. HOPPER EXTENSION WITH LASER MOUNTING BRACKETS

Each pump shall be supplied with a hopper extension that is pre-installed and flange mounted to the pump. The hopper extension shall include the following as a minimum:

1. A maximum overall height of no more than 5-1/4”
2. Shall include an open hopper flange for the integration of the pump with a customer supplied transition hopper that will extend from the dewatering equipment to the extension flange.
3. The integral flanged hopper extension shall integrate a window on the drive end of the hopper extension. This window will be used for level measurement and presence/absence detection of cake.
4. The integral hopper extension shall include a metal fabricated sloped canopy internal to the hopper extension and covering the window. This canopy will eliminate any cake from falling out of the hopper and obstructing the level measurement and presence/absence detectors.
5. The hopper extension shall incorporate a flexible polycarbonate shield that will divert falling cake away from the level measurement equipment signal. This shield will be clear polycarbonate and will be between 1/8” and ¼” thick depending on the application. It will be flexible in order to prevent cake build up and eliminate possibility of bridging.
6. The hopper extension shall include all adjustable brackets to mount all of the presence/absence and level control transmitters and receivers

K. BOUNDARY LAYER INJECTION SYSTEM

A boundary layer injection system shall be supplied by the pump manufacturer. The system includes injection ring(s) and injection pump(s) size as required for a proper boundary layer in the discharge piping. The purpose of the boundary layer is to create a layer of injected product between the inside pipe wall and pumped product to help convey the pumped product to the discharge point.

1. INJECTION RING: Injection rings shall be made of (304 or 316SS) and machined in such a manner that they fit between two ANSI flanges; sized according to the discharge piping. Injection rings have equally spaced injection points around the perimeter of the ring with properly sized fittings and hoses manifold to one minimum ½” NPT connection point. Two injection rings will be included, which are:

    a. Air injection – the air injection will be connected to the air compressor, which is to be provided by the dewatered sludge feed pump manufacturer, as part of this contract.

b. Polymer injection – the polymer injection ring will be included for potential future use. The practice of injecting polymer to lower headloss is not anticipated in existing conditions and the injection ring is included in this Contract so that the County has the ability to utilize polymer injection as a method of boundary layer injection in the future. No additional polymer pumps or connections are required at this time.

L. LASER LEVEL TRANSMITTER

Each pump will be supplied / installed with three (3) pre-programmed laser measurement devices that incorporate the following characteristics:

1. Each laser shall be self-contained and have an IP67 rating for being capable of being fully submersed.
2. Must be able to measure distances ranging from 8”-390” with an overall accuracy of not more ¾” where extraneous light is less than 40klx.
3. The laser level transmitter shall project a dot no larger than 5/8” diameter at the maximum measuring length.
4. The laser measurement system shall be able to operate in environmental temperatures ranging from 15-140° F
5. Each laser transmitter shall utilize sealed M12 connections to prevent any contamination, but easy period maintenance or removal and replacement.
6. Each laser transmitter shall incorporate a discrete output to represent the laser line being broke by falling cake. Additionally, the laser transmitter shall include a analog process signal indicating the proximity of cake from the sensor.
7. Each of the three laser transmitters shall be programmed identically in order to permit them to measure level or indicate presence of cake. The operator shall be able to switch the function of each transmitter only by swapping the M12 quick connector.

M. LEVEL CONTROLLER

The system shall include a separate level controller for each cake pump to analyze all of the level signals and provide on-the-fly filtering to determine proper operation and speed of the pump to keep the process operating in a continuous manner. The controller shall be as manufactured by the pump manufacturer and include the following features:

1. Minimum of 5 previous installations that incorporate the controller and hardened control algorithms.
2. The controller shall be housed in a non-metallic enclosure that carries a minimum rating of NEMA 4X.
3. The control panel shall include Nema rated window kits for each controller.

4. The control panel shall include a manual transfer switch and separate main breakers to receive power from two separate 120VAC sources.
5. The controller shall feature a 5.7" color touch screen, capable of producing a 64,000-color gamut, which will permit operators of selecting or changing parameters of operation. The display shall incorporate a resistive touch display that will permit operation with gloved hands. Controller shall be V570 controller or equal.
6. The control system shall permit the control of boundary layer injection pumps to reduce frictional piping losses pressure in application that may convey for longer distances.
7. The controller shall be capable of accepting/transmitting a minimum of the following control signals:
    a. Qty four (4) analog process inputs.
    b. Qty four (4) analog process outputs.
    c. Qty sixteen (16) discrete inputs that are 24 VDC tolerant
    d. Qty fifteen (15) dry contact relay outputs that are each rated for 10 Amps resistive.
8. The control system shall include an Allen Bradley Compactlogix 1769-L18ER with ethernet IP communications to the VFDs and to the BFP control panels.

N. SHOP TESTING

1. Provide motor shop testing in accordance with Section .

O. PUMP TESTS

Note that factory testing is required on all dewatered sludge feed pumps. The pump that shall serve as a spare pump will not be installed nor testing on the site. The pump shall be placed on the shelf, as directed by the County.

1. Provide hydrostatic test of assembled pump at a maximum of 65 psi. Test wet end with pump assembled. Test shall be on the pressure branch only.

2. Certified performance.

    a. Run pump at full speed rating point for 60 minutes prior to start of any testing.

    b. Full speed tests:

        1) Take readings to determine flow, differential pressure, rpm, horsepower, displacement and efficiency.

    c. Variable speed tests:

1) Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.

2) Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.

d. Factory tests on pumps:

1) Use tested job motors.

2) Use factory calibrated test drives.

e. Provide a minimum of 30 days written notice to the Engineer prior to shop testing.

3. Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.

4. Testing Tolerances: ANSI/HI

5. In the event that specified tests indicate that pump, motor, or variable frequency motor controller will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps, motors, and variable frequency motor controllers at no additional cost to the Owner.

6. Repeat tests until specified results are obtained.

7. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

L. ADJUSTABLE FREQUENCY DRIVES

Pumps that require adjustable frequency drives (AFDs) are listed within this Section. AFDs shall be constant torque type and shall be as specified in Section 16000 2.06I. For AFD driven units, the pump supplier shall be responsible for the provision of the fixed reduction between the motor and the pump. The reduction ratio shall be that required to operate the pump at its maximum operating speed when the motor is operating at its nominal rated full speed in accordance with the schedule in paragraph 11390-1.01 G. AFD controls shall be such that pumps cannot operate at a speed lower or higher than that which corresponds to the minimum and maximum speed as specified within this Section.

L. AIR COMPRESSOR

The air compressor to be provided as part of Unit Responsibility shall be Speedaire 35WC42. The compressor shall be a 2-stage electric air compressor and of vertical tank mounted design, 5 HP stationary air compressor with a capacity of 80 gallons and capable of maintaining pressures between 140 and 175 psi. Any alternatives will require approval and recommendation from the manufacturer. Other minimum requirements include:

Voltage: 480
HP: 5
Phases: 3
Hertz: 60
Motor RPM: 760
Enclosure: NEMA 4X
Motor Type: Dripproof

2.04 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Mill certifications confirming hardness of rotor and stator specified in paragraph 11390-2.02.

2. Operating and maintenance information specified in Section 01730.

3. Motor data as specified in paragraph 11060-2.05.

4. Manufacturer's certification that the pumping units will meet the vibration and critical speed limitations as specified in Section 11020.

5. Installation certification Form 11000-A as specified in paragraph 11390-3.01.

6. Training Certification Form 11000-B as specified in paragraph 11390-3.03.

2.05 SPARE PARTS

One set of packing tools shall be provided to service the pumps. In addition, the following shall be provided for each pump size:

1 - stator
1 - rotor
1 - connecting rod
2 - sets of packing rings

1 - pin joint kit including pin joint seals
2 - spare V570 controllers with final programs preloaded

1 – spare VFD.

Spare parts shall be tagged and stored in accordance with provisions of paragraph 11000-2.12.

PART 3 – EXECUTION

3.01 INSTALLATION

The pumps shall be installed as specified and in accordance with manufacturer's written recommendations. The installation and initial operation of all components shall be certified on Form 11000-A as specified in Section 01999. Coordinate with Owner, Systems Integrator, and BFP vendor regarding I/O list requirements, tagging standards, VFD I/O list/standardization. Reference to Section 17315 regarding implementation plan meetings requirements.

3.02 TESTING

After completion of installation, the pumps shall be completely tested to demonstrate compliance with operating requirements as specified.

3.03 TRAINING

A minimum of 4 hours of training shall be provided by the pump manufacturer's service engineer. The 4 hours of training shall be inclusive of all progressive cavity pumps supplied, including the polymer pumps and dewatered sludge feed pumps. Training shall conform to Section 01664 and shall be certified on Form 11000-B as specified in Section 01999.

END OF SECTION

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SECTION 14553

SHAFTLESS SCREW CONVEYORS

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies shaftless screw conveyors. The conveyor is located in the dewatering building. The conveyor transfers cake solids that are loaded on to a horizontal screw conveyor from a belt filter press to a feed hopper on a cake pump. The conveyor supplied shall include drive units, flighting, troughs and liners, covers, supports, hoppers, discharge chutes, safety devices, all metal construction specified, and appurtenances required for a complete and operable installation and shall be the product of a single manufacturer.

B. TYPE:

The conveyor shall be the shaftless formed steel spiral type conveyor designed to convey municipal wastewater raw screenings collected from static screens discharge point. The conveyor shall be reversible for cleaning and dejamming. The conveyor shall be designed with the motor and drive unit located in a pushing mode with remote bearings at the drive end and a replaceable wear liner installed throughout the length of the trough providing support to the spiral screw.

C. EQUIPMENT LIST:

Equipment numbers are as follows:

Item	Equipment number
Shaftless Inclined Screw Conveyor – A	NWR85-CON-402
Shaftless Inclined Screw Conveyor - B	NWR85-CON-404

D. PERFORMANCE AND DESIGN REQUIREMENTS:

1. GENERAL: The system components shall be designed and selected for continuous or intermittent duty while conveying the specified product in either the forward or the reverse direction. The cake may contain quantities of wastewater, grit, hair, grease, plastic, rubber, industrial solvents, animal fats, and oils, rocks, bricks, wood, sticks, metal objects, glass, rags and gross waste solids.

2. OPERATING REQUIREMENTS: The conveyor shall be sized to meet the specified requirements at less than 60 percent of the conveyor's rated capacity or 30 percent trough filling. Drive unit shall be designed for 125 percent of rated capacity. Specific operating requirements for the equipment to be provided under this section are as follows:

Item	NWR85-CON-402 & 404
Maximum capacity, cf/hr	100
Density, lbs/cf	60
Maximum Loading Rate, lbs/hour	1,500
Maximum solids concentration, percent	25
Approximate length[a], feet	45
Maximum screw speed, rpm	10
Maximum filling factor at maximum loading, percent	50
Minimum flight outside screw diameter[b] inches	11
Minimum spiral weight[b], lbs/ft	20
Minimum trough width[b], inches	12
Maximum drive horsepower[b]	5
Location of drives	Inlet
Motor type, reference Division 16	Explosion proof
Reversing screw	Yes
Incline Angle, approximate	25%
Discharge opening, in	Bottom[b]

3. EQUIPMENT GUARDS: Equipment guarding shall be in conformance with OSHA requirements.

4. OPERATION: The control panel shall be provided by the manufacturer. The control panel shall contain all the necessary controls to operate the conveyance equipment. The reversing motor starter will be provided in a NEMA 4X panel along with the over torque protection. the panel will be mounted remotely in the building's control room. In the automatic mode, the unit shall be activated by an adjustable timing function.

The control panel shall be provided with local indicating lights for alarm and status. Status lights shall be provided to indicate run and ready conditions. Alarm lights conforming to division 16 shall be provided to indicate motor overload.

Status contacts shall be provided for remote indication to indicate that the conveyor is ready, running or in trouble. Each set of contacts shall be electrically isolated and shall be rated NEMA B600 (10 amperes) and wired to terminals within each control panel. The trouble alarm contact shall open when any alarm conditions occur and shall close after all alarm conditions have been corrected and a manual alarm reset button has been depressed. An alarm reset pushbutton shall be provided to reset all alarms. The ready status contact shall close when the system is available to run. Running status signal contacts shall close during the run cycle, maintain closure during the entire run cycle, and open after the cycle is complete and the drive mechanism is in its normal parked position.

The Contractor shall ensure the local control panels and control stations comply with the contract drawings, division 16, Section 11010, and the requirements of this section.

The conveyor shall be provided with torque and 120 VAC speed switch to protect the unit when an overload occurs. The conveyor motor will be controlled by a new reversing motor starter located in the existing motor control centers.

The conveyor will be controlled independently. Each conveyor will have a Hand-Off-Auto switch and a Forward-Off-Reverse switch (REVERSE shall be spring return and OFF shall be lockable) located at the motor end of each conveyor. In the automatic position, an adjustable timer in the plant's PLC will start and run for a preset time. The Forward-Off-Reverse switch will allow the conveyor to be moved forward or reversed while holding the switch in that direction. The conveyor will be interlocked with the compactor cycle through the plant PLC and shall function as described herein and section 11631.

In addition, there shall be a pullcord safety switch along the full length of conveyor for emergency shut-off. The emergency switch shall be located at the motor end.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section references the following documents. They are part of this section insofar as specified and modified herein. In case of conflict between the requirements of this section and the listed documents, the requirements of this section shall prevail.

Reference	Title
AGMA 6010 E-88	Spur, Helical, Herringbone, and Bevel Enclosed Drives
AISI-85	Pocketbook of AISI Standard Steels
AFBMA 9-90	Load Ratings and Fatigue Life for Ball Bearings
AISI C-1020	Carbon Steel
ASTM A36-90	Structural Steel
ASTM A53-90	Pipe, Steel, Black and Hot-dipped, Zinc-Coated, Welded and Seamless
ASTM A276-91	Stainless Steel and Heat-Resisting Steel Bars and Shapes
ASTM A480/ A480M-90	General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM D4020	Ultra-high Molecular Weight (UHMW) Polyethylene Moldin Gand Extrusion Materials
CEMA	Standard Number 300
UBC-91	Uniform Building Code
AWS-D1. 1-90	Structural Welding Code – Steel
JIC EMP-1-67	Electrical Standards for Mass Production Equipment
NEMA ICS 2-88	Industrial Control Devices, Controllers and Assemblies
NFPA-70-96	National Fire Protection Association; 1996 National Electrical Code
UL	Underwriter's Laboratories, Inc. 1. Electrical Construction Materials Directory 2. UL-508 Industrial Control Equipment

B. EXPERIENCE:

The equipment specified herein shall be furnished by a manufacturer who shall have previously furnished equipment of the same or larger capacity and length for at least three installations, with a minimum of 5 years of satisfactory operation at each installation. The manufacturer shall guarantee that the equipment performs as specified for a period of 1 year from the date of start-up. If during this period, the equipment fails to perform, then the failure shall be remedied by the manufacturer at no cost to the Owner.

C. STANDARDS:

The conveyor shall be designed and constructed to the standards of the Conveyor Equipment Manufacturers Association (CEMA) Standard No. 300 as a minimum unless exceeded by this specification.

D. FACTORY TESTING:

The conveyor shall be assembled at the shop and tested for at least 1 hour prior to shipment. This test may be witnessed by the Construction Manager. Notify the Construction Manager 2 weeks prior to the test.

1.03 ENVIRONMENTAL CONDITIONS

Equipment shall be installed at a wastewater treatment plant that is approximately 50 feet above sea level.

1.04 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specifications compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked “no changed required”. Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

3. Experience statement specified in paragraph 14553-1.02B with list of installations.

4. Catalog data on all ancillary electrical components, including limit switches, torque and speed sensors, etc.

5. Motor data as specified in paragraph 11010-1.03.

6. Gear reduction unit catalog data indicating the unit's AGMA service classification and service factor.

7. Listing of conveyor components and materials.

8. Structural calculations for the design of the conveyor support and anchoring system signed by a registered professional engineer confirming anchor embedment as well as conveyor design.

9. Operations and maintenance (O&M) manuals shall be provided in accordance with Section 01730.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

The County believe the following manufacturers are capable of producing equipment and products, which will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's product, nor shall it be construed that a named manufacturer's standard product will comply with the requirements of this Section. Candidate manufacturers include Spirac, American Bulk Conveyor, ASDOR/U.S. Filter, and JDV, or equal.

2.02 MATERIALS

Materials of construction shall be:

Component	Material
Chutes and sidewall splash plates	AISI, Type 304 Stainless Steel
Trough, end plates, lids, and drive	AISI, Type 8620 Stainless Steel
Hoppers	AISI, Type 304 Stainless Steel
Supports, Brackets	AISI, Type 304 Stainless Steel
Guards	AISI, Type 304 Stainless Steel

Component	Material
Flight screw and spiral insert	High Strength Alloy Carbon Steel with minimum hardness of 250 Brinnell, 80,000 psi tensile strength minimum
Wear liner	UHMW or Ceramic Chip Embedded Polyurethane, minimum 1/2 inch thick
Gaskets	Neoprene
All nuts, bolts, washers, fasteners	AISI, Type 316 Stainless Steel

2.03 EQUIPMENT

A. TROUGH AND SIDEWALLS:

Trough shall be U-shaped fabricated from a minimum 1/4 inch stainless steel plate. Stiffeners shall be placed across the top of the trough and fastened to both sides of the trough to maintain trough shape and act as a face seal for the sidewalls. A continuous gasket one inch wide shall be provided to the entire top face of the trough top flange and stiffeners. Sidewall splashguards shall be of minimum 1/8 inch stainless steel flanged, gasketed and bolted to the trough. Discharge openings shall be flanged for bolting and gasketing. Discharge shall be fabricated from a minimum 1/4 inch 304 stainless steel. Sidewalls shall be full length of conveyor except at screen discharge points and shall effectively contain splashing material off the screen face.

Conveyor supports shall be provided suitable for mounting onto a steel support structure. A 3 inch flanged drain outlet shall be provided with each conveyor at the low point to facilitate cleaning. A 1 inch NPT connection for overflow when drain is plugged shall be provided at the top edge above the drain.

The conveyor shall discharge to the corresponding hopper of the screenings compactor (specification Section 11631) using a hopper provided by the conveyor manufacturer. Conveyor manufacturer shall coordinate the hopper design with conveyor manufacturer. The screw conveyor manufacturer shall provide the structural support system for the conveyor system, including supports for discharge chutes.

B. SCREW:

The conveyor shall be the shaftless spiral screw type with spiral insert. The spacing, size, and pitch of the flights shall be as required to provide the specified performance. The material to be handled may be abrasive, hardened steel material shall be provided for both conveyor flights and insert. The minimum diameter of all coupling bolts shall be 7/8 inch. Spiral flighting shall be formed in

sections from one continuous flat bar and shall be concentric to within plus or minus 2 mm.

The shaftless screw shall be designed to handle a torque of at least 3,200-foot-pounds. Supplier shall demonstrate that, at 250 percent of the motor nameplate horsepower, the drive unit cannot produce more torque than the torsional rating of the flighting, and that the "spring effect" of the spiral shall not exceed 0.08 inch per feet of length at maximum load conditions.

Spiral flighting shall have full penetration welds at all splice connections. The flights shall be aligned to assure true alignment when assembled in the field and shall be made in accordance with the supplier's requirements. The spiral flights shall be coupled to the end shaft by a flanged, bolted connection.

A gland packing ring consisting of two teflon coated packing rings shall seal the drive shaft at its penetration through the end plate.

The connection of the spiral to the drive system shall be through a flanged connection plate that is welded to the spiral forming a smooth and continuous transformation from the flange plate to the spiral. The drive shaft shall have a mating flange and shall be bolted to the spiral connection plate. Additionally, a grease lubricated labyrinth seal shall be shaft mounted internally in the conveyor between the back plate and spiral coupling connection.

C. HOPPERS:

Screw conveyor supplier shall coordinate all hopper/sidewall configurations and connection points shown on the Drawings with the static screens and screenings compacting equipment and coordinate with those manufacturers. Refer to Section 11631. Hoppers and chutes shall be 3/16 inch 304 stainless steel reinforced for the required service.

D. SPEED SENSOR:

The conveyor shall be provided with a 120 VAC non-contact speed sensor. The speed sensor shall be mounted such that any repair on the conveyor shaft shall not require removal of the speed sensor. The speed sensor shall be provided in accordance with Division 17 The speed sensor alarm contact shall open in case of speed failure.

E. SUPPORTS:

Provide Type 304 stainless steel mounting supports welded to the trough, suitable for the conveyor. Supports shall be from the floor, and not from walls or ceilings. The supports shall be shop fabricated from structural shapes and plates and shall be assembled and fitted to the conveyor prior to its delivery. All supports shall be

designed per UBC-95 zone 0, and to avoid interference with other equipment or equipment supports. The supports shall be designed to prevent excessive vibration of any portion of the conveyor unit under all loading conditions.

F. BEARINGS:

The conveyor screw shall be supported at the drive end by a bearing. All thrust shall be taken by the end bearings. End bearings shall be outboard pillow block bearings and shall be serviceable from the outside of the conveyor. The end bearings shall be designed for thrust loads developed with the conveyor in forward or reverse.

All bearings shall be designed and constructed to withstand the maximum combination of peak radial and thrust loads imposed on it during operation. Bearing shall have a minimum L-10 rating of 100,000 hours. Bearings shall be permanently lubricated.

G. DRIVE UNIT:

The conveyor drive unit shall consist of a constant speed electric drive motor. The electric motor shall be energy-efficient Type 3 explosion-proof motor per Division 16 designed for 480 volts, 3-phase, 60 Hz electric service. Guards shall meet OSHA requirements.

H. EQUIPMENT PROTECTION:

In addition to the speed controls specified in paragraph 14553-2.03D, each conveyor drive unit shall be equipped with an emergency trip cord and safety switch and torque switch. The emergency cord shall run the full length of each conveyor. The trip switch shall immediately stop the conveyor when the switch is actuated. The torque switch setting shall be adjustable from torque at empty to torque required to protect the screw. Motors shall be controlled by reversing starters located in motor control centers specified in Division 16.

The electrical and process control design has been based on the manufacturers named in paragraph 14553-2.01.

I. GEAR REDUCER:

Gear reducers shall conform to AGMA Class I. Gear reducers shall be single-, double-, or triple-reduction helical gear units with roller bearings and shall be directly coupled to the screw. Bearings shall have an AFMBA L-10 life of 100,000 hours. The gear reducers shall be air-cooled with no auxiliary cooling allowed. The shaft seals shall be suitable for the service conditions. Guards shall meet OSHA requirements.

J. SURFACE PREPARATION:

All iron and mild steel surfaces to be painted in accordance with Section 09900. Grit blasted surfaces shall be painted within 24 hours to prevent rusting and surface discoloration. Stainless steel components shall be provided with an ASTM A480, No. 1 finish.

K. WEAR LINER:

The wear liner for each conveyor shall be fabricated of 1/2 inch thick ultra high molecular weight polyethylene sintered with an anti-wear filler to reduce wear and synthetic lubricant to reduce friction. The wear liner shall be furnished in maximum 4-foot sections to provide ease of replacement. The liner shall be held in place with clips.

L. TORQUE SWITCHES:

Torque switches shall be provided on the connection between the drive shaft and the drive motor. The switches shall open on excessive torque to stop the drive motor. The switch contacts shall be rated 120VAC, 2 amperes. The torque switch enclosures shall be rated NEMA 4X/7, corrosive/explosion-proof.

M. CONTROL PANEL:

There is no control panel for the screw conveyors. Starters and controls are located in the belt filter press control panels, located in the electrical room.

1. EXTERNAL CONTROL INTERLOCKING AND ALARMS: The control panel will be located in the control room. The Hand-Off-Auto switches and Forward-Off-Reverse switches for the drive motor will be located next to the equipment at a control station that is a NEMA 7 enclosure. When the switch is in the “hand” position, the motor can be operated in either the forward or reverse direction. In the “auto” position, the timing function actuates the conveyor cycle with a momentary (1 second) contact closure. The H-O-A switch shall have an extra contact which closes in the auto position. The H-O-A “auto” status contact shall provide an input to the plant’s PLC that the switch is in the “auto” position. An emergency stop switch (maintained) will be provided next to the equipment to shutdown the conveyor with one switch. The switch shall open when the button is pushed. This shall cause the motor to immediately stop. The unit shall be provided with local indicating lights for alarm and status. Status lights shall be provided to indicate run and ready conditions. Alarm lights shall be provided to indicate the following conditions:

Torque Overload

Provide status contacts to indicate that the conveyor is running and a common trouble alarm contact shall be provided for remote indication and alarm. Each set of contacts shall be electrically isolated and shall be rated NEMA B600 (10 amperes) and wired to terminals within each control panel. The trouble alarm contacts shall open when any alarm condition occurs and shall close after all alarm conditions have been corrected and a manual alarm reset button has been depressed. Manual alarm reset button shall be surface mounted on the local control panel. Status signal contacts shall close during the run cycle, maintain closure during the entire run cycle, and open after the cycle is complete and the drive mechanism is in its normal parked position.

2.04 SPARE PARTS

The following spare parts shall be provided:

1 set shaft seals
45 linear feet of liner material
1 speed sensor (Motion detector)

Spare parts shall be packed and boxed as specified in Section 11000.

2.05 PRODUCT DATA

The following information shall be provided as indicated:

1. Motor data as specified in Division 16.

2. Three copies of Installation Certification Form 11000-A as specified in paragraph 14553-3.01 shall be provided prior to any testing of the equipment.

3. Three copies of Training Certification Form 11000-B as specified in paragraph 14553-3.03 shall be provided immediately after completion of training.

PART 3 – EXECUTION

3.01 INSTALLATION

Conveyor shall be installed as shown on the contract drawings and in accordance with manufacturer's recommendations. Installation shall be carried out by mechanics/millwrights skilled in work of this kind, under the general supervision of a factory-trained representative of the manufacturer. Raceway and cable shall be installed in accordance with paragraphs 16110-3.02 and 16120-3.01, respectively. The equipment

shall be checked, aligned, tested, and placed in operation in accordance with Sections 01660 and 01662

3.02 TESTING

After completion of installation, conveyor shall be completely tested to verify compliance with this specification. Controls shall be tested for operation before actual operation with screenings. Testing and commissioning shall be carried out in accordance with Sections 01660 and 01662.

3.03 TRAINING

Factory trained maintenance and operation instruction specialists shall provide on-site training for the equipment in accordance with the requirements of Section 01664. As part of the training for the staff, the steps involved with the replacement of the trough liner shall be described in detail, and two 4-foot sections of the trough liner shall be removed completely from the trough and then reinstalled. Training shall conform to section 01664 and shall be certified on Form 11000-B in Section 01999.

END OF SECTION

SECTION 15050

PIPING SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies systems of process piping and general requirements for piping systems. Detailed specifications for the components listed on the Piping System Specification Sheets are found in other sections of Division 15. This section shall be used in conjunction with those sections.

B. DEFINITIONS:

Pressure terms used in Section 15050 and elsewhere in Division 15 are defined as follows:

1. Maximum: The greatest continuous pressure at which the piping system operates.

2. Test: The hydrostatic pressure used to determine system acceptance.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been

superseded by a version with a later date, discontinued or replaced.

Reference	Title
AASHTO M36/M36M	Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains
ANSI A13.1	Scheme for the Identification of Piping Systems
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.3	Malleable Iron Threaded Fittings Class 150 and 300
ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ANSI B16.11	Forged Steel Fittings, Socket Welding and Threaded
ANSI B16.12	Cast Iron Threaded Drainage Fittings
ANSI B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ANSI B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ANSI B31.1	Power Piping
ANSI B31.3	Chemical Plant and Petroleum Refinery Piping
ASME Section IX	Boiler and Pressure Vessel Code; Welding and Brazing Qualifications
ASTM A47	Malleable Iron Castings
ASTM A53	Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless
ASTM A74	Cast Iron Soil Pipe and Fittings
ASTM A105/A105M	Forgings, Carbon Steel, for Piping Components
ASTM A106	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A197	Cupola Malleable Iron
ASTM A234/A234M	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A312/A312M	Seamless and Welded Austenitic Stainless Steel Pipe
ASTM A403/A403M	Wrought Austenitic Stainless Steel Piping Fittings
ASTM A536	Ductile Iron Castings

Reference	Title
ASTM A570/A570M	Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
ASTM B88	Seamless Copper Water Tube
ASTM C76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C296	Asbestos-Cement Pressure Pipe
ASTM C443-REV A	Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C564	Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM D1248	Polyethylene Plastics Molding and Extrusion Materials
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D2513	Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D2665	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2996	Filament-Wound Reinforced Thermosetting Resin Pipe
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3261	Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D4174	Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems
ASTM D4101	Propylene Plastic Injection and Extrusion Materials
ASTM F441	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
AWWA C105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 Inch Through 48 Inch, for Water and Other Liquids
AWWA C111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids

Reference	Title
AWWA C200	Steel Water Pipe 6 Inches and Larger
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe--4 In. and Larger--Shop Applied
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Services--Sizes 4 In. through 144 In.
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C209	Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C210	Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipe
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWA C301	Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids
AWWA C303	Reinforced Concrete Pressure Pipe--Steel Cylinder Type, Pretensioned, for Water and Other Liquids
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C651	Disinfecting Water Mains
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches, for Water
AWWA M11	Steel Pipe--A Guide for Design and Installation
CISPI 301	Specification Data for Hubless Cast Iron Sanitary System with No-Hub Pipe and Fittings
FEDSPEC L-C-530B(1)	Coating, Pipe, Thermoplastic Resin or Thermosetting Epoxy
MIL-H-13528B	Hydrochloric Acid, Inhibited, Rust Removing
MIL-STD-810C	Environmental Test Methods
SAE J1227	Assessing Cleanliness of Hydraulic Fluid Power Components and Systems
UPC	Uniform Plumbing Code

B. FITTINGS AND COUPLING COMPATIBILITY:

To assure uniformity and compatibility of piping components, fittings and couplings for grooved end piping systems shall be furnished by the same manufacturers.

PART 2 – PRODUCTS

2.01 PIPING MATERIALS

Unless otherwise specified, piping materials, including pipe, gaskets, fittings, connection and joint assemblies, linings and coatings, shall be selected from those listed on the piping system specification sheets. Piping materials shall conform to detailed specifications for each type of pipe and piping appurtenance specified in other sections of Division 02 and 15.

2.02 PIPING IDENTIFICATION

A. PLASTIC CODING MARKERS:

Plastic markers for coding pipe shall conform to ANSI A13.1 and shall be as manufactured by W. H. Brady Company, Seton Name Plate Corporation, Marking Services Inc., or equal. Markers shall be the mechanically attached type that are easily removable; they shall not be the adhesive applied type. Markers shall consist of pressure sensitive legends applied to plastic backing which is strapped or otherwise mechanically attached to the pipe. Legend and backing shall be resistant to petroleum-based oils and grease and shall meet criteria for humidity, solar radiation, rain, salt, fog and leakage fungus, as specified by MIL-STD-810C. Markers shall withstand a continuous operating temperature range of -40 degrees F to 180 degrees F. Plastic coding markers shall not be the individual letter type but shall be manufactured and applied in one continuous length of plastic.

Markers bearing the legends on the background colors specified in the PIPESPEC shall be provided in the following letter heights:

Outside pipe diameter,[a] inches	Letter height, inches
Less than 1-1/2	1/2
1-1/2 through 3	1-1/8
Greater than 3	2-1/4

[a] Outside pipe diameter shall include insulation and jacketing.

In addition, pipe markers shall include uni- and bi-directional arrows in the same sizes as the legend. Legends and arrows shall be white on blue or red backgrounds and black on other specified backgrounds.

B. PLASTIC TRACER TAPE:

Tracer tape shall be 6 inches wide, colored the same as the background colors as specified in Table A, paragraph 15050-3.06, and made of inert plastic material

suitable for direct burial. Tape shall be capable of stretching to twice its original length and shall be as manufactured by Allen Systems, W. H. Brady Co., Seton Name Plate Corporation, Marking Services Inc., or equal.

Two messages shall be printed on the tape. The first message shall read ***"CAUTION CAUTION CAUTION _____ PIPE BURIED BELOW"*** with bold letters approximately 2 inches high. The blank shall be filled with the particular system fluid such as chlorine, oxygen or sulfur dioxide. The second message shall read ***"CALL _____"*** with letters approximately 3/4 inch high. Both messages shall be printed at maximum intervals of 2 feet.

2.03 VALVES

Valves of the same size and service shall be provided by a single valve manufacturer. Packing shall be non-asbestos material. Actual length of valves shall be within 1/16 inch (plus or minus) of the manufacturer's specified length. Flanges shall meet the requirement of ANSI B16.5. Push-on and mechanical joints shall meet the requirements of AWWA C111. Valve operators are specified in Sections 02640.

2.04 PRODUCT DATA

Product data on piping materials shall be provided in accordance with Section 01300 where specified.

Piping layout drawings shall be transmitted to the Construction Manager a minimum of 2 weeks prior to construction. Drawings shall be original layouts by the Contractor; photocopies of contract drawings are not acceptable.

PART 3 – EXECUTION

3.01 INSTALLATION

A. LOCATION:

Piping shall be provided as specified except for adjustments to avoid architectural and structural features and shall be coordinated with electrical construction.

B. PIPING SIZES:

Where the size of piping is not specified, the Contractor shall provide piping of the sizes required by UPC. Unless specified otherwise, small piping (less than 1 inch in diameter) required for services not described by UPC shall be 1/2 inch.

C. PIPE SUPPORT, ANCHORAGE AND SEISMIC BRACING:

1. GENERAL: Piping shall be supported by anchor brackets, guides, saddles or hangers. Acceptable types of supports, guides, saddles, hangers and structure attachments for general pipe support, and expansion/contraction as well as anchorage details, are shown on the drawings. Minimum spacing shall be as specified for supports. Pipe supports shall be designed and furnished by the Contractor. The supports and layout shall be designed and submitted by a Professional Engineer registered in the State of Florida. Where a specific type of support or anchorage is indicated on the drawings, then only that type shall be used there. Piping shall be vertically supported by anchor brackets, guides, saddles or hangers and shall be braced where indicated to resist lateral load. Supports shall be provided on each run at each change of direction. Pipe supports shall be hot-dip or mechanically galvanized. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.

2. PIPING CONNECTIONS TO MACHINES: Piping at machine connections shall be aligned in all planes to permit insertion of bolts at bolted connections or coupling screwed connections without using jacks, come-a-longs or other mechanical means to align field piping with the connections at the machines. Bolts shall not be forced into mating flange bolt holes and shall be capable being withdrawn using finger pressure alone. The use of 'dutchmen' mitered sections or similar specials to achieve the required alignment with machine connections is strictly prohibited.

D. ANCHORAGE FOR BURIED PIPING:

All plugs, caps, tees and bends in buried pressure piping systems shall be anchored by means of reaction backing or restrained joints as specified.

E. BEDDING AND BACKFILL:

Bedding and backfill for buried piping shall be as specified.

F. EQUIPMENT CONNECTION FITTINGS

Where shown, equipment connection fittings as specified in Section 15085 shall be provided between field piping systems and equipment inlet and outlet connections.

G. FLEXIBILITY

Unless otherwise specified, piping passing from concrete to earth shall be provided with two pipe couplings or flexible joints as specified in Section 15085.

3.02 PIPING IDENTIFICATION

A. PIPE CODING:

After application of the specified coating and insulation systems, exposed piping, interior and exterior, and piping in ceiling spaces, pipe trenches, pipe chases and valve boxes shall be identified with plastic markers as specified in paragraph 15050-2.02 A. Legend markers and directional arrows shall be located at each side of walls, floors and ceilings, at one side of each piece of equipment, at piping intersections, and at approximately 50-foot centers.

B. PLASTIC TRACER TAPE:

A single line of tape as specified in paragraph 15050-2.02 B shall be provided 2.5 feet above the centerline of buried (insert required systems) pipe. For (insert required systems) pipelines buried 8 feet or greater below finished grade, contractor shall provide a second line of tape 12 inches below finished grade, above and parallel to each buried pipe. Tape shall be spread flat with message side up before backfilling.

3.03 VALVE IDENTIFICATION

Stainless steel tags bearing the specified valve number stamped in 1/4-inch high letters shall be installed on valve flanges in a position visible from floor level. Flangeless valves 8 inches in diameter and larger shall have tags attached to the valve body by self-tapping corrosion resistant metal screws. Flangeless valves 6 inches in diameter and smaller shall have tags attached to the valve stem by stainless steel wire. Wire shall be 0.063 inch minimum.

3.04 TESTING

A. GENERAL:

Upon completion of piping, but prior to application of insulation on exposed piping, the Contractor shall test the piping systems. Pressures, media and test durations shall be as specified in the PIPESPEC. Equipment which may be damaged by the specified test conditions shall be isolated. Testing shall be performed using calibrated test gages and calibrated volumetric measuring equipment to determine leakage rates. Each test gage shall be selected so that the specified test pressure falls within the upper half of the gage's range. Unless otherwise specified, the Contractor shall notify the Construction Manager 24 hours prior to each test.

Unless otherwise specified, testing, as specified herein, shall include existing piping systems which connect with new pipe systems. Existing pipe shall be tested to the

nearest existing valve. Any piping which fails the test shall be repaired. Repair of existing piping will be considered and paid for as extra work.

B. LIQUID SYSTEMS:

Leakage shall be zero at the specified test pressure throughout the specified duration for the following systems: exposed piping, buried insulated piping, and buried or exposed piping carrying liquid chemicals. Testing procedures for hydraulic and lube oil systems are specified in paragraph 15050-3.04 E. Unless otherwise specified, leakage from other buried liquid piping systems shall be less than 0.02 gallon per hour per inch diameter per 100 feet of buried piping.

3.05 CLEANING AND FLUSHING

A. GENERAL:

Piping systems shall be cleaned following completion of testing and prior to connection to operating, control, regulating or instrumentation equipment. The Contractor may, at his option, clean and test sections of buried or exposed piping systems. Use of this procedure, however, will not waive the requirement for a full pressure test of the completed system. Unless specified otherwise, piping 24 inches in diameter and smaller shall first be cleaned by pulling a tightly fitting cleaning ball or swab through the system. Piping larger than 24 inches in diameter may be cleaned manually or by jetting or with a cleaning ball or swab.

B. TEMPORARY SCREENS:

Upon completion of the cleaning, the Contractor shall connect the piping systems to related process equipment. Temporary screens, provided with locator tabs which remain visible from the outside when the screens are in place, shall be inserted in pipelines at the suction of pumps and compressors in accordance with the following table:

Equipment suction or piping size, inches	Maximum screen opening, inches
0 –1	1/16
1-1/4 – 3	1/4
3-1/2 – 6	1/2
Over 6	1

The Contractor shall maintain the screens during testing, initial start-up, and initial operating phases of the commissioning process. In special cases, screens may be removed as required for performance tests. The Contractor shall remove the temporary screens and make the final piping connections after the screens have

remained clean for at least 24 consecutive hours of operation. Systems handling solids are exempted.

C. LIQUID SYSTEMS:

After completion of cleaning, liquid systems, unless otherwise specified, shall be flushed with clean water. With temporary screens in place, the liquid shall be circulated through the piping system using connected equipment for a minimum period of 15 minutes and until no debris is collected on the screens.

3.06 PIPING SPECIFICATION SHEETS (PIPESPEC)

Piping and valves for groupings of similar plant processes or types of service lines are specified on individual piping specification sheets (PIPESPECS). Piping services are grouped according to the chemical and physical properties of the fluid conveyed and/or by the temperature or pressure requirements. Each grouping of services (PIPESPEC) is identified by a piping system number.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping Symbol/Service: RW--Raw Water

Test Requirements:

Medium:	Water; ref. spec paragraph 15050-3.04 C.
Pressure:	125 psig
Duration:	60 minutes

Gasket Requirements:

Flange:	Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Push-on/Mech Cpl:	Nitrile or Neoprene

Exposed Pipe and Valves:
(See drawings for pipe size and valve type)

(3" and smaller)

Pipe:	Steel; ASTM A53, galvanized. Ref. spec Section 15061. Conn; taper threaded, ANSI B1.20.1. Flanged adapters for 2-1/2 inch, 3 inch valves. Ftgs; malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized.

(2" and smaller)

Valves:	Ball; Jamesbury Fig. 351, Nibco T-580, or equal. Globe; Crane 7TF or 17TF, Lunkenheimer 123 or 214, or equal. Swing check; Crane 137, Lunkenheimer 230, or equal.

(4" thru 8")

Pipe:	Steel; ASTM A53, ERW, Grade B, black, with cement mortar lining. Ref. spec Section 15061. Conn; grooved mech pipe coupling or flanged. Ftgs; malleable iron, ductile iron, or steel, per spec Section 15061; ends and lining to match pipe.

(2 1/2" thru 8")

Valves:	Butterfly; Ref. spec Section 15103. Substitute Type B on 2-1/2-inch lines. Swing check; spring loaded per spec Section 15118.

(10" thru 24")

Pipe:	Steel; same as 8 inch or AWWA C200, 3/16 inch thick, with cement mortar lining. Ref. spec Section 15061. Conn; same as 8 inch. See Remarks.

Ftgs; steel, ASTM A234, or fabricated steel, AWWA C208. Lining and ends to match pipe.

Valves: Butterfly; ref. spec Section 15103.
Swing check; spring loaded per spec Section 15118.

(26" and larger)
Pipe: See Remarks
Valves: See Remarks

Buried and Encased Pipe and Valves:
(See drawings for pipe size and valve type. Omit coating on encased pipe.)

(3" and smaller)
Pipe: PVC; ASTM D1784, Class 12454-B, NSF certified, ASTM D1785, Sch. 80. Ref. spec Section 15064. Provide magnetic tracer tape.
Conn; plain end; solvent weld with threaded or flanged adapters for valves.
Ftgs; PVC, Sch. 80, socket weld.

Valves: Gate; ref. spec Section 15101, with extension stem and valve box. Coating M-1 per spec Section 09900.

(4" to 12")
Pipe: Ductile iron; AWWA C151 with cement mortar lining. Ref. spec Section 15062.
Conn; grooved end or restrained push-on rubber gasket joint. Flanged adapters for valves.
Ftgs; ductile iron per spec Section 15062; coating, lining and ends to match pipe.

Valves: Butterfly; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09900.

(14" and larger)
Pipe: Ductile iron; same as 12 inch for pipe and ftgs, or
Concrete cylinder; ref. spec Section 15057.
Conn; restrained bell and spigot with O-ring rubber gasket joint. Flanged adapters for valves.
Ftgs; fabricated steel, mortar lined and coated. Ref. spec Section 15057.

Valves: Butterfly; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09900.

Remarks:

1. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline as specified in paragraph 15095-3.03.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping Symbol/Service:	CEN--Centrate CS--Circulating Sludge DS--Digested Sludge DSS--Screened Digested Sludge SN--Supernatant ES--Equalized Sludge F--Float FLT--Filtrate FS--Flotation Sludge TO--Thickener Overflow	System--15

Test Requirements:

Medium:	Water; ref. spec paragraph 15050-3.04 C.
Pressure:	100 psig (300 psig for cake piping)
Duration:	120 minutes

Gasket Requirements:

Flange:	Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Push-on/Mech Cpl:	Nitrile or Neoprene

Exposed Pipe and Valves:
(See drawings for pipe size and valve type)

(2" and smaller)

Pipe:	Steel; ASTM A53, galvanized. Ref. spec Section 15061. Conn; taper threaded, ANSI B1.20.1. Ftgs; malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized.
Valves:	Eccentric plug; per spec Section 15110. Install valve with seat upstream. Swing check; Lunkenheimer 230, Crane 137, or equal.

(2 1/2" thru 8")

Pipe:	Steel; ASTM A53, ERW, Grade B, black, no lining. Ref. spec Section 15061. Conn; butt weld, grooved mech pipe coupling or flanged. Ftgs; malleable iron, ductile iron, or steel per spec Section 15061; ends to match pipe.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping System:	15 (continued)
Valves:	Eccentric plug; per spec Section 15110. Install valve with seat upstream. Swing check; spring loaded per spec Section 15118.
(10" and larger)	
Pipe:	Steel; same as 8 inch or AWWA C200, 3/16 inch thick, with lining. Ref. spec Section 15061. Conn; butt weld, mech pipe coupling, or flanged. See Remarks. Ftgs; steel, ASTM A234, or fabricated steel, AWWA C208; lining and ends to match pipe.
Valves:	Eccentric plug; ref. spec Section 15110. Swing check; spring loaded per spec Section 15118.

Buried and Encased Pipe and Valves:
(See drawings for pipe size and valve type. Omit coating on encased pipe.)

(3" and smaller)	
Pipe:	PVC; ASTM D1784, Class 12454-B, ASTM D1785, Sch. 80. Ref. spec Section 15064. Provide magnetic tracer tape. Conn; plain end; solvent weld with threaded or flanged adapters for valves. Ftgs; PVC, Sch. 80, socket weld.
Valves:	Eccentric plug; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09900.
(4" thru 12")	
Pipe:	Ductile iron; AWWA C151. Ref. spec Section 15062. Conn; grooved end or restrained push-on rubber gasket joint. Flanged adapters for valves. Ftgs; ductile iron per spec Section 15062; coating, lining and ends to match pipe.
Valves:	Eccentric plug; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09900.
(14" and larger)	
Pipe:	Ductile iron; same as 12 inch for pipe and ftgs or Concrete cylinder; ref. spec Section 15057.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping System:	15 (continued)
	Conn; restrained bell and spigot with O-ring rubber gasket joint. Flanged adapters for valves. Ftgs; fabricated steel, mortar lined and coated. Ref. spec Section 15057.
Valves:	Eccentric plug; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09900.

Remarks:

1. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline as specified in paragraph 15095-3.03.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping Symbol/Service:	AL--Alum	System--19
	B--Brine	
	CLS--Chlorine Solution	
	CSO--Caustic Soda	
	FC--Ferric Chloride	
	HOCL--Sodium Hypochlorite (See Remark 1)	
	POL--Polyelectrolyte	
	SDS--Sulfur Dioxide Solution	

Test Requirements:

Medium:	Water; ref. spec paragraph 15050-3.04 C.
Pressure:	150 psig
Duration:	120 minutes

Gasket Requirements:

Flange:	PTFE bonded EPDM, full-face gaskets, ANSI B16.1.
Push-on/Mech Cpl:	N/A

Exposed Pipe and Valves:
(See drawings for pipe size and valve type)

(All sizes)

Pipe: PVC; ASTM D1784, Class 12454-B, NSF certified, ASTM D1785, Sch. 80. Pipe and fittings exposed to sunlight shall be painted. Ref. spec Section 15064.
Conn; plain end, solvent weld, flanged for valves 3 inch and larger.
Ftgs; PVC, Sch. 80, solvent weld.

(4" and less)

Valves: Ball; PVC Chemtrol Tru Bloc TU Series, Asahi/America Duo Bloc TU Series, GSR TU Series, or equal, with PTFE seats and EPDM 0-rings.
Diaphragm; PVC body, Chemtrol Series PD, Posacon 677, Asahi/America, or equal with EPDM or PTFE diaphragm.
Ball check; PVC body, Chemtrol Series BC, Asahi/America, or equal with EPDM or PTFE seats/seals.

(5" and larger)

Valves: Diaphragm; ITT Dia-Flo 2558-2-M, Hills-McCanna 0649-1-38, or equal.
Swing or ball check; fully lined valve body; fully coated swing check flapper or ball check ball; lining and coating shall be Hypalon or fluorinated ethylene propylene. Valve

and Primer Co. APCO Series 100R, Peabody Dore Model 770, or equal.

Buried and Encased Pipe and Valves:
(See drawings for pipe size and valve type)

(All sizes)
Pipe: PVC; same as exposed. Provide magnetic tracer tape.
Conn; same as exposed.
Ftgs; same as exposed.

(2" and less)
Valves: Ball; same as exposed with extension stem and valve box.

(2 1/2" and larger)
Valves: Diaphragm; same as exposed with extension stem and valve box.

Remarks:

1. For HOCL service, the following shall apply:

   a. Ball valves are not permitted on HOCL service.

   b. Diaphragm valves 4 inches and smaller shall be provided with PTFE diaphragms; valves 5 inches and larger shall be provided with Hypalon or PDVF linings with PTFE diaphragms.

END OF SECTION

SECTION 15085

PIPING CONNECTIONS

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies the following methods of connecting metallic piping: flanges, threading, mechanical couplings, equipment connection fittings, dielectric unions, and welding.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI Bl.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI Bl.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI B18.2.1	Square and Hex Bolts and Screws Inch Series
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ANSI B31.1	Power Piping
ANSI B31.3	Chemical Plant and Petroleum Refinery Piping
ASME Section IX	Boiler and Pressure Vessel Code; Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators Qualifications

Reference	Title
ASTM B98	Copper-Silicon Alloy Rod, Bar and Shapes
ASTM F37	Standard Test Methods for Sealability of Gasket Materials
ASTM F104	Standard Classification System for Nonmetallic Gasket Materials
ASTM F152	Standard Test Methods for Tension Testing of Nonmetallic Gasket Materials
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Service-Size 4 in. through 144 in.
AWWA C219	Bolted, Sleeve-Type Couplings for Plain-End Pipe
AWWA C550	Protective Epoxy Coatings for Valves and Hydrants
AWWA C606	Grooved and Shouldered Joints
AWWA M11	Steel Pipe-A Guide for Design and Installation
NSF 61	Drinking Water System Components - Health Effects

1.03 SUBMITTALS

In addition to the material listed in the detailed specification, the following submittals shall be provided in accordance with Section 01300:

1. For Equipment Connection Fittings used in pumping applications submit thrust rod stretch calculations in accordance with paragraph 2.01D. and dimensional layout data.

PART 2 – PRODUCTS

2.01 FLANGE ASSEMBLIES

A. FLANGES:

1. GENERAL: Flanges shall either be flat flanges or convoluted ring flanges as specified in the following paragraphs.

2. FLAT FLANGES: Cast iron flanges shall be faced in accordance with ANSI B16.1. Where companion flanges are used, the flanges on pipe shall be refaced to be flush with the companion flange face. Class 150 and Class 300 forged steel flanges shall be raised face conforming to ANSI B16.5. Lightweight slip-on flanges shall be plain face conforming to AWWA C207, Class B and ANSI B16.5. Unless otherwise specified, steel flanges shall be ANSI B16.5, Class 150 or AWWA C207, Class D. Class E AWWA flanges

shall be provided where test pressure exceeds 175 psi. Plain faced flanges shall not be bolted to raised face flanges.

3. CONVOLUTED RING FLANGES: Convoluted ring flanges shall be ductile iron, forged steel or cast stainless steel, designed to bear on hubs welded to the pipe and shall be as manufactured by Improved Piping Products. The flange joints shall be rated for not less than 150 percent of the test pressures listed in Section 15050 and shall conform to the requirements of ANSI B 16.5 and AWWA C207. The flange manufacturer shall be prepared to demonstrate, by certified pressure test that the flanges will meet these requirements.

B. GASKETS:

Gasket material shall be as specified in paragraph 15085-2.03.

Gaskets for plain faced flanges shall be the full-face type. Thickness shall be 1/16 inch for pipe 10 inches and less in diameter and 1/8 inch for pipe 12 inches and larger in diameter. Unless otherwise specified, gaskets for raised face flanges shall match the raised face and shall be 1/16-inch-thick for pipe 3-1/2 inches and less in diameter and 1/8-inch-thick for pipe 4 inches and larger.

C. BOLTS:

Flange assembly bolts shall be ANSI B18.2.1 standard square or hexagon head bolts with ANSI B18.2.2 standard hexagon nuts. Threads shall be ANSI Bl.1, standard coarse thread series; bolts shall be Class 2A, nuts shall be Class 2B. Bolt length shall conform to ANSI B16.5.

Unless otherwise specified, bolts shall be carbon steel machined bolts with hot pressed hexagon nuts. Bolts for submerged service shall be made of Type 316 stainless steel in conformance with ASTM F593, marking F593F. Nuts for submerged service shall be made of copper-silicon alloy bronze conforming to ASTM B98, alloy C65100, designation H04 or alloy C65500, designation H04. Bolts and nuts for buried service shall be made of noncorrosive high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21, regardless of any other protective coating. Where washers are required, they shall be of the same material as the associated bolts.

2.02 EQUIPMENT CONNECTION FITTINGS

Equipment connection fittings shall provide both lateral and angular misalignment adjustment between equipment connection flanges and the connection to field piping systems by providing individually adjustable flexible joints at each connection. In addition, equipment connection fittings shall provide full pressure thrust restraint between the field piping connection and equipment connection flanges.

Equipment connection fittings shall consist of two flanged coupling adapters, a plain end section of pipe and thrust restraint rods and associated fittings designed to transmit thrust without transmitting shear to the thrust restraint rods and without compromising provisions for accommodating angular and parallel misalignment. Materials and features shall conform to the requirements established in this paragraph. Standard "dismantling joints" incorporate only one flanged coupling adapter and are not acceptable substitutes. Equipment connection fittings shall be Romac ECF Series, or Baker Coupling Company, or equal, modified as specified to provide the required features.

Equipment connection fittings shall each consist of a single sleeve of plain end piping conforming to the requirements of the specified piping system of sufficient length to span the gap between the connection at the equipment and the connection at the field piping with gasketed flange adapters at each end. Thrust restraint shall be provided by means of all threaded rod spanning between flanges and male rod nuts and female washers that are rounded to provide a ball-joint type self aligning feature. All threaded restraint rod shall project through flange and mating flange coupling adapter bolt holes or through holes in restraint lug plates that extend above the flanges and are secured to the flanges with a minimum of two flange bolts. Where the all threaded rods project through flange bolt holes, ball joint type nut and washer combinations and lock washers shall be provided at each face, each end. Where restraint lug plates are employed, ball joint type nuts and washers shall be provided only on the outside faces of the plates and the nuts shall have a self-locking feature that prevents nut movement due to vibration or other operational or environmental causes. Double nutting with non-locking nuts shall not be an acceptable method of providing the self-locking feature. Thrust rod diameter and material shall be selected to provide sufficient freedom of movement through all bolt holes to allow unrestricted maximum adjustment of equipment connection fittings to accommodate piping misalignment without transmitting any shear to the thrust rods and also to permit full development of thrust restraint at all thrust rod tension take-ups. Design of equipment connection fittings shall conform to AWWA C219.

Thrust rods, restraint lug plates, nuts, washers and lock washers shall be Type 316 stainless steel, all selected to develop full rated piping system pressure thrust forces. Equipment connection fittings for pump applications shall have thrust rod number and diameter selected such that thrust rod stretch under piping system operating pressure does not exceed 2 mils. Calculations shall be submitted. Dry film molybdenum di-sulfide anti-galling compound shall be factory applied to ends of thrust rods, covering all threads subject to nut travel and tightening. Gaskets shall be as specified in paragraph 15085-2.03. Flange gaskets shall be full face type. Follower gaskets shall be compression wedge type.

Sleeves shall be carbon steel or as specified for the specific piping system. Pressure rating of flange adapters shall equal or exceed the pressure rating of mating flanges. All metal portions of equipment connection fittings, with the exception of 316 stainless steel components, shall be coated and lined with fusion bonded epoxy conforming to AWWA C550 and NSF 61.

A. DISMANTLING JOINTS

Dismantling joints may be used as takedown couplings in accordance with paragraph 15085-3.03. Dismantling joints shall fully restrained double flange fittings consisting of a flange coupling adapter and flanged spool piece that allows for longitudinal adjustment. Thrust restraint shall be provided by means of all threaded rod spanning between flanges and secured to the flanges with a minimum of two flange bolts. Design of equipment connection fittings shall conform to AWWA C219. Sleeves shall be carbon steel or as specified for the specific piping system. Pressure rating of flange adapters shall equal or exceed the pressure rating of mating flanges. All metal portions of equipment connection fittings, with the exception of 316 stainless steel components, shall be coated and lined with fusion bonded epoxy conforming to AWWA C550 and NSF 61. Dismantling joints shall be Romac DJ-400, Smith Blair 975, or Crane-Viking Johnson Dismantling Joint.

2.03 GASKETS

Gaskets designated in Section 15050 shall be as follows:

1. EPDM: ethylene-propylene-diene-terpolymer.

2. Neoprene: neoprene.

3. Nitrile: nitrile (Buna N).

4. Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder; ASTM F104 (F712400), 2500 psi (ASTM F152), 0.2 ML/HR LEAKAGE FUEL A (ASTM F37).

5. Compressed gasketing consisting of organic fibers (Kevlar) and SBR binder; ASTM F104 (F712400), 2500 PSI (ASTM F152), 0.1 ml/hr leakage Fuel A (ASTM F37).

6. Gylon gasketing, Garlock Style 3500, 2000 psi (ASTM F152), 0.22 ml/hr Fuel A (ASTM F37).

7. Gylon gasketing, Garlock Style 3510, 2000 psi (ASTM F152), 0.04 ml/hr Fuel A (ASTM F37).

8. Gylon gasketing, Garlock Style 3504, 2000 psi (ASTM F152), 0.12 ml/hr Fuel A (ASTM F37).

9. TFE: noncreeping tetrafluoroethylene (TFE) with insert filler.

10. PTFE bonded EPDM: PTFE bonded to EPDM in full-face gasket having concentric-convex molded rings; Garlock Stress Saver 370 or equal.

2.03 PRODUCT DATA

In accordance with Section 01300, the Contractor shall provide for each welder, a welder qualification certificate indicating the welder is certified for pipe welding in accordance with ASME Boiler and Pressure Vessel, Section IX. Each welder's certificate shall be provided to the Construction Manager prior to that welder working on the job.

PART 3 – EXECUTION

3.01 PIPE CUTTING, THREADING AND JOINTING

Pipe cutting, threading and jointing shall conform to the requirements of ANSI B31.1.

3.02 PIPE WELDING

Pipe shall be welded by ASME-certified welders using shielded metal arc, gas shielded arc or submerged arc welding methods. Welds shall be made in accordance with the requirements of ANSI B31.1 for piping Systems 8, 26, and 28 specified in Section 15050. Welds shall be made in accordance with the requirements of ANSI B31.3 for piping System 20 specified in Section 15050.

Welds for piping systems not specified above shall be made in accordance with AWWA C206.

3.03 FLEXIBILITY

Unless otherwise specified, piping passing from concrete to earth shall be provided with two pipe couplings or flexible joints (or a single Flexijoint) as specified on the buried pipe within 2 feet of the structure for 2-inch through 6-inch diameter pipe; within 3 feet of the structure for 8-inch through 24-inch diameter pipe; and within one and one-half pipe diameters of the structure for larger pipe. Where required for resistance to pressure, mechanical couplings shall be restrained in accordance with Chapter 13 of AWWA M11, including Tables 13-4, 13-5 and 13-5A, and Figure 13-20.

3.04 EQUIPMENT CONNECTION FITTINGS

Where shown, equipment connection fittings shall be provided between field piping systems and equipment inlet and outlet connections.

END OF SECTION

SECTION 15094

PIPE HANGERS AND SUPPORTS

PART 1 – GENERAL

1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals and install pipe hangers, supports, concrete inserts and anchor bolts including all metallic hanging and supporting devices for supporting exposed piping. Pipe hangers and supports shall be designed by the Contractor's Engineer who is a Professional Engineer registered in the State of Florida.

1.02 QUALIFICATIONS

A. Hangers and supports shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for pipe supports shall be five (5) times the ultimate tensile strength of the material.

B. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the Contractor shall submit a certification stating that such requirements have been complied with.

1.03 SUBMITTALS

A. Submit to the County for approval, as provided in the Contract Documents, shop drawings of all items to be furnished under this Section.

B. Submit to the County, for approval, samples of all materials specified herein.

C. All pipe hangers, supports, hanger rods, clamps, concrete inserts and wall brackets, etc., whether specified or not, shall be submitted (together with load calculations) to the County for approval, if requested.

PART 2 – PRODUCTS

2.01 GENERAL

A. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, and fittings and to support and secure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and

contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact. All pipe supports shall be approved prior to installation.

B. All materials used in manufacturing hangers and supports shall be capable of meeting the respective ASTM Standard Specifications with regard to tests and physical and chemical properties and be in accordance with MSS SP-58.

C. Hangers and supports shall be spaced in accordance with ANSI B31.1.0 except that the maximum unsupported span shall not exceed 10 feet unless otherwise specified herein.

D. Unless otherwise specified herein, pipe hangers and supports shall be as manufactured by Grinnell Co., Inc., Carpenter and Patterson, Inc., or equal. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary. Any item comparable in type, style, quality, design and performance will be considered for approval.

2.02 PIPE HANGERS AND SUPPORTS FOR METAL PIPE

A. Suspended single pipes shall be supported by hangers suspended by steel rods from galvanized concrete inserts, beam clamps, or ceiling mounting bolts.

The following sizes are minimum requirements and are subject to the County's approval:

1. Hanger rods shall be rolled steel machine threaded with load ratings conforming to ASTM Specifications and the strength of the rod shall be based on root diameter. Hanger rods shall have the following minimum diameters:

Pipe Size, Inches	Min. Rod Diameter, In.
Less than 2-1/2	3/8
2-1/2 through 4	1/2
4	5/8
6	3/4
8-12	7/8
14-18	1
20-30	1-1/4
Above 30	See SPECIAL SUPPORTS Paragraph 2.04

2. Where applicable, structural attachments shall be beam clamps. Beam clamps, for rod sizes 1/2-inch through 3/4-inch shall be equal to Grinnell Fig. No. 229, and for rod sizes 7/8-inch through 1-1/4 inches shall be equal to Grinnel Fig. No. 228, or equal.

3. Concrete inserts for pipe hangers shall be continuous metal inserts designed to be used in ceilings, walls or floors, spot insets for individual pipe hangers, or ceiling mounting bolts for individual pipe hangers and shall be as manufactured by Unistrut Corp., Wayne, Michigan; Carpenter and Patterson, Inc., Laconia, New Hampshire; Richmond or equal and shall be as follows:

   a. Continuous concrete inserts shall be used where applicable and/or as shown on the Drawings and shall be used for hanger rod sizes up to and including 3/4-inch diameter. Inserts to be used where supports are parallel to the main slab reinforcement shall be Series P3200 by Unistrut Corp., Fig. 1480 Type 2 by Carpenter and Patterson, Inc. or equal. Inserts to be used where supports are perpendicular to the main slab reinforcement shall be Series P3300 by Unistrut Corp., Fig. 1480 Type I by Carpenter and Patterson, Inc., or equal.

   b. Spot concrete inserts shall be used where applicable and shall be used for hanger sizes up to and including 7/8-inch diameter. Inserts shall be Fig. 650 by Carpenter and Patterson, Inc. for hanger rod sizes 1/2-inch through and including 3/4-inch and Fig. 266 by Carpenter and Patterson, Inc., for 7/8-inch hanger rods.

   c. Ceiling mounting bolts shall be used where applicable and be for hanger rod sizes 1-inch through and including 1-1/4 inches shall be Fig. 104M as manufactured by Carpenter and Patterson, Inc. or equal.

   d. All pipe hangers shall be capable of vertical adjustment under load and after erection. Turnbuckles, as required and where applied, shall be equal to Grinnell Fig. No. 230.

4. Wall or column supported pipes shall be supported by welded steel brackets equal to Grinnell Fig. 194, 195 and 199 as required, for pipe sizes up to and including 20-inch diameter. Additional wall bearing plates shall be provided where required.

   a. Where the pipe is located above the bracket, the pipe shall be supported by an anchor chair and U-bolt assembly supported by the bracket for pipes 4 inches and larger or by a U-bolt for pipes smaller than 4-inches. Anchor chairs shall be equal to Carpenter & Patterson Fig. 127. U-bolts shall be equal to Grinnell Fig. 120 and 137.

   b. Where the pipe is located below the bracket, the pipes shall be supported by pipe hangers suspended by steel rods from the bracket. Hangers and steel rods shall be as specified above.

c. Wall or column supported pipes 2-inches and smaller may be supported by hangers equal to Carpenter and Patterson Figures 74, 179 or 237 as required.

5. Floor supported pipes 3-inches and larger in diameter shall be supported by either cast-in-place concrete supports or adjustable pipe saddle supports as directed by the County. In general, concrete supports shall be used when lateral displacement of the pipes is probable (unless lateral support is provided), and adjustable pipe saddle type supports shall be used where lateral displacement of the pipes is not probable.

   a. Each concrete support shall conform to the details shown on the Drawings. Concrete shall be poured after the pipe is in place with temporary supports. Top edges and vertical corners of each concrete support shall have 1-inch bevels. Each pipe shall be secured on each concrete support by a wrought iron or steel anchor strap anchored to the concrete with cast-in-place bolts or with expansion bolts. Where directed by the County, vertical reinforcement bars shall be grouted into drilled holes in the concrete floor to prevent overturning or lateral displacement of the concrete support. Unless otherwise approved by the County, maximum support height shall be five (5) feet.

   b. Concrete piers used to support base elbows and tees shall be similar to that specified above.

      Piers may be square or rectangular.

   c. Each adjustable pipe saddle support shall be screwed or welded to the corresponding size 150 lb. companion flanges or slip-on welding flanges respectively. Supporting pipe shall be of Schedule 40 steel pipe construction. Each flange shall be secured to the concrete floor by a minimum of two (2) expansion bolts per flange. Adjustable saddle supports shall be equal to Grinnell Fig. No. 264. Where used under base fittings, a suitable flange shall be substituted for the saddle.

   d. Floor supported pipes less than 3-inches shall be supported by fabricated steel supports.

6. Vertical piping shall be supported as follows:

   a. Where pipes change from horizontal to vertical, the pipes shall be supported on the horizontal runs within two feet of the change in direction by pipe supports as previously specified herein.

b. For vertical runs exceeding 15 feet, pipes shall be supported by approved pipe collars, clamps, brackets, or wall rests at all points required to insure a rigid installation.

c. Where vertical piping passes through a steel floor sleeve, the pipe shall be supported by a friction type pipe clamp which is supported by the pipe sleeve. Pipe clamps shall be equal to Grinnell Fig. 262.

7. Anchor bolts shall be equal to Kwik-Bolt as manufactured by Hilti Fastening Systems, Tulsa, Oklahoma or Wej-it manufactured by Wej-it Expansion Products, Inc., Bloomfield, Colorado.

8. All rods, hangers, inserts, brackets, and components shall be furnished with galvanized finish.

2.03 PIPE HANGERS AND SUPPORTS FOR PLASTIC PIPE

A. Single plastic pipes shall be supported by pipe supports as previously specified herein.

B. Multiple, suspended, horizontal plastic pipe runs, where possible, and rubber hose shall be supported by ladder type cable trays such as the Electray Ladder by Husky-Burndy, the Globetray by the Metal Products Division of United States Gypsum, or equal. Ladder shall be of mild steel construction. Rung spacing shall be approximately 18 inches for plastic pipe and 12 inches for rubber nose. Tray width shall be approximately 6-inch for single runs of rubber hose and 12 inches for double runs of rubber hose. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc. required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners equal to Globe Model M-CAC, Huskey-Burndy Model SCR or equal. Spacing between clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe.

C. Individual clamps, hangers, and supports in contact plastic pipe shall provide firm support, but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

2.04 SPECIAL SUPPORTS

A. The pipes shall be supported by means of a supporting framework suitably anchored into the floor or curbing. The vertical piping shall be suitably secured to horizontal support members connected at each end to vertical support members and spaced as required to provide a rigid installation.

1. The complete supporting system shall be as manufactured by the Unistrut Corporation, Globe-Strut as manufactured by the Metal Products Division of U.S. Gypsum, or equal.
2. Vertical and horizontal supporting members shall be U-shaped channels similar to Unistrut Series P1000. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps equal to Unistrut Series P1100M and Series P2558. All components shall be of mild steel.
3. The assemblies shall be furnished complete with all nuts, bolts, and fittings required for a complete assembly.
4. The design of each individual framing system shall be the responsibility of the Contractor. Shop drawings shall be submitted and shall show all details of the installation including dimensions and types of supports.

B. Any required pipe supports for which the supports specified in the Section are not applicable, including pipe supports for above 30-inch pipe, shall be fabricated or constructed from standard aluminum shapes in accordance with Specifications, concrete and anchor hardware similar to items previous specified herein and shall meet the minimum requirements listed below and be submitted to the approval of the County.

1. Pipe support systems shall meet all requirements of this Section and all related Sections of this Specification.
2. Complete design details of the entire pipe support systems shall be provided by the Contractor, for approval by the County.
3. The pipe support system shall not impose loads on the supporting structures, in excess of the loads for which the supporting structure is designed.
4. Hanger rods for above 30-inch pipe shall be a minimum of 1-1/2 inch diameter and shall not exceed the manufacturer's standard maximum recommended safe load.

C. Pipe supports in lift stations shall be as shown in the Utility Standards details.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All pipes, horizontal and vertical, shall be rigidly supported from the building structure by approved supports. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or specified herein. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless it is so indicated on the Drawings, or specifically directed or authorized by the County.

B. All pipe supports shall be designed with liberal strength and stiffness to support the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement, and pressure forces, thermal

expansion and contraction, vibrations, and all probable externally applied forces. Prior to installation, all pipe supports shall be approved by the County.

C. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings, and sleeve type couplings and to minimize all pipe forces to pump housings. Pump housings shall not be utilized to support connecting pipes.

D. Pipe supports shall be provided as follows:

1. Cast iron and ductile iron shall be supported at a maximum support spacing of 10 feet-0-inches with a minimum of one support per pipe section at the joints.
2. Supports for multiple PVC pipes shall be continuous wherever possible. Individually supported PVC pipes shall be supported as recommended by the manufacturer except that support spacing shall not exceed five (5) feet.
3. Support spacing for galvanized steel pipe and copper tubing shall not exceed five (5) feet.
4. All vertical pipes shall be supported at each floor or at intervals of at least 15 feet by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to insure rigid construction.

E. Pipe supports shall not result in point loadings, but shall distribute pipe loads evenly along the pipe circumference.

F. Effects of thermal expansion and contraction of the pipe shall be accounted for in pipe support selection and installation.

G. Inserts for pipe hangers and supports shall be installed on forms before concrete is poured. Before setting these items, all drawings and figures shall be checked which have a direct bearing on the pipe locations. Responsibility for the proper location of pipe supports is included under this Section.

H. Continuous metal inserts shall be embedded flush with the concrete surface.

3.02 PRIME COATING

A. Prior to prime coating, all pipe hangers and supports shall be thoroughly clean, dry, and free from all mill-scale, rust, grease, dirt, paint, and other foreign substances to the satisfaction of the County.

B. All submerged pipe supports shall be prime coated with TNEMEC 69-1211 Epoxy Primer or equal. All other pipe supports shall be prime coated with TNEMEC 66-1211, or equal.

C. Finish coating shall be compatible with the prime coating used and shall be applied as specified in the Contract Documents.

END OF SECTION

SECTION 15095

PIPING APPURTENANCES

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE

This section specifies pipeline pressure gages.

B. EXCLUSIONS:

Temperature, pressure and flow measuring devices used for instrumentation are specified in Division 17. Instruments specified in Section 17211 are identified in the instrument index in Section 17200.

PART 2 – PRODUCTS

2.01 PRESSURE DEVICES

A. PRESSURE GAGES:

Unless otherwise specified, pressure gage scales shall be selected so that the normal operating pressure falls between 50 and 80 percent of full scale, shall be 4 1/2-inch, 270-degree movement, 1/2-percent accuracy, full-scale, and suitable for bottom stem mounting. Gages shall have a 316-SS bourdon tube. All gages shall have a 300 series stainless steel case, shatterproof glass, and a 1/2-inch NPT bottom connection.

Pressure gages for air, gas, and low-pressure services (0-10 feet) shall be premium grade, heavy-duty bourdon-tube units (bellow type for vacuum) with Delrin bushings and pinion, and stainless-steel sector.

Gages on liquid service shall be as noted above, except they shall be provided with an internal pulsation dampening system consisting of either a glycerin fill or a silicone fluid fill. Snubbers or orifices shall not be utilized. Gages shall be Ashcroft Duragauge Fig. 1279, Ametek 1981L, or equal.

B. DIAPHRAGM SEALS:

Unless otherwise specified, seals shall be diaphragm type with 1/4-inch flushing connection, Type 316 stainless steel body and Type 316L diaphragm. Fill fluid shall

be Silicone DC200 unless otherwise specified. Seal shall be Mansfield and Green Type SG, Ashcroft Type 101, or equal.

C. PRESSURE SENSORS

Unless otherwise specified, pressure sensors (tubular chemical seals) shall be the in-line full stream captive sensing liquid type. Wetted parts shall be 316 stainless steel. Flexible cylinder shall be Buna-N unless otherwise specified. Seals shall be rated for 200 psi with 5-inch SC hysteresis. Seals shall be Ronningen-Petter, Red Valve, or equal.

Fill fluid shall be rated for a temperature range of -20 degrees F to 200 degrees F. Capillary tubing shall be armored stainless steel. Fittings shall be provided for vacuum filling of system. Systems that are not factory filled shall be vacuum filled in the field. Filling connections shall be soldered shut after vacuum evacuation and filling.

2.03 PRODUCT DATA

Manufacturer's product data shall be provided in accordance with Section 01300.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 15147

SOLENOID VALVES

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies 2- and 3-way solenoid valves, direct or pilot operated type, for control of process fluids.

B. TYPE:

Valves with piping connections less than 1-1/2 inches in diameter shall be direct-acting type.

Valves with piping connections 1-1/2 inches in diameter and greater shall be pilot operated globe body type.

C. DESIGN REQUIREMENTS:

Unless otherwise specified, solenoid valves shall be designed to seal or unseal the pressurized (supply) port upon the action specified in the paragraph 1.03, Solenoid Valve Schedule.

Valves shall be listed by Underwriters Laboratories Inc. in accordance with UL 429 and UL 1002. Solenoid valves for gas service shall be approved by Factory Mutual Engineering Corporation. The minimum acceptable operating pressure differential for pilot operated valves shall be 5 psi.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no

replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A48	Gray Iron Castings
UL 429	Electrically Operated Valves
UL 1002	Electrically Operated Valves for Use in Hazardous Locations, Class I, Groups A, B, C, and D, and Class II, Groups E, F, and G

PART 2 – PRODUCTS

2.01 MANUFACTURERS

The County believes the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section.

A. DIRECT ACTING TYPE:

Candidate manufacturers include:

1. Automatic Switch Company (ASCO)
2. Honeywell-Skinner
3. or equal

B. PILOT TYPE:

Candidate manufacturers include:

1. Cla-Val Co.
2. Golden Anderson
3. or equal

2.02 MATERIALS

A. DIRECT ACTING TYPE:

Materials of construction shall be as follows:

Component	Material
Body	Brass or stainless steel, Type 304
Seal	Teflon or Buna-N
Disc	Teflon or Buna-N

B. PILOT TYPE:

Materials of construction shall be as follows:

Component	Material
Main valve body	Cast iron, ASTM A48
Pilot control body	Brass

2.03 EQUIPMENT

A. GENERAL:

Solenoid valves shall be rated for continuous duty at 24 volts DC or 120 volts AC as indicated. Valves shall be threaded for sizes 2-inch and smaller and flanged for sizes 2-1/2 inch and larger.

B. DIRECT ACTING TYPE AND PILOT TYPE:

Solenoid valves shall be suitable for the area location and usages as indicated in the schedule with fully encapsulated Class H coils. Enclosure type:

1. NEMA 4X watertight / dust tight / corrosion resistant

Unspecified solenoid valves enclosures shall be NEMA 4X.

2.04 PRODUCT DATA

Manufacturer's product data shall be provided in accordance with Section 01300.

PART 3 – EXECUTION

Solenoid valves shall be installed in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 15180

POWER ACTUATED VALVE SCHEDULES

PART 1 – GENERAL

1.01 DESCRIPTION

This section contains schedules of power actuated valves and gates for this work that incorporate actuators specified in Section 15185.

1.02 VALVE SIZING

Where the specific valve is smaller than the connected pipe, the Contractor shall provide reducers.

1.03 SCHEDULE

Powered actuator types are specified in Section 15185 and for use in the valve and gate schedule are defined as follows:

Actuator Type (ACTUSPEC)	Service	Definition
EMTI	Isolating (Open-Close)	Electric motor multi-turn
PCI	Isolating (Open-Close)	Pneumatic Cylinder

ELECTRIC MOTOR ACTUATED VALVE SCHEDULE

Valve Number	Service	Number of Valves	Valve size, inches	Actuator type	Actuator Enclosure	Open/close Time seconds; Motor duty, minutes	Starter duty, starts/hour; accuracy, percent
NR85-CV-401 thru 408	Open/ Close	8	8	EMTI		15	1 start / hour
NR85-SV-401	Open/ Close	1		PCI		15	2 starts/hour

**END OF SECTION*

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SECTION 16000

GENERAL REQUIREMENTS — ELECTRICAL

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies general requirements for electrical work. Project detailed requirements specified in other sections are subject to the general requirements of this section.

1. Furnish labor, equipment, tools, materials, supplies, and perform operations necessary to install a complete and operable electrical system. Furnish incidental material and perform work shown on the Drawings or in the Specifications.

2. Perform electrical work and provide material and equipment in compliance with applicable National, State, and Local codes, regulations, laws, and ordinances.

3. Obtain electrical permits, arrange for required inspections, correct deficiencies resulting from inspections, and pay permit fees and inspections charges. Pay fines and the cost of extra work incurred by action or inaction of the Contractor, at no additional cost to the Owner.

4. Furnish properly executed certificates of final electrical inspection and approval from the Code Authority Having Jurisdiction (AHJ) at the conclusion of the work, before final acceptance.

5. Adhere to the Area Classification shown for the product required and the installation required. Provide products in Hazardous Classified Areas in accordance with NEC Article 500 for the Class and Division specified or identified and products in corrosive areas in accordance with this specification.

6. Maintain a complete set of Contract Drawings in “Record” condition, available for review by the Owner or Engineer. Mark, initial, and date changes, modifications, or corrections, as they occur. Refer to the Record Drawing specification section requirements.

7. Field verify the exact locations of equipment or equipment terminations since the electrical drawings and schedules included in these Specifications are functional in nature. Use accepted equipment submittals as the basis of the conduit openings and slab penetrations.

B. DRAWING DEFINITIONS AND REQUIREMENTS:

1. ELEMENTARY OR SCHEMATIC DIAGRAM: Shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement that facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts.

2. ONE-LINE DIAGRAM: Shows by means of single lines and graphical symbols the course of an electrical circuit or system of circuits and the components, devices or parts used therein. Physical relationships are usually disregarded.

3. BLOCK DIAGRAM: Diagram of a system, instrument, computer, or program in which selected portions are represented by annotated boxes and interconnecting lines.

4. WIRING DIAGRAM OR CONNECTION SYSTEM: Includes all of the devices in a system and shows their physical relationship to each other including terminals and interconnecting wiring in an assembly. A panel layout diagram shows the physical location of devices and the wiring connections.

5. INTERCONNECTION DIAGRAM: Shows external connections between terminals of equipment in panels or electrical assemblies and outside points, such as motors, auxiliary devices, control devices, and instruments. Provides references to connection diagrams that interface to the interconnection diagrams of the continuous line type.

   Shows bundled wires as a single line with the direction of entry/exit of the individual wires clearly shown. Shows each wire identification as actually installed. Wireless diagrams and wire lists are not acceptable.

   Provides wire identification for each end of the same wire for devices and equipment. Indicates terminal blocks identification actually installed with individual terminal identification.

   Shows jumpers, shielding and grounding termination details not shown on the equipment connection diagrams on the interconnection diagrams. Wires or jumpers shown on the equipment connection diagrams shall not

be shown again on the interconnection diagram. Signal and Direct Current (DC) DC circuit polarities and wire pairs shall be shown. Shows spare wires and cables.

6. ARRANGEMENT, LAYOUT, OR OUTLINE DRAWINGS: Shows the physical space and mounting requirements of a piece of equipment and may indicate ventilation requirements, space provided for connections, or the location connections are to be made.

7. DRAWING CROSS-REFERENCING: References each submittal drawing submitted to the associated Contract Document and indicates the one-line diagrams, schematics, control diagrams, block diagrams, and Process and Instrumentation Diagrams (P&IDs) cross-referenced on the submittal drawings.

   Internally cross-reference submittal drawings related to the same subject shall be referenced to other submittal drawings. Failure to cross-reference Contract Documents with the submittal shall be cause for rejection of the entire submittal with no further consideration.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI A58.1 / ASCE 7	Minimum Design Load in Buildings and Other Structures, 1982
ANSI/IEEE C57.12.01	General Requirements for Dry-Type Distribution and Power Transformers
ANSI/UL 506	Specialty Transformers
ANSI C80.1	Rigid Steel Conduit - Zinc Coated, 1994
ASTM B3	Standard Specification for Soft or Annealed Copper Wire, 2001
ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft, 1999
ASTM B33	Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes, 2000
ICEA S-68-516 / NEMA WC 70, 71, & 74	Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
ICEA S-95-658	Standard for Non-Shielded Power Cables Rated 2000 Volts or Less, 2000
IEEE 81	Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System, 1983
IEEE 383	Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations, 1974 (1992)
JIC EMP-1	Electrical Standard for Mass Production Engineering, 1967
NEMA TC2	Electrical Polyvinyl Chloride (PVC) Conduit, 2003
NEMA 250	Enclosures for Electrical Equipment (1000 Volt Maximum)
NEMA WC-70	Non-Shielded Power Cable 2000V or Less (ICEA S-95-658), 1999 (2001)
NEMA WD-1	General Requirements for Wiring Devices, 1999
NEMA ST20	Dry-Type Transformers for General Application
NFPA 70	National Electrical Code (NEC)
NFPA 70E	National Electrical Safety Code (NESC)
UBC	Uniform Building Code
UL 1	Flexible Metal Electrical Conduit
UL 6	Electrical Rigid Metal Conduit – Steel, 12th Edition, 2000 (2003)

Reference	Title
UL 44	Thermoset-Insulated Wires and Cables, 15th Edition, 1999 (2002)
UL 67	Panelboards, 11th Edition, 1993 (2003)
UL 83	Thermoplastic-Insulated Wires and Cables, 13th Edition, 2003 (2004)
UL 263	Fire Tests of Building Construction and Materials, 13th Edition, 2003
UL 360	Liquid-Tight Flexible Steel Conduit, 5th Edition, 2003
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, 10th Edition, 2002 (2003), Adopted: NEMA AB 1-1999
UL 1277	Electrical Power and Control Tray Cables With Optional Optical Fiber Members, 4th Edition, 2001 (2003)
UL 886	Outlet Boxes and Fittings for Hazardous (Classified) Locations

B. LISTED AND LABELED PRODUCTS:

Provide electrical equipment and materials listed or labeled by an independent testing laboratory for the purpose for which they are to be used and provide associated testing laboratory label.

The independent testing laboratory shall be acceptable to the inspection authority having jurisdiction. Test Laboratory examples: Underwriters Laboratories (UL), Electrical Testing Laboratories (ETL), and Canadian Standards Association (CSA).

Include costs and expenses incurred for special inspections in the contract price for electrical products required to undergo a special inspection either at the manufacturer's place of assembly or at the installed location by the local inspection authority when a product is not available with a testing laboratory listing or labeling.

C. FACTORY TESTS:

Perform factory tests at the place of fabrication and on completion of manufacture or assembly where specified in the individual product specification section.

1. Include the costs of factory tests in the contract price.
2. Include the costs of Engineer witness of factory tests in the contract price.

1.03 SUBMITTALS

A. The following information shall be provided for all electrical equipment and materials in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole.

   If deviations from the specifications are shown, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

   The OWNER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

   Failure to include a copy of the marked-up specification sections, along with justification for requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Catalog cuts of equipment, devices, and materials requested by the individual specification sections.

   a. Catalog information with technical specifications and application information including ratings, range, weight, accuracy, and other pertinent product information.

   b. Edit catalog cuts to show only the items, model numbers, and information that apply.

   c. Assemble catalog cuts in a folder or three ring binders with a cover sheet, indexed by item, and cross-referenced to the appropriate specification paragraph.

3. Arrangement, layout, and outline drawings with dimensions and weight, as appropriate.

4. Control schematics and interconnection wiring diagrams depicting internal and external wire and cable terminations. Drawing cross-reference to specification and Contract Document drawings.
5. Conduit and cable tag numbers, including conduit and cable schedules. County may at its discretion advise the preferred tag numbering system. Coordinate with the County during construction. Provide the tag numbers at no additional cost to the county.

1.04 DRAWINGS

Prepare specified drawings on 11-inch by 17-inch drafting media complete with borders and title blocks clearly identifying project name, equipment and the scope of the drawing.

Prepare drawings to reflect the final constructed state of the project installation or supplied equipment. Provide drawing quality, clarity, and size of presentation to permit insertion in operation and maintenance manuals.

1.05 PROJECT / SITE CONDITIONS

A. GENERAL:

Unless otherwise specified, equipment and materials shall be sized and derated for the ambient conditions specified in Section 01800, but not less than an ambient temperature of 40 degrees C at an elevation ranging from sea level to one thousand two hundred feet (1,200) feet without exceeding the manufacturer's stated tolerances.

B CORROSIVE AREAS:

The following areas are designated as corrosive:

All outdoors and process areas are corrosive, including Belt Filter Press, Polymer Room, Truck Load out areas).

C. HAZARDOUS (CLASSIFIED) AREAS:

The following areas are designated as hazardous (classified) in accordance with the NEC:

a. Sludge Feed Pump Areas and Belt Filter Press Areas: Class I, Division 2, Group D hazardous areas as defined by NFPA 820, latest edition.

D. SEISMIC:

Electrical equipment and supports shall be braced in accordance with Florida Building Code.

E. CONSTRUCTION MATERIALS:

Refer to the individual specification section for each component for material composition and installation practices.

Construction materials required for each area classification are listed in the following table that specifies the type of raceway required for each location and application by RACESPEC (Section 16000, paragraph 2.02 K) sheet. Unscheduled conduit shall be Rigid Aluminum Conduits, RACESPEC type RAC.

Location	Application/Condition	RACESPEC
Indoor non-corrosive	Exposed	RAC
Indoor corrosive	Exposed	RAC
Outdoor	Exposed (WWTP)	RAC
Outdoor	Exposed (other)	RAC
Concealed	Embedded in concrete structure or beneath slab-on-grade	PVC4
Underground	Instrumentation, communications and data signals encased in concrete, ductbank	PVC4
Underground	Instrumentation, communications and data signals directly buried	PVC4
Underground	Power directly buried (Non-Power Utility)	PVC4
Non-hazardous	Final connection to equipment and light fixtures	LFS
Hazardous corrosive	Exposed	RAC
Architecturally finished areas	Concealed in framed walls and ceiling spaces (lighting and receptacle circuits only)	RAC
Architecturally finished areas	Final connection to light fixtures	FLEX

Notes:

1. Install conduit connections to control stations, enclosures, and device boxes through threaded hubs.

2. Install flexible conduit for final connections to devices, equipment and motors not exceeding eighteen (18) inches. Limit length to thirty-six (36) inches where flexibility is required.

3. Mount enclosures, device boxes, control stations, and raceway systems with 1/4-inch (minimum) air space between the electrical system and supporting structure.

1.06 STORAGE OF MATERIALS AND EQUIPMENT

Store equipment and materials in the factory-sealed container and protect with additional covering and materials to avoid physical damage or weather damage.

1.07 ELECTRICAL NUMBERING SYSTEMS

A. RACEWAY NUMBERS:

Tag raceways with stainless steel tags at both ends at the access locations including manholes, pull boxes, junction boxes, and at the terminations.

Tag raceways with aluminum tags where subject to hydrogen sulfide atmosphere typically found at wastewater treatment facilities.

Raceway numbers are derived from the “Cable and Conduit Schedule” or the ductbank cross-sections. Where raceway numbers are not provided, use the circuit number on the power and control single line diagrams.

B. WIRE AND CABLE CIRCUIT NUMBERS:

Identify wire and cable circuit numbers at both ends. Refer to the circuit identification/ labeling method specified and shown in the drawings to label circuits.

Identify lighting and receptacle branch circuits with the power source and circuit load, at source and destination locations. Identify the load, location, and circuit in typed panel schedules with corrections shown.

Include copies of schematic diagrams, wiring connection diagrams, and interconnection diagrams inside of the equipment enclosure, protected in a plastic container in the equipment print holder.

PART 2 – PRODUCTS

2.01 EQUIPMENT AND MATERIALS, GENERAL

Provide new equipment and materials free from defects. Provide material and equipment of the same or a similar type of the same manufacturer throughout the work. Use standard production materials wherever possible.

2.02 RACEWAYS, BOXES, AND SUPPORTS

A. RACEWAYS AND BOXES:

Pullboxes, handholes, and device boxes are generally called boxes herein. Size boxes, manholes, and handholes in accordance with the National Electrical Code. Provide separate raceways for lighting, receptacles, power, control, instrumentation, and signaling systems.

B. BOXES AND WIREWAYS:

Provide indoor boxes, larger than Ferrous Deep (FD) boxes, constructed of sheet steel and galvanized after fabrication.

Provide boxes located outdoors and in corrosive areas with NEMA-4X rating of stainless steel or nonmetallic material where stainless steel is not compatible.

Provide enclosures rated for outdoor installation with gaskets on the hinged doors or removable covers and sized for conduit hub fittings.

Size and provide wireways at locations above and below boxes, panels and groups of devices. Comply with the NEC sizing for conductor fill requirements. Wireway NEMA type shall match the location and area classification and equipment NEMA enclosure ratings.

Bolt-on junction box covers 3 feet square or larger, or heavier than 25 pounds, shall have a rigid handle. Covers larger than 3 x 4 feet shall be split.

C. TERMINAL CABINETS:

Provide cabinets located indoors with NEMA-12 Rating. Provide cabinets located outdoors and in corrosive areas with NEMA-4X rating of stainless steel or nonmetallic material where stainless steel is not compatible. Provide cabinets with hinged doors and 2 or 3-point latching with locking features via handle or latching clasps with provisions for padlocks.

Provide adjustable terminal strip mounting accessories and with channel mounted terminal blocks rated 30 amperes, 600 volt AC. Provide No. 8 minimum strap-screw type terminal strip, suitable for ring tongue, locking spade terminals. Provide Phoenix Contact products, or approved equals, with capture feature and terminal identification method per terminal, as specified.

D. MANHOLES, HANDHOLES AND PULLBOXES:

Manholes, handholes and pullboxes generally called boxes herein, contain wires, cables, and conductors. Provide box dimensions where shown. Provide boxes per NEC sizing rules where the dimensions are not sized or shown.

Provide concrete boxes with covers designed for H-20 loading in traffic areas. Engrave box cover: "ELECTRICAL". Provided boxes with hinged, aluminum checkered plate covers with pull-handle to open in non-traffic areas.

Provide precast Quazite Compsolite cement/polymer products, or approved equals, for handholes, pullboxes, manholes, meter boxes, equipment pads, and vaults where allowed by the electric power utility and for projects where precast concrete is not specifically shown or specified.

E. RACEWAY AND BOX SUPPORTS:

Provide hot-dip galvanized framing channel with end caps to support groups of conduits. Provide individual conduit supports that have one-hole galvanized malleable iron pipe straps used with galvanized clamp backs and nesting backs.

Provide stainless steel supports, channel, fittings, all-thread, and fasteners in outdoor locations, in corrosive areas, and as shown. Provide factory end-caps for supports and channels.

Independently support boxes by galvanized brackets, expansion bolts, toggle bolts, or machine or wood screws as appropriate. Wooden or plastic plugs inserted in masonry or concrete shall not be used as a base to secure boxes, nor shall welding or brazing be used for attachment.

F. UNDERGROUND MARKING TAPE:

Provide low-density, polyethylene plastic, underground marking tape and install above and centered for early warning protection for digging near electrical ductbanks.

Provide Brady "Identoline"; Services and Materials "Buried Underground Tape"; Somerset (Thomas & Betts) "Protect-A-Line"; or approved equals. Provide tape with nominal dimension of six (6) inches wide, 4-mil thickness.

Provide underground marking tape six (6) inches wide metallic-lined tape with red polyethylene film on top and with clear polyethylene film on the bottom of the tape for installation above and centered on direct buried cables and conduits without ductbank encasement.

Provide black over red marking tape clearly printed with: "CAUTION ELECTRIC LINE BURIED BELOW" or provide OSHA approved marking tape.

G. NAMEPLATES:

Provide nameplates for all boxes and enclosures with nameplate wording as shown on the drawings. Provide the tag number or box number with device functional description on device nameplate. Nameplate wording may be changed without additional cost where changes are made during the submittal process or prior to commencement of engraving.
Provide machine engraved laminated white phenolic nameplates with black lettering for panel-mounted equipment with the instrument tag number/description in 3/32-inch minimum size lettering and attach to the panel or enclosure with a minimum of two self-tapping 316 stainless steel screws. Provide nameplates for power sources indicating the power loads and nameplates for power loads that indicate the power sources, in accordance with these specifications and the NEC.

H. RACEWAY MARKERS:

Provide raceway markers: 0.036-inch minimum thickness, solid brass tags or aluminum tags with raceway number or the circuit number, stamped in 3/16-inch minimum height characters and attach tags to the raceway with 316 stainless steel wire. Install raceway markers inside of pull boxes, handholes, manholes, and where entering into electrical equipment enclosures.

Provide raceway markers indicating the power source and circuit number for lighting and receptacle raceways to the associated panelboard. Interior lighting and receptacle raceways do not require raceway markers for conduit between components.

I. IDENTIFICATION TAGS:

Provide the following:

1. Equipment: Typical size 1 x 3 inches wide, white with black engraved equipment number and equipment description.

2. Raceway/Conduit: Tags with raceway or conduit number or circuit shown.

3. Instrument: 1.5 inches wide, aluminum tag with instrument number and description.

4. Conductor: Power, control, or instrument cable with the circuit identified as shown; power source or power/control panel identified; power load, equipment, instrument, or device identified; purpose of the conductors identified.

5. Fastener: nylon-coated 48-mil stainless steel wire. Manufacturer: Brady catalog number 23310 or approved equal with double ferrule type brass wire clamps. Manufacturer: Brady number 23312, or approved equal.

J. GENERAL RACEWAY REQUIREMENTS:

Provide additional pullboxes for conduit runs with greater than 360 degrees in any run between pull boxes. Limit maximum conduit runs without additional pullboxes to four hundred (400) feet, less one hundred (100) feet for every 90 degrees for the conduit run change in direction.

Determine conduit routing that conforms to the installation requirements set forth herein and in accordance with the NEC requirements for size and number of pullboxes. The RACESPEC sheets with specified requirements begin on the next page.

K. RACEWAY SPECIFICATION SHEETS (RACESPEC):

IDENTIFICATION:	RAC
Description:	Rigid Aluminum Conduit
Materials:	Conduit and fittings: 6063 aluminum alloy with temper designation T-1.
Compliance:	ANSI and UL
Finish:	Smooth finished outside and inside surfaces.
Manufacturers:	Alcoa, Allied Tube and Conduit Corp., Wheatland Tube Co., or equal.
Application /Conditions:	Indoors, corrosive and non-corrosive areas Outdoors, non-corrosive and non-process areas. Rigid aluminum conduit shall not be installed in concrete, direct buried, or where exposed to severe corrosion, or where exposed to physical damage.
Minimum size:	Unless otherwise specified, 3/4 inch for exposed, 1 inch for inaccessible.
Fittings:	Locknuts: stainless steel. Bushings: non-corrosive cast aluminum alloy, stainless steel, or nonmetallic. Bushings: insulating collar. Grounding bushings: locking type with a feed-through compression lug for securing the ground cables. Threadless fittings: not acceptable.
Manufacturers:	Thomas & Betts, O.Z. Gedney, Crouse–Hinds or equal.
Expansion Fittings:	Expansion fittings shall be watertight with an internal bonding jumper. The expansion material shall be neoprene and shall allow for 3/4-inch movement in any direction.
Manufacturers:	Appleton, Crouse-Hinds, Hubbell, O. Z. Gedney, or equal.

Identification:	RAC (continued)
Hubs:	Hubs: threaded non-corrosive cast aluminum alloy with powdered epoxy finish for connection of conduit to junction, device, or terminal boxes. Hubs: insulating bushings with bonding locknut. Hubs: neoprene "O" ring for a watertight connection.
Manufacturers:	O-Z Gedney, CHM-XXT, or equal
Unions:	Unions shall be non-ferrous alloy type.
Manufacturers:	Appleton UNF or UNY, Crouse-Hinds UNF or UNY, or equal.
Boxes:	
Indoor:	Type FD cast aluminum with powdered epoxy finish for device boxes and junction boxes with a dimension less than 6 inches for the longest side. NEMA Class 12 welded aluminum with threaded hubs with a dimension of 6 inches for the longest side and larger. Boxes in wet locations: PVC coated.
Outdoor:	Type FD, PVC coated, cast aluminum for device boxes and junction boxes with a dimension of less than 6 inches for the longest side. NEMA Class 4X welded stainless steel with threaded hubs for a dimension of 6 inches for the longest side and larger.
Corrosive:	NEMA 4X, stainless steel or PVC coated cast aluminum.
Hazardous:	NEMA Class 7 cast aluminum.
Elbows:	
(3/4" thru 1-1/2")	Factory fabricated or field bent.
(2" thru 6")	Factory fabricated only.

Identification:	RAC (continued)
Conduit Bodies:	
(3/4" thru 4")	Oversized conduit bodies: non-ferrous, copper-free aluminum alloy type with powdered epoxy finish and screw taps for fastening covers. Gaskets shall be made of neoprene. Tapered threads for conduit entrances.
(5" and 6")	Cast aluminum box.
Manufacturers:	Appleton, Crouse-Hinds, Hubbell, O. Z. Gedney, or equal.
Installation:	Joints: made with standard couplings or threaded unions. RAC:

1. Made up tight with thread compound by Ideal, NoAlox anti-oxidant, Crouse-Hinds STL or equal.

2. Supported away from the structures and concrete using stainless steel straps with nesting backs.

3. Terminate with a threaded hub with a grounding bushing where entering boxes.

4. Exposed male threads on rigid aluminum conduit shall be coated with Teflon-rich product.

5. Threaded with manufacture approved special dies and bent proper tools.

Identification:	LFSC
Description:	Liquid-Tight Flexible Steel Conduit
Application:	Final connection to equipment subject to vibration or adjustment.
Compliance:	UL 360
Construction:	Spirally wound galvanized steel strip with successive convolutions securely interlocked and jacketed with liquid-tight plastic cover.
Minimum size:	3/4 inch
Fittings:	Cadmium-plated malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral and O-ring seals around the conduit and box connection and insulated throat. Forty-five and 90-degree fittings shall be used where applicable.
Installation:	Do not exceed 36-inch length.

Identification:	PVC4
Description:	Heavy wall thickness for direct bury, concrete encasement or surface mounting where not subject to physical damage. DZYR category per NEC Article 352.
Compliance:	NEMA TC2, UL 651
Construction:	Schedule 40, high-impact, polyvinyl-chloride (PVC)
Minimum size:	3/4 inch exposed; 2-inch embedded or encased
Fittings:	PVC solvent weld type
Boxes:	
Indoor:	NEMA Class 4, nonmetallic
Outdoor and corrosive:	NEMA Class 4X, nonmetallic
Installation:	PVC conduit entering fiberglass boxes or cabinets shall be secured by threaded bushings on the interior of the box and shall be terminated with a threaded male terminal adapter having a neoprene O-ring. Joints shall be made with standard PVC couplings. PVC conduit shall have bell ends where terminated at manholes, handholes, or building walls. Bell ends shall terminate flush at the walls and floors and not extend or protrude.

Raceway Identification:	PGRS
Description:	Rigid Steel Conduit, Corrosion-Resistant, Polyvinyl Chloride (PVC) Coated
Compliance:	ANSI, ETL and UL. The PVC coated rigid galvanized steel conduit shall be stamped with the ETL Verification Mark "ETL Verified to PVC-001".
Finish:	Hot-dip galvanized rigid steel conduit, to which a minimum 40-mil thick PVC coating has been bonded to the outside of the conduit. A 2-mil coat of urethane coating shall be bonded to the inside. Coating shall be free of pinholes. Bond strength shall exceed the tensile strength of the PVC coat. Elbows and fittings shall be factory made and coated.
Fittings: (includes unions, condulet bodies and expansion fittings)	Refer to RACESPEC RMC-Steel for additional requirements. Similarly coated to the same thickness as the conduit and provided with type 316 stainless steel hardware. Conduit and fittings shall be manufactured by the same company.
Hubs:	Hubs for connection of conduit to junction, device, or terminal boxes shall be threaded with the same PVC coating as the conduit and provide a watertight connection.
Boxes:	Refer to RACESPEC RMC-Steel. FD boxes shall be PVC coated.
Elbows:	Refer to RACESPEC RMC-Steel. Elbows shall be PVC coated.
Manufacturers:	PVC coated conduit shall be by Robroy Industries, PLASTI-BOND RED; Occidental Coating Company (OCAL), or approved equal.

Raceway Identification:	PGRS
Installation:	Plastic coated conduit shall be made up tight, threaded, and installed using tools approved by the conduit manufacturer. Conduit threads shall be covered by a plastic overlap which shall be coated and sealed per manufacturer's recommendations. Painted fittings are not acceptable. Pipe wrenches and channel locks shall not be used for tightening plastic coated conduits. Damaged areas shall be patched, using manufacturer's recommended material.

2.03 CONDUCTORS, WIRE, AND CABLE

Provide products specified.

A. UNSCHEDULED CONDUCTOR SIZING:

Size conductors, wire, and cables in accordance with the National Electrical Code (NEC) where not specified on the Drawings, and install in the minimum size raceway as specified in the RaceSpecs herein.

B. CONTROL WIRE COLOR CODING:

Provide control wires with the following colors for the shown voltage:

120 VAC Power, line and load	Red
120 VAC Control	Red
24 VAC	Orange
12 VAC	Brown
Foreign Voltage (AC) (Interlock)	Yellow
AC Neutrals	White
Ground	Green
24 VDC (+ & -)	Blue
12 VDC (+ & -)	Blue
Foreign Voltage (DC)	Violet/white or Blue/White

C. POWER CONDUCTORS:

Provide power conductors with following colors for the shown voltage:

Wire	480Y/277V, 3Ø	208Y/120V, 3Ø	240/120V, 3Ø
Phase A	Brown	Black	Black
Phase B	Orange	Red	Orange per NEC 408.3(E) and 215.8
Phase C	Yellow	Blue	Blue
Ground	Green	Green	Green
Neutral	White or Gray per NEC 210.4(D)	White	White

Provide black insulation conductors larger than #10 AWG with colored 3/4-inch vinyl plastic tape to identify the phase color at each cable termination. Tape wrap with 25% overlay to provide minimum of three (3) inches of coverage.

D. SCHEDULED AND UNSCHEDULED WIRE AND CABLE:

Provide the insulation and jacket material specified in the CABLESPEC sheets for scheduled and unscheduled (not shown) conductors. Provide stranded copper conductors for all wire and cable.

E. ELECTRICAL ENCLOSURE CONDUCTOR RATINGS:

Provide conductors with 600-volt insulation ratings in panels and other electrical enclosures. Conductors with less than 600-volt insulation ratings are prohibited, unless specifically identified.

Bundle and lace conductors in panels and electrical equipment at intervals not greater than six (6) inches, spread into trees and connected to their respective terminals. Provide lacing using plastic cable ties that are tensioned and cut off using a tool specifically designed for the purpose such as a Panduit GS2B, or approved equal. Other methods of cutting cable ties are prohibited.

Bundle conductors crossing hinges into groups not exceeding ten (10) to fifteen (15) conductors and protected using nylon spiral flexible covers to protect conductors and provide oversized plastic panel wiring duct within panels.

Provide slack in junction boxes, pull boxes, handholes and manholes sufficient to allow cables or conductors to be routed along the walls with the amount of slack equal to largest dimension of the enclosure.

Provide dedicated electrical wireways and insulated cable holders mounted and secured on stainless steel unistrut in manholes and handholes.

F. INSTRUMENT SIGNAL CABLE:

Provide terminal blocks at instrument cable junctions within dedicated terminal boxes provided by the installer. Provide twisted shielded cable with individual shield for each pair. Provide twisted shielded cable multi-pair with overall shield and jacket. Provide triads wherever 3-wire circuits are required. Circuits shall not be made using conductors from different pairs or triads.

Install instrument, signal, and data communication circuits without splices between instruments, terminal boxes, or panels. Shields as a signal path, except for circuits operating at radio frequencies and utilizing coaxial cables are not

acceptable. Common ground return conductors for two or more circuits are not acceptable.

Bond shields to the signal ground bus at the control panel. Isolate shields from ground and other shields at other locations by cutting short or taping. Provide terminal strips for signal leads and shield drain wires.

Terminate spare circuits and the shield drain wire on terminal blocks at both ends of the cable run. Shields or drain wires for spare circuit cables shall be bonded at control panel only with the other end insulated by tape cover.

Provide an instrument stand with terminal box mounted approximately three (3) feet above grade to center or as shown. Provide terminal boxes for instrument cable with the cable and conductor labels specified.

Install and terminate conductors for paging, security, data communication, voice communication, and telephone systems in compliance with the manufacturer and the system utility recommendations.

G. SPLICING AND TERMINATING MATERIALS:

Use an UL listed tool for the applied compression type of connectors with the correct size and type. Provide tin-plated high conductivity copper connectors. Mechanical clamp, dimple, screw-type connectors are prohibited.

Provide polymeric insulating material over motor terminations with high dielectric strength mastic or material to seal the ends against ingress of moisture and contamination.
Cover splices with electrical products designed for the application and insulate with a heat-shrinkable sleeve or boot.

H. FIRE STOP SEALANT MATERIALS:

Provide non-combustible silicone sealant for sealing apertures and cable through-penetrations for electrical conductors meeting UL 263 4-hour time-temperature requirements.

Manufacturer: STI Inc., Pensil Silicone Sealants PEN300 SpecSeal Firestop, or approved equal.

I. CIRCUIT NUMBERING MARKING SYSTEM:

Identify each power, control, and signal conductor at each terminal connection. Machine print the letters and numbers with black on white alphanumeric characters representing the circuit numbering system.

Identify conductors, including spares. Provide cable markers and wire markers for distribution and utilization equipment circuits identifying the power source and circuit source from which it is served.

Provide the identification system of stainless steel (SS) on both ends of conduits, and vinyl for power cable strap-on cable markers, vinyl multi-conductor control cable strap-on cable markers, and vinyl or polyolefin wire slip-on sleeves and encircle the conductor.

Provide conductor marker used in outdoor, damp, or wet locations on heat-shrinkable polyolefin shrinkable marking sleeves covered with clear heat-shrink sleeve or clear tape cover.

Print conductor markers using the Brady Marker "XC PLUS", the Brady LS2000 printer with the Bradysleeve wire marking system, or Engineer accepted equal.

J. TERMINAL BLOCKS:

Provide terminal blocks with the following features:

1. Voltage rated: 600 volts.

2. Current rated: match largest conductor connected to the assembly.

3. Integral marking strips.

4. Terminal block assemblies: provide with mounting channels, barriers, and end clamps.

5. Power and grounding terminal blocks: solderless box lug type.

6. Control and signal terminal blocks. Manufacturer: Allen-Bradley 1492-HM1GY, NEMA type, 30-ampere, or approved equal.

7. DIN-rail mount for direct wiring into terminal blocks.

8. Pre-printed snap-in markers.

K. CABLESPEC SHEETS:

The following CABLESPEC sheets are included in this section:

Type	Volt	Product	Purpose
DC1	300	RS-422: 4-PAIR, 24-AWG Unshielded Jacketed Premise Wire	Data Communication, Cat 6, Fast Ethernet: 100 Base T Cable, Video, CCTV
DC2	30	RS-485: 24-AWG, Jacketed Premise Wire	Data Communication Remote I/O Cable
DC3	300	Fibers Cable Indoor/Outdoor	Data Communication Fiber Optic Cable
SIC	600	P-OS: 1-PR#16SH OR 1-TR#16SH	Instrument
MIC	600	SP-OS: MULT-PR#16 Shielded (TC) with Individual Pair Shields and Overall Cable Shield	Instrument
XHHW-2	600	XLP Insulated Industrial Grade Conductor	Power, Control, Lighting, & Receptacles
THWN	600	Building Wire	Power
CORD		Heavy Duty Cable: SJOOW	Portable Items

Cable System Identification:	DC1
Description:	Premise Cable: IEC Category 5 UTP; NEMA WC-63.1 Category 6; Fast Ethernet: 100 Base TX; 4 pair, #24 AWG Cable
Voltage:	300 V RMS -
Conductor Material:	Solid Bare copper
Insulation Material:	FRPO - Flame Retardant Polyolefin / FEP -Fluorinated Ethylene Propylene Color Coded conductor insulation
Jacket:	LS PVC - Low Smoke Polyvinyl Chloride with ripcord Trade Name Example: Flamarrest Sequential Footage Marking: every two feet Jacket Color: Blue
Manufacturer(s):	Cooper Industries – Belden 1585A; or approved equal.
Execution:	
Applications:	Gigabit Ethernet Data Communications LAN, CCTV Fixed. Component or Composite Video, Digital Video, RS-422,
Installation:	Install in accordance with associated equipment manufacturer's instruction.
Testing:	Test in accordance with section 16030.

Cable System Identification:	DC2
Description:	Shielded Data Communication Cable Remote I/O Cable: RS-485 #22 or #24 AWG Copper
Voltage:	30 V RMS
Conductor Material:	Tinned copper
Insulation:	Polyethylene; Trade Name Example: Datalene
Jacket:	PVC or CPE Color: Chrome
Manufacturer(s):	Cooper Industries-Belden YM-29560 or approved equal

Execution:

Application:	DCU or PLC to Remote I/O - Data Communications Cable
Installation:	Install in accordance with associated equipment manufacturers instruction.
Testing:	Test in accordance with section 16030.

Cable System Identification:	DC3
Description:	Fiber Optic Data Cable; X-Conductor (a shown on drawings): Color Examples: 1-Blue, 2-Orange, 3-Green, 4-Brown, 5-Slate, 6-White; Indoor/Outdoor; Heavy Duty-MFPT; Cable Tray Rated
Material:	62.5/125/250 micron
Jacket:	Chlorinated Polyethylene (CPE) Color: Orange
Type:	NEC (UL): OFNR with industrial cable tray rating IEEE flame test rated: 802.3Z
Manufacturer(s):	Cooper Industries-Belden I100666; or Engineer accepted equal

Execution:

Application:	Data Communications. (Not Plenum Rated)
Installation:	Install in accordance with Section 16000, paragraph 2.03 and associated equipment manufacturers instruction.
Testing:	Test in accordance with section 16030.

Cable System Identification:	SIC
Description:	Single twisted, shielded pair or triad, 16 AWG, instrumentation and signal cable; UL listed; Cable Tray rated.
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded per ASTM B8
Insulation:	15 mil, 90 degree C, polyvinylchloride (PVC) with 4 mil nylon conduit or jacket
Lay:	Twisted on a 2-inch lay
Shield:	100 percent, 1.35 mil aluminum-Mylar tape with a 7-strand tinned copper drain wire
Jacket:	45 mil Polyvinylchloride (PVC)
Flame Resistance:	UL 1277
Manufacturer(s):	Okonite, Okoseal-N type P-OS, Cooper Industries-Belden, or approved equal

Execution:

Use:	Analog signal cable and RTD device Triad extension cable.
Installation:	Install in accordance with Section 16000, paragraph 2.03.
Testing:	Test in accordance with section 16030.

Cable System Identification:	MIC
Description:	Multiple twisted, shielded pairs, 16 AWG, with overall shield instrumentation cable, UL listed, with number of pairs as shown.
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded in accordance with ASTM B8
Insulation:	15 mil, 90 degree C, polyvinylchloride (PVC) with 4 mil nylon conduit or jacket
Lay:	Twisted on a 2-inch lay
Shield:	100 percent, 1.35 mil aluminum-Mylar tape with 18 AWG 7-strand tinned copper drain wire
Overall Shield:	2.35 mil aluminum-Mylar tape with a 7-strand tinned copper drain wire
Jacket:	45 mil polyvinylchloride (PVC)
Flame Resistance:	UL 1277
Manufacturer(s):	Okonite, Okoseal-N type SP-OS, Cooper Industries-Belden, or approved equal.

Execution:

Installation:	Install in accordance with section 16000.
Testing:	Megger test: use Form in section 01999.

Cable System Identification:	XHHW-2
Description:	Industrial grade single conductor Sizes: 14 AWG through 750 kcmil as shown
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded per ASTM B8
Insulation:	NEC Type XHHW-2; 90 degree C dry and C wet; Cross-Linked Polyethylene (XLP) per ICEA S-66-524 and UL-44; Color in sizes 14, 12 and 10 AWG: Black, Green, Yellow, White, Orange, Brown, Red, Blue
Jacket:	None
Flame Resistance:	UL 83
Manufacturer(s):	Okonite, X-Olene; Cablec, Durasheath XLP; or approved equal.
Uses Permitted:	Power, control, lighting and outlet circuits.
Execution:	
Installation:	Install in accordance with Section16000, paragraph -2.03.
Testing:	Test in accordance with section 16030.

Cable System Identification:	THWN
Description:	Single conductor lighting and receptacle type indoor branch circuit conductor.
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded in accordance with ASTM B-3 or B8.
Insulation:	THWN/THHN, 90 degree C dry, 75 degree C wet, polyvinylchloride (PVC) with nylon jacket per UL 83. May substitute XHHW2 with XLP insulation without a jacket.
Jacket:	Nylon
Flame Resistance:	UL 83
Manufacturer(s):	Okonite, Okoseal-N, series 116-67-XXXX; or approved equal.
Uses Permitted:	Lighting, receptacle and appliance circuits, power circuits.
Execution:	
Installation:	Install in accordance with section 16000.
Testing:	Megger Test: use Form in section 01999.

Cable System Identification:	MXLPE / S / PVC
Description:	1000 Volt Rated - Flexible Motor Supply Shielded Cable
Power Cable:	Multi-conductor shielded motor feeder cable with PVC jacket: 3/C cable with conductors sizes from #16-AWG to #2-AWG with grounding conductor.
Ground Conductor Size:	Sized per NEC 250
Application:	Feeder cable between VFD motor controller and motor.
Conductor Material:	Flexible copper with high strand count
Insulation:	Thermoset Crosslinked Polyethylene (XLPE): 90 degree C dry, 75 degree C wet, per UL 44.
Jacket:	PVC over assembly; jacket thickness per UL 1277 Cable Tray rated UL 1277 Type TC
Shield:	Tinned copper braid and foil
Flame Resistance:	IEEE 383 Fire Test (70,000 BTU) IEEE 1202: Limited Smoke rated and labeled on cable jacket UL 1685: Vertical Tray Flame Exposure Test
Manufacturer(s):	Anixter B2095XX series Belden 295XX series LAPPUSA OLFLEX VFD Symmetrical: 1AWG – 500 kcmil LAPPUSA OLFLEX Servo 2YSLCY-JB flexible cable

Execution:

Installation:	Install in accordance with paragraph 16000-3.01D. Install in conduit or cable tray. Not to be used for open wiring installation. Ground shields at both ends. Shield terminating gland may be used at the motor to ensure grounding the shield.
Testing:	Test in accordance with paragraph 16000-3.02.

2.04 WIRING DEVICES

Unless specified otherwise, provide UL approved wiring devices for the current and voltage ratings specified and comply with NEMA WD-1 with provisions for back wiring and side wiring with captive held binding screws.

A. HEAVY DUTY 120V RECEPTACLES:

1. SINGLE PHASE: Duplex 20-amp, NEMA 5-20R accepting NEMA 5-15P and 5-20P plugs. Cooper 5362, Hubbell 5362, or approved equal.

2. GROUND FAULT INTERRUPTING: Ground fault interrupting (GFI) receptacles: duplex, 20 amp, NEMA 5-20R, specification grade that accepts NEMA 5-15P and 5-20P plugs. Provide GFI receptacles outdoors and as shown, UL listed with provisions for testing and resetting. Manufacturer: Hubbell GF-5352-I, or approved equal.

3. THREE-PHASE RECEPTACLES AND BOXES: Cooper Series 309 watertight pin & sleeve receptacles, plugs, and back boxes, or approved equal.

B. SWITCHES:

1. INDOOR SWITCHES: Quiet AC type, heavy duty, specification grade in accordance with rated capacities as required. Match the switch color and the receptacles color. Manufacturer: Cooper, Hubbell, or approved equal.

2. SWITCHES FOR OUTDOOR AND CORROSIVE AREAS: Provide 20-ampere, push-type switches; Cooper Tap-Action, Hubbell PressSwitch, or approved equal.

C. DEVICE PLATES:

Provide device plates with switches and receptacles that match the area classification location.

1. INDOOR, ARCHITECTURALY FINISHED AREAS: Provide switch and receptacle device plates of sheet steel, zinc electroplated with chrome finish. Manufacturer: Crouse-Hinds, Appleton, or approved equal.

2. INDOOR, NON-FINISHED, NON-CORROSIVE: Provide cast covers, Appleton, Crouse-Hinds, or approved equal.

3. INDOOR, NEMA-12 AREAS: In areas designated NEMA-12, or other areas specified provide hinged covers with neoprene gaskets. Manufacturer: Hubbell, Cooper, or approved equal.

4. NEMA 4X - CORROSIVE: In areas designated NEMA-4X, COOROSIVE, or other areas specified provide corrosion-resistant/marine-duty type covers. Manufacturer: Hubbell, or approved equal.

5. IN-USE COVERS: In areas designated NEMA-4X, CORROSIVE, or other areas specified, and in outdoor areas, provide in-use type weatherproof lift covers that maintain weatherproof rating with plug installed for equipment that is cord connected with plug and receptacle. Covers shall be cast aluminum, except in corrosive areas where covers shall be plastic. Manufacturer: Outdoor, NEMA 4X areas: In-use covers shall be Hubbell WP7, WP8, WP26, or equal. CORROSIVE areas; Manufacturer: TayMac Corporation 20510, Carlon E9UXXXX, Hubbell WP826XXX, or approved equal.

6. WET/CORROSIVE SWITCH COVERS: In outdoor, areas, wet areas, areas designated NEMA-4X, CORROSIVE, or other areas specified, provide weatherproof, corrosion-resistant covers for switches to maintain weatherproof rating during operation of switch. Covers shall have flexible bubble of silicone or neoprene rubber for switch operation. Manufacturer: Cooper, Hubbell, or approved equal.

7. HAZARDOUS AREAS: Device plates in hazardous areas shall be cast iron, rated NEMA 7, suitable for use outdoors and in wet areas. Manufacturer: Appleton, Crouse-Hinds, or approved equal.

D. PILOT DEVICES:

Provide heavy-duty push buttons, selector switches and indicating lights: 30mm, oil-tight, NEMA 4X. Indicating lights shall be light emitting diode (LED) type lamps. Unless otherwise shown, provide push-to-test type indicating lights. Provide diode isolating type pilot indicating lights specified for remote-test.

Provide 120VAC control units: heavy-duty type Allen-Bradley 800H, or approved equal. For 24VDC: Allen-Bradley 800T, Square-D Class 9001 Type J, or approved equal.

2.05 GROUNDING SYSTEM

Provide electrical system grounding electrode conductors, equipment grounding conductors for equipment grounding and raceways, grounding electrodes, grounding

electrode conductors, connections, and bonding in compliance with the National Electrical Code-Article 250 and the National Electrical Safety Code.

Provide annealed bare copper, concentric stranded grounding conductors. Provide the minimum sizes per NEC Article 250 for grounding conductors or service entrance conductors, if not sized on the drawings.

Bond grounding conductors entering enclosures together to metallic enclosure and to metallic raceways terminating at the enclosure. Clean the conductor and enclosure metal surface at the point of connection prior to making equipment grounding connections or bond connections.

Make grounding conductor connections to equipment and ground rods by bolted clamps, compression connectors, or exothermic weld connections in accordance with manufacturer's installation and testing instructions. Make connections to buried grounding connections using compression connectors or exothermic weld connections. Make connections at the ground grid test wells using bolted clamps.

Connect the ground grid to the following with grounding conductor specified herein or connect to the ground grid with grounding conductor as shown on the drawings:

1. Electrical ductbank #4/0 embedded conductor with #4/0 bare copper
2. Electrical distribution or utilization equipment metal enclosures with #4/0 AWG green insulated aluminum
3. Metal enclosure not containing electrical distribution with #4 AWG green insulated aluminum
4. Pump/motor frames with #4 AWG bare aluminum or insulated
5.
6. Equipment ground plate with #4/0 AWG bare copper.
7. Other equipment: provide #1 AWG green insulated copper. Provide ¾" conduit protection where subject to damage.

F. RACEWAY GROUND:

Install metallic conduits to provide a continuous ground path. Use insulated grounding bushings and bond to the ground grid system in compliance with Article 250 of the National Electrical Code.

Provide an equipment-grounding conductor with green insulation in all metallic and non-metallic conduit, raceway, wireway, gutter, or ductbanks.

Provide an equipment grounding conductor with green insulation for sizes up to #6 AWG and provide green color insulation tape band for conductor size #4 AWG and larger.

2.06 POWER, CONTROL, AND METERING EQUIPMENT (NOT USED)

A. PANELBOARDS:

Provide panelboards: circuit breaker, dead front type with bus bar construction composed of individually mounted circuit breakers with screw-connection, designed to be removed without disturbing other breakers. Provide lockable, hinged door-in-door construction for flush mounted panels and hinged-trim covers for surface mounted panels.

Provide tin-plated copper buss and with the current rating as shown on the panel schedules sized in accordance with UL 67 and withstand rating equal to the interrupting rating of the smallest circuit breaker in the panel. Series rated products are prohibited. Silver plated equipment is prohibited.

Provide panelboards with a separate ground bus and a full capacity neutral bus. Mount neutral bus on insulated standoffs. Provide removable link connector from the neutral bus to the ground bus. Provide listed and labeled panelboard for service entrance disconnect as shown.

Panelboards shall be as manufactured by Square D or equal.

B. COMBINATION MOTOR STARTERS:

Provide NEMA rated for the horsepower for combination motor starters with motor circuit protector and solid-state type overload relay. Provide a reset button located on the unit door exterior.

Provide adjustable motor circuit protector with magnetic only trip setting adjustable over a range of 600- 300% of full load current of the motor served. Field adjust motor circuit protector setting per NEC and manufacture’s recommendations. Provide 22,000 symmetrical ampere interrupt rating, where not shown on the power single line diagrams.

Provide solid-state adjustable overload relay to latch in the open position. Provide adjustable trip settings with minimum adjustable range from 85-115% of full load current of motor served. Field adjust overload setting per NEC and manufacture's recommendations.

Provide control power transformers with two primary fuses rated at 100,000 amperes at 600VAC and one secondary fuse rated at 10,000 at 250VAC and sized at 125% of the control circuit full load current. Ground the non-fused leg of the secondary circuit.

Provide switchboard type MTW or SIS control circuit conductors rated 90 degree C above ambient temperature. Conductors shall be identified with tag numbers.

Provide motor contactor "Run" status contact and "Overload" alarm contact. Provide "Hand-Off-Remote" (HOR), "Hand-Off-Auto" (HOA), and other shown selector switches with a "Remote Mode" or "Auto Mode" status contact.

Provide heavy-duty selector-switches and pushbutton and indicating lights with rating to match enclosure type. Provide control devices rated at 600VAC, 10-ampere continuous with

Provide start/stop pushbuttons with "Run" and "Stop" indicating lights including other control devices as shown. Provide push-to-test transformer type pilot lights or LED pilot lights. Lens color as shown on the drawings or as specified herein.

Combination Motor Starters shall be as manufactured by Siemens Compact Sirius 3rm1007-1aa04ms or equal.

C. CIRCUIT BREAKERS:

Provide circuit breakers: molded-case type provided for the current ratings and pole configurations as shown or as specified on the panelboard schedule and with a minimum interrupting current rating as shown on drawings or schedules, but not less than 22,000 AIC for 240 volt rated devices or 35,000 AIC for 480 volt rated devices. Series rated branch, main, or other devices are prohibited.

Provide circuit breakers listed in accordance with UL 489 for the service specified and load terminals with solderless connectors. Provide bolt-on type circuit breakers. Provide circuit breakers with machine-printed, circuit number labels indicting the load served.

E.

D. LOAD-SWITCHING CONTROL RELAYS:

1. Heavy-duty, machine tool type for switching load such as solenoids, actuators, contactors, motor starter coils, etc and used for remote interlocking.

2. Contacts: 4-pole and field interchangeable to either normally open or normally closed and capable of accepting a 4-pole contact block adder.

3. AC relays: NEMA A600 contact ratings and electrical clearances for up to 600 volts.

4. DC relays: NEMA P300 contact ratings and electrical clearances of up to 250 volts.

5. Manufacturer: Allen Bradley Bulletin-700, Square D Class 8501 Type X, or approved equal.

E. LOGIC-LEVEL RELAYS:

Logic-Level switching solid-state logic and signal circuits:

1. Minimum of three (3) Single Pole Dual Throw (SPDT), silver cadmium oxide contacts rated 10-amperes-resistive at 120VAC or 28VDC.

2. Plug-in type with heavy-duty, barrier-protected screw terminal sockets.

3. Clear polycarbonate dust cover with clip fastener.

4. AC models: neon lamp indicator wired in parallel with coil.

5. Manufacturer: Idec Series RH, Square D Class 8501, or approved equal.

F. TIMING RELAYS:

1. Multi-function, micro-controller based, socket mounted timing relay.

2. Single functions:

   a. Delay on Make
   b. Delay on Break
   c. Recycle (on time first, equal recycle delays)
   d. Single shot
   e. Interval
   f. Trailing edge single shot
   g. Inverted single shot

h. Inverted delay on break
i. Accumulative delay on make
j. Retriggerable single shot

3. Dual functions:

a. Delay on make/delay on break
b. Delay on make/recycle (on time first, equal recycle delays.)
c. Delay on make/interval
d. Delay on make/single shot
e. Interval/recycle (on time first, equal recycle delays)
f. Delay on break/recycle (on time first, equal recycle delays)
g. Single shot/recycle (on time first, equal recycle delays)
h. Recycle – both times adjustable (on time first)
i. Recycle – both times adjustable (off time first)
j. Interval/delay on make
k. Accumulative delay on make/interval

4. Time delay range, switch selectable:

a. Single function 0.1 second to 1,705 hours in 8 ranges.
b. Dual function 0.1 second to 3,100 minutes in 8 ranges.
c. Setting accuracy +/- 1 percent or 50 milliseconds, whichever is greater.
d. Repeat accuracy +/- 0.1 percent or 16 milliseconds, whichever is greater.

5. Output: Two Form-C electromechanical isolated contacts rated 10-amperes resistive at 240VAC and 1/3-horsepower at 120 or 240VAC; double pole double threw: Dual Pole Dual Throw (DPDT). Mechanical life: 10,000,000 operations and electrical life: 1,000,000 operations at full load.

6. Mounting: Magnal Plug 11-pin socket

7. Environment: -20 degree-C to +65 degree-C.

8. ABB/SSAC multifunction type TRDU time delay relay with dip-switch function setting with 12VDC, 24VAC, 120VAC, 240VAC inputs as required; Agastat, STA series; or Engineer accepted substitute.

G. SAFETY DISCONNECT SWITCHES:

Provide safety disconnect switches:

1. Motor horsepower rated, heavy-duty, non-fusible
2. Safety type rated 600 volts AC
3. Ratings and fuse size as shown
4. Rating and fuse size as required by the utilization equipment manufacturer
5. Disconnect "open status" switch rated 1-ampere
6. Switch operator with a positive, quick-make, quick-break mechanism
7. NEMA-4X below grade, outdoors, or corrosive areas, or as shown
8. NEMA-7 hazardous classified areas.
9. Tinplated copper products. Silver-plated products are prohibited.

H. ELAPSED TIME INDICATORS:

Elapsed time indicators shall be panel mounted, non-resettable five-digit, hour indicator, rated 120 volts, 60 Hz.

I. ADJUSTABLE FREQUENCY DIVES (AFD)/VARIABLE SPEED DRIVES (VFD):

The terms AFD (adjustable frequency drive), ASD (adjustable speed drive), VFD (variable frequency drive), and VSD (variable speed drive) are interchangeable for the purposes of this specification.

Variable speed drives shall be rated for 480 Vac, 6 pulse, using insulated gate bipolar transistors (IGBT) for pulse width modulation technology (PWM)

Provided with the following functional requirements and features:

1. SUPPLY POWER: Operate continuously with supply power of 480 volts plus or minus 10 percent, 60 Hertz plus or minus 3% and remain on line and operate without damage to the AFD or connected load during a supply power under-voltage variation to the drive up to 85% of its nominal value for 30 milliseconds at full load.

2. LOAD: Continuously driving the specified maximum motor load under the conditions:
   a. Deliver 110 percent of the specified load for up to 60 seconds in variable torque applications.
   b. Deliver 150 percent of the specified load for up to 60 seconds in constant torque applications.

3. EFFICIENCY: Not less than 95 percent at 60 Hertz output driving the specified maximum load.

4. FREQUENCY AND VOLTAGE REGULATION: Output frequency regulated to within 0.6 Hertz of the signal/output frequency relationship.

Output voltage regulated to within 1.0 percent to produce minimum motor heating at any operating frequency within the specified range.

5. Fused control circuit transformer and microprocessor for system logic sequencing functions. Provide fuses with blown fuse indicator lamps.

6. Accept 4 to 20 mA dc input speed reference signal.

7. A 4 to 20 mA dc output signal proportional to inverter output frequency for the speed range specified.

8. Adjustable minimum/maximum frequency limits:
   a. Minimum frequency shall be adjustable from 6 to 40 Hertz.
   b. Maximum frequency shall be adjustable from 48 to 66 Hertz.

9. Adjustable and independent timed linear acceleration and deceleration functions, adjustable from 6-20 seconds.

10. Current limiting.

11. Automatic restart.

12. Control Wiring:
   a. 600volt stranded copper
   b. 90 degrees C color-coded insulation
   c. No. 16 AWG

13. Wiring Identification and Termination: Crimp type wire lugs with sleeve type markers at each termination point and numbered terminal blocks for external connections.

14. Electrically isolated auxiliary contacts for ready, running, remote mode status and trouble alarm.

15. Conformal coated terminal blocks for control and signal wires entering and leaving the controller.

16. Control Power: Provide a 120 Vac, triple fused, control power transformer for cooling fans and external control circuits when required. Control circuits shall be isolated from power circuits by distance and by insulated barriers.

17. Provide 120 Vac or 24 Vdc as required for Operator Interface Unit.

18. Fault Alarm: Indicates the cause of any shutdown visible on the AFD keypad/display without opening the AFD enclosure. As a minimum, the following faults shall be alarmed:
    a. Motor over-temperature
    b. Motor overcurrent
    c. Incoming power line over/under/unbalanced-voltage
    d. AFD over-temperature
    e. AFD over-voltage
    f. AFD control failure

19. Control and Monitoring Devices:
    a. Digital Operator keypad/display, located on door (not dead front).
    b. Local-Off-Remote door mounted selector switch.
    c. Manual speed control: potentiometer function.
    d. Ethernet com card: Si-EN dual port
    e. Internal terminal strips for remote and local monitoring:
        1) Run status
        2) Trouble/Fail alarm
        3) Auto Mode status
        4) Additional devices as indicated on the drawings.

20. Programming: VFD's provided as follows:

a. In MCC's: For Sludge Feed Pumps, and cake pumps,
b. In Vendor Control Panels: For BFP Drives, and Polymer Pumps

New VFD's provided in Vendor Supplied Control panels shall be programmed bt the Vendor. New VFD's provided in the MCC's or by Contractor supplied control panels shall be programmed by the contractor. VFD I/O Tag List with descriptions shall be provided to the owner. Vendors and Contractor shall coordinate with the Owner to ensure proper communication between the VFD's and SCADA.

21. Manufacturers:
    a. Yaskawa iQ1000 with ethernet card SI-EN3/V, and EMC Filter,
    b. Or approved equal

2.07 ELECTRICAL SAFETY MAT

A. MCC's matting shall be provided for added protection of operations staff and workers to cover concrete surfaces in front of electrical equipment.
    1. Matting shall meet ASTM D-178 specifications for manufacture of Type II, Class 2: ¼" thickness matting.
    2. Flame and oil resistant tested per ASTM standards.
    3. ASTM certification engraved or stamped on the back surface of the matt.

4. Matting shall be tested and certified for industrial use. Matt rolls shall be proof testing over the entire surface at 20,000 VAC, and a dielectric test voltage of 30,000 VAC.
5. The Contractor shall provide matting in the existing electrical rooms in front of all new electrical switchboards.
6. The Contractor shall provide matting in the front of all interior new control panels.
7. Single piece rolls are preferred to be used in front of long sections of electrical equipment including, but not limited to, switchboards, switchgear, motor control centers, panelboards and control panels.
8. Matting shall be a minimum of 48" wide corrugated black for interior areas.

2.07 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Operating and maintenance information as specified in Section 01730.

2. One 11" x 17" set of drawings in a protective covering and shipped with the equipment in the internal equipment pocket at the time of equipment delivery to the project site.

3. Record documents as required.

4. Certificates of final electrical inspection and approval from the Code Authority Having Jurisdiction (AHJ) as specified in Section 16000, paragraph 1.01 A 4.

PART 3 – EXECUTION

3.01 GENERAL

A. CONSTRUCTION:

Perform the work specified by Contract Documents in accordance with these specifications.

Coordinate the location of electrical material or equipment with the work and adjust conduit location to accommodate equipment in accordance with the accepted submittal drawings from the manufacturer.

B. HOUSEKEEPING:

Protect electrical equipment from dust, water and damage. Cover the exterior to keep dry. Electrical distribution equipment such as motor control centers, switchgear, switchboards, panelboards, and other power source buses shall be clean and free of dust and dirt.

Protect electrical equipment temporarily exposed to weather, debris, liquids, or damage during construction as specified in Shipment, Protection, and Storage section. Touch up scratches on equipment as specified in Coating Systems section before final acceptance.

Wipe clean and vacuum equipment on the inside prior to acceptance testing and energization and again prior to detailed inspection and acceptance of the work.

C. INSTALLATION:

Perform the installation work specified in accordance with these specifications.

1. Splices are not allowed except by permission. Splices and terminations are subject to inspection prior to and after insulating and may require re-termination after inspection.

2. Lighting and receptacle circuits may be in the same conduit in accordance with derating requirements of the NEC. Lighting and receptacle circuits in conduits with power or control conductors is prohibited.

3. Adhere to the NEC raceway fill limitations. Provide separate conduits for signal and instrument conductors and cables.

4. Install power conductors derived from uninterruptible power supply systems in separate raceways.

5. Provide terminations at 460-volt motors by bolt-connecting the lugged connectors and insulating. Alternately, provide Tyco Electronics GelCap Motor Connection Kit by Raychem, or approved equal.

6. Install pre-approved in-line splices and tees with tubular compression connectors and insulate. Splices and tees in underground handholes or pull boxes shall be insulated using Scotch-cast epoxy resin splicing kits, or approved equals.

7. Provide self-insulating tubular butt-splice type of compression connectors for terminations at solenoid valves, 120-volt motors, and other devices furnished with pigtail leads.

8. Adjust motor circuit protectors in accordance with manufacturer's instructions and NEC requirements.

9. Adjust motor overload device in accordance with manufacturer's instructions and NEC requirements.

D. CONDUCTORS, WIRE, AND CABLE INSTALLATION:

Identify conductors at each connection terminal and at splice points with the identification marking system specified.

Install wire and cable into raceways, conduit, cable trays, or wireways without damaging or putting undue stress on the insulation or jacket. Provide manufacture's recommended and UL Listed pulling compounds lubricants for pulling wire and cable. Grease is prohibited.

Raceway construction shall be complete, cleaned, and protected from the weather before cable is installed. Provide wire or cable support where wire or cable exits a raceway. Provide reusable stainless steel Kellums grips or approved equal product where cable support is required and where loads are removable.

Scratch-brush the contact areas and tinplate the connection where flat bus bar connections are made with tinplated or unplated flat bus bar. Provide non-oxide material approved for the function. Torque bolts to the bus manufacturer's recommendations.

Adhere to raceway fill limitations defined by NEC and the following: Lighting and receptacle circuits may be in the same conduit in accordance with de-rating requirements of the NEC. Lighting and receptacle circuits shall not be in conduits with power or control conductors. Signal conductors shall be in separate conduits.

Install pre-approved in-line splices and tees made with tubular compression connectors and insulated as specified for terminations and for motor terminations. Splices and tees in underground handholes or pull boxes shall be insulated using Scotch-cast epoxy resin or approved equal splicing kits.

E. RACEWAY INSTALLATION:

Provide additional pullboxes for conduit runs with greater than 360-degrees in any run between pull boxes. Limit maximum conduit runs without additional pullboxes to 400-feet, less 100-feet for every 90-degrees for the conduit run change in direction.

Determine conduit routing that conforms to the installation requirements set forth herein and in accordance with the NEC requirements for size and number of pullboxes.

1. Install exposed conduit either parallel or perpendicular to structural members and surfaces.

2. Route two (2) or more exposed conduits in the same general routing parallel with symmetrical bends.

3. Install exposed conduit on supports spaced not more than ten (10) feet apart.

4. Install conduits out from the wall using framing channel where three (3) or more conduits are located in parallel run.

5. Install conduits between the reinforcing steel in walls or slabs that have reinforcing in both faces. Verify installation method for conduits larger than 2-inch with OWNER prior to installation.

6. Install conduit in slabs that have only a single layer of reinforcing steel, under the reinforcement.

7. Install conduits with large radii under the slab in a one-sack concrete slurry.

8. Route conduit clear of structural openings and shown future openings.

9. Provide conduit roofs or wall penetrations with flashing sealed watertight and fire-stop, as required to maintain the structural rating.

10. Grout conduit into any openings cut into concrete and masonry structures.

11. Cap conduits during construction to prevent entrance of dirt, trash, and water. Cap or plug empty conduit designated as “future”, “spare”, or “empty” and include a pulling line accessible at both ends. Plug threads prior to installation.

12. Terminate exposed conduit stubs for future use with pipe-caps and provide couplings and pipe-plugs where flush with the slab.

13. Determine concealed conduit stub-up locations from the manufacturer's shop drawings.

14. Terminate conduit in equipment with conduit couplings with pipe-plugs flush with structural surfaces for empty conduit.

15. Install conduit horizontally with at least seven (7) feet of headroom clearance.

16. Terminate conduit with fittings that ensure the NEMA rating of the enclosure and provide conduit hubs, as required heretofore.

17. Provide conduit crossing structural joints with structural movement with O-Z "Type DX" or Crouse-Hinds "Type XD," bonded, weather-tight expansion fitting of the same size and type as the conduit, or approved equal.

18. Seal conduits in corrosive areas using removable mastic material.

F. UNDERGROUND RACEWAY INSTALLATION:

Provide excavation, backfilling, and concrete work as specified and shown.

Provide underground conduit installations that conform to the following requirements:

1. Direct bury underground conduits that are not shown to be installed in an electrical ductbank.

2. Underground conduit bend radius: not less than two (2) feet minimum at vertical risers nor less than three (3) feet elsewhere for up to 2-inch diameter conduit.

3. Determine conduit manufacturer’s bending radius requirement for 3-inch and larger diameter conduit and use factory “long radius” ells.

4. Underground ductbanks and direct-buried conduits: 2-feet minimum earth cover, except where shown otherwise.

5. Concrete encased conduit:

   a. Minimum concrete thickness of 2-inches between conduits 2.5-inch and smaller.

   b. 3-inches between 3-inch conduit and larger or per NEC requirements.

   c. 1-inch between conduit and reinforcing.

d. 3-inches over reinforcing.

e. Embed #4/0 bare ground in the concrete encasement and installed with direct buried raceways.

f. Standard detail or typical details shown supersede these general requirements.

g. Provide 3-pounds of red-oxide dye-color per sack of cement for in the concrete encasement for electrical ductbanks.

h. Provide 467-ASTM coarse aggregate size with 3-cement sacks per cubic yard concrete.

i. Provide concrete with 28-day, 2000-psi compressive strength unless specified at higher value in the cast-in-place concrete specification.

G. CONDUIT SEAL-OFF FITTINGS:

Conduits passing:

1. Between Class I, Division 1 area and Class I, Division 2 area; provided with sealing fittings located at the boundary in accordance with NEC Article-500.

2. From hazardous or corrosive area into a non-hazardous or non-corrosive area.

Install the seal-off material in the conduit seal-off fittings after inspection.

H. ELECTRICAL EQUIPMENT LABELING:

Electrical equipment shall have field marked signs and labeling to warn qualified persons of the potential electric arc flash hazards per NEC Article 110.16 Flash Protection.

Electrical equipment shall have NFPA 70E labels installed stating the results of the Arc Flash analysis. A Short Circuit and Protective Device Coordination Study shall be done by the electrical equipment manufacturer.

Electrical distribution equipment and utilization equipment shall be field labels to identify the power source and the load as specified. Refer to NEC Article 110.22 for Identification of Disconnecting Means installation criteria. Specific information is required such as the equipment tag number and equipment description of both the power source and the load equipment.

3.02 TESTING

Provide electrical equipment acceptance tests in accordance with the latest version of NETA Acceptance Testing Specification for electrical distribution and utilization equipment to demonstrate that all electrical equipment is functioning as designed.

Test lighting system for proper function. Test wiring devices for correct connections. Test outlet grounding and polarity using a plug-in test device. Test motor control stations and control devices for proper function.

Test power, control, instrument, and signal conductors to verify free from grounds. Megger test all conductors with the test voltage appropriate to the conductor insulation voltage. Use a 600 or 1000-volt megohmmeter for resistance measurements for 600VAC rated insulation and all motors. Test between conductors and from conductor to ground. Insulation with resistance of less than 10-megohms is not acceptable. Record the insulation resistance measurements in a format similar to or on the Form 16000-A in Section 01999.

Pre-test conductors prior to installation, as appropriate. Replace damaged conductors. Test all conductors after installation.

Measure motors insulation resistance before they are connected. For 50-horsepower and larger motor, measure the motor insulation resistance at the time of delivery and after they are connected. Insulation resistance values less than 10 megohms are not acceptable. Complete the Installed Motor Test Form: 16000-B in Section 01999, for each motor after installation.

3.03 FUNCTIONAL CHECKOUT

Prior to energization of equipment, perform a functional checkout of the control circuit. Prior to functional testing, adjust and make protective devices operative by energizing each control circuit and operating each control, status, alarm, protective device, and each interlock to verify that the specified action occurs. Submit a description of his proposed functional test procedures prior to the performance of functional checkout.

Verify motors are connected to rotate in the correct direction by momentarily energizing the motor. Prior to motor rotation test, confirm that the motor, the driven equipment, nor personnel will be damaged by reverse operation.

3.04. GROUNDING SYSTEM TESTS

PERFORM COMPLETE GROUND TESTING OF ENTIRE BFP BUILDING AND SUBMIT REPORT, INCLUDING DEFICIENCIES, IF ANY, AND CORRECTIVE MEASURES PROPOSED.

Test each grounding connection to determine the ground resistance per the IEEE Standard 81. Submit a plot of ground resistance readings for each isolated ground rod or ground mat to the OWNER on 8-1/2 x 11 inch size graph paper.

The current reference rod shall be driven at least one hundred (100) feet from the ground rod or grid under test. Make measurements at 10-foot intervals, beginning twenty-five (25) feet from the test electrode and ending seventy-five (75) feet from it, in direct line between the ground rod or center of grid and the current reference electrode.

A grounding system that shows greater than 2-ohm resistance, for the flat portion of the plotted data, is considered inadequately grounded.

3.05 RECORD DOCUMENTS

Provide Record Drawings and documents maintained and annotated during construction. Submit drawings in accordance with Section 01720 and the following.

Include addendum items, requests for information, change orders, and field changes posted or drawn on the Record Drawings. Include the following drawings with the Record Drawings:

1. Interconnection Diagrams specified herein.
2. Original Submittal Drawings specified herein.

Schedule a meeting with the Engineer in the Engineer's office to review the Record Drawings at the end of the project. Make corrections to the Record Drawings prior to re-submitting the Record Drawings to the Engineer.

Submit Record Drawings and Operations and Maintenance (O&M) Manuals to be included in the completed project Record Document Set for the OWNER.

END OF SECTION

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SECTION 16030

ELECTRICAL ACCEPTANCE TESTING

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

The electrical equipment and conductors to be tested are specified herein and shown on the electrical drawings of the Contract Documents.

The Contractor shall retain an independent InterNational Electrical Testing Association (NETA) member Engineering and Testing Firm (Testing Firm) for specified on-site acceptance testing of the project electrical power distribution system and utilization equipment covered by this contract.

The Testing Firm shall be responsible for the Short Circuit and Protective Device Coordination Report as specified in Section 16431. The Testing Firm shall verify the protective device settings are implemented in accordance with Section 16431. The Testing Firm work includes the ARC-Fault equipment labeling work as specified in Section 16431.

Tests performed by the Testing Firm shall be witnessed by the Owner's Representative. Provide the Construction Manager 30-day advanced notice for Testing Firm tests. Insulation tests by the Contractor typically will not be witnessed. Critical equipment witness testing may be requested by the Construction Manager.

The manufacturer of the electrical equipment supplied for the project shall complete their on-site factory inspection, testing, and setup prior to the Testing Firm's Acceptance Testing and subsequent Protective Device setting verification work. The power monitors shall be set up by the factory representatives and power monitor readings and settings verified by the Testing Firm. Manufacturer work is specified in the respective equipment sections.

The Installation Contractor shall test motors, conductors, and equipment as specified and shown. Contractor shall provide the labor, tools, material, including quality power sources required by the Testing Firm equipment, and other services necessary to provide specified tests and retesting.

Submit proposed electrical test procedures for tests to be performed by the Installing Contractor, other than insulation resistance testing, and proposed test procedures for tests to be performed by the Testing Firm.

1.02 QUALITY ASSURANCE

A. REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/NETA ATS	International Electrical Testing Association (NETA) - Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

B. TESTING FIRM

The Testing Firm and their proposed project team shall possess the following minimum qualifications:

1. Testing Firm shall be an independent testing organization providing unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems to be evaluated.

2. Testing Firm shall be regularly engaged in the testing of electrical equipment, devices, installations, and systems.

3. Testing Firm shall be a "NETA Accredited Company" of the InterNational Electrical Testing Association (NETA providing testing in accordance

with ANSI/NETA ATS published specifications or the pre-approved firms that use the NETA methods and published testing specifications.

4. If firm's own published testing specifications are proposed, then submit a copy to the Engineer for acceptance and submit the qualifications of the testing staff.

5. Testing Firm's lead technical person shall be currently certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution systems testing. Submit proof of technical training and certification for performing testing work.

6. Testing Firm's technicians shall be regularly employed, qualified testing staff.

7. The following are pre-qualified Testing Firms:

    a. Emerson Electrical Reliability Services

    b. Power Systems Testing Co.

C. TESTING FIRM QUALIFICATIONS

For any Testing Firm not pre-qualified, the Contractor shall receive Construction Manager approval of the proposed Testing Firm, their proposed project team, and their test procedures prior to the Pre-Test Submittals.

1. Project Team: Identify lead technical person and testing staff and provide documentation of training and experience demonstrating compliance with the qualifications specified.

2. Testing Firm: Provide reference names and current phone numbers of the Owner, Contractor, Engineer, or Construction Manager that has knowledge of the Firm’s work:

    a. Three projects for Owner completed within the past four years, or

    b. Three projects for Brown and Caldwell completed within the past four years, or

    c. Provide references for five recent projects that were completed within the last four years. Provide a description of the scope of the referenced project.

3. For Testing Firm’s experience to be judged acceptable, the Contractor shall demonstrate that the proposed Testing Firm's reference projects are

of similar scope and size to this project, and in performing these projects the following has been achieved:

a. Testing Firm's work did not delay the projects or adversely impact the progress of the Contractor's work or the Owner's project.

b. Specified requirements were achieved.

c. Work was performed in accordance with ANSI/NETA ATS, MTS, or other Engineer accepted testing criteria.

d. Submittals approved with two or fewer re-submittals after the initial submittal.

e. No warranty claims related to the Testing Firm's work.

4. Provide documentation demonstrating NETA Accreditation and compliance with the qualification specified.

1.03 SUBMITTALS

Contractor shall submit the following information in accordance with specification Section 01300:

A. TESTING FIRM QUALIFICATIONS:

For any Testing Firm not pre-qualified per paragraph 1.02 B, submit qualifications per paragraph 1.02 C.

B. PRE-TEST SUBMITTALS:

1. Description or samples of specified test procedures.

2. Sample test report forms for the specified tests.

3. Preliminary Schedule listing equipment to be tested.

4. Notification form for the work scheduled.

5. Pre-Functional test procedures and testing schedule.

6. Functional test procedures and testing schedule.

C. POST-TEST SUBMITTALS:

1. Completed Section 01999-Test Record:

a. Wire and Cable Resistance Test Data Form: 16000-A

b. Installed Motor Test Form: 16000-B

c. Dry Transformer Test Data Form: 16000-
d. Pad Mounted Transformers
e. Variable Frequency Drives

2. Test Reports specified in Part 3 of this Section.

PART 2 – PRODUCTS

2.01 TESTING EQUIPMENT AND INSTRUMENTS

The test equipment, instruments and devices used for testing shall be calibrated to test equipment standards with references traceable to the National Institute of Standards and Technology.

The test equipment, instruments and devices shall have current calibration stickers indicating date of calibration, deviation from standard, name of calibration laboratory and technician, and date of next recalibration.

PART 3 – EXECUTION

3.01 GENERAL

The Contractor shall submit a schedule for the Testing Firm work and notify the Construction Manager 30 days prior to commencement of any witnessed testing.

The required tests, including correction of defects where found, and subsequent retesting, shall be completed prior to energizing electrical distribution system, utilization systems, and conductors and completed prior to functional testing. The installation of the protective device, breaker, and relay settings shall be completed and verified.

3.02 INSTALLATION CONTRACTOR TESTING

A. GENERAL:

Submit all completed test report forms in a 3-ring binder type notebook at the project Substantial Completion date.

B. INSULATION RESISTANCE MEASUREMENTS:

1. TESTS: Insulation resistance measurements shall be made on conductors and electrical equipment that will carry current. Where not specified, the minimum acceptable values of insulation resistance shall be in accordance with the applicable NETA-ATS, ICEA, NEMA, or ANSI standards for the equipment or material being tested.

   The ambient temperature at which insulation resistance is measured shall be recorded on the test form. A megohmmeter shall be used for insulation resistance measurements.

   Refer to specification Section 01999-Reference Forms for the test forms required to document the testing performed by the Installing Contractor.

2. CONDUCTOR AND CABLE TESTS: The phase-to-ground insulation resistance shall be measured for circuits 120 volts and above except lighting circuits. Measurements may be made with motors and other load equipment connected. Insulation resistance measurements shall be recorded on Form 16000-A contained in Section 01999, and submitted. Insulation with resistance of less than 100 megohms is not acceptable.

3. MOTOR TESTS: The Installed Motor Test Form, 16000-B, contained in Section 01999, shall be completed for each motor after installation and submitted. All motors shall have their insulation resistance measured before they are connected.

   Motors 50 HP and larger shall have their insulation resistance measured at the time of delivery and when they are connected. Insulation resistance values less than 50 megohms are not acceptable.

   Verify that motors are connected to rotate in the correct direction with the load disconnected. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation.

   Motor running current shall be measured on each phase with the motor operating under load. Current imbalance shall be less than 5-percent difference between phases.

C. POWER DISTRIBUTION EQUIPMENT:

Transformers, panelboards, and other power distribution equipment shall have their insulation resistance measured phase-to-phase and phase-to-ground. Insulation resistance values less than 10 megohms are not acceptable.

D. POWER UTILIZATION EQUIPMENT:

Test receptacles and power outlets using a device to verify polarity, grounding, and the correct wiring connections.

E. SIGNAL AND DATA CABLE TESTS:

Signal conductors and shield drain shall be tested for insulation resistance with the other conductors in the cable grounded. Each shield drain conductor shall be tested for continuity. Insulation resistance measurements shall be recorded on Form 17000-A contained in Section 01999, and submitted.

Instruments used for continuity measurements shall have a resolution of 0.1 ohms and an accuracy of better than 0.1 percent of reading plus 0.3 ohms. A 500-volt or 1000-volt meg-ohmmeter shall be used for insulation resistance measurements as appropriate.

F. PRE-FUNCTIONAL CHECKOUT:

Prior to energizing equipment, the Contractor shall perform a pre-functional checkout of the power and the control circuit. Protective devices shall be installed and available for service and calibrated or adjusted with specified setpoints installed. Contractor selected initial setpoints shall be installed and recorded, when specified setpoints are not required from the manufacturer or the Engineer.

Contractor shall submit a description of proposed test and checkout procedures conforming to the following requirements, including a schedule for conducting these procedures, not less than 30 days prior to the performance of pre-functional testing.

Pre-functional checkout shall consist of energizing each control circuit and operating each control device, protective device, monitoring or alarm device, and each interlock and verify the specified action or response occurs. Coordinate testing with the requirements specified in Section 01660 – Equipment and System Performance and Operational Testing.

G. FUNCTIONAL TESTING:

Contractor shall submit a description of proposed functional test and checkout procedures conforming to the following requirements, including a schedule for conducting these procedures, not less than 30 days prior to the performance of functional testing.

Prior to functional testing, all protective devices shall be adjusted and made operative. Prior to energization of associated equipment, perform a functional checkout of all electrical and instrumentation control circuits as specified in the following and in Division 17. Checkout shall consist of energizing each control

circuit and operating each control, alarm, safety device, and each interlock, in turn, to verify that the specified action occurs.

Record and submit data sheets as specified. Coordinate testing with the requirements specified in Section 01660 – Equipment and System Performance and Operational Testing.

3.03 TESTING FIRM ACCEPTANCE TESTING REQUIREMENTS

A. ACCEPTANCE TEST REPORTS:

The Contractor shall maintain a written record of all inspection and test results and, upon completion of the project, shall assemble and certify a final test report

A copy of the preliminary test results shall be provided to the Construction Manager at the end of each day of testing.

Furnish two copies of the complete acceptance testing final report to the Construction Manager at Substantial Completion of the project.

B. ACCEPTANCE TEST DOCUMENTATION

The Contractor shall submit test documentation forms and a detailed description of the proposed inspection and test procedures to be performed by the Testing Firm. Testing shall not commence until the Construction Manager has approved the proposed forms and procedures.

The description shall identify the test equipment required for each specified test to be performed. Test report forms shall include the following information:

1. Electrical equipment description.

2. Electrical equipment identification number.

3. Electrical equipment nameplate data.

4. Electrical equipment settings.

5. Time and date of test.

6. Ambient conditions at time of test.

7. Inspection checklist and results.

8. Test results.

9. Test equipment used with manufacture, model number, and calibration date.

10. Remarks about test procedures, results, and suggestions.

11. Name and signature of testing personnel.

12. Name and signature of test witness.

C. ACCEPTANCE TESTING FIRM TESTS:

Acceptance testing procedures and test results shall be as specified in ANSI/NETA ATS. The following types of equipment and systems shall be inspected and tested by the Testing Firm. Acceptance testing work shall not be limited to equipment shown on the drawings. Refer to Division 16 specification for the electrical equipment specified.

Refer to the electrical drawings for location and identification of the electrical distribution system equipment, utilization equipment, and electrical conductors, included but not limited to:

1. Switchboard Assemblies.

2. Transformers Dry-Type Air-Cooled.

3. Transformers Liquid Filled.

4. Cables Low-Voltage 600 Volt Maximum.

5. Cables Medium-Voltage.

6. Circuit Breakers Low-Voltage, 100A frame and larger.
7. Protective Relays.

8. Instrument Transformers.

9. Metering, include non-utility power metering equipment.

10. Grounding Systems include installed grounding systems and existing grounding systems that are being utilized.

11. Ground Fault Protection Systems.

12. Motors.

13. Motor Starters Low-Voltage.

14. Adjustable Speed Drive Systems and harmonic testing per Section 16000.

15. Surge Protection Devices, include lightning arresters, surge capacitors, and TVSS.

16. Uninterruptible Power Systems (UPS).

17. Manual Transfer Switched (MTS).

3.04 ACCEPTANCE TEST VALUES

Minimum acceptable test values shall be as specified in ANSI/NETA ATS. Where acceptance test values are not specified, the equipment manufacturer's recommended test values shall be used. Where acceptance test values are not specified and the equipment manufacturers recommended test values are not available, request acceptance test values from the Construction Manager.

3.05 ACCEPTANCE TEST FINAL REPORT

Test report shall be assembled as described in ANSI/NETA ATS. Test results shall be organized by electrical distribution system equipment, project utilization equipment, and electrical conductors with individual tab dividers with labels to identify each group of items and cross-referenced to the Contract Documents. The equipment description, equipment number, and equipment tag number shall be used as shown on the drawings or listed in specifications.

Final Test Reports that are illogically assembled, labeled, and organized shall be returned for rework at no cost to the Owner and resubmitted in an acceptable format.

Deficiencies and non-compliant test results found during acceptance testing shall be identified in the test report and cover letter. The Testing Firm shall certify in the final test report that all deficiencies and non-compliant test results listed have been "corrected" and shall include a description of the resolution for each problem listed.

3.06 PROTECTIVE DEVICE FIELD SETTINGS

The Testing Firm shall verify, and certify in the acceptance test final report, that the protective device coordination study settings for new and existing equipment based on the Short Circuit and Protective Device Coordination Report specified in Section 16431 have been implemented and recorded on the Testing Firm's Data Sheets.

3.07 ARC FLASH STUDY RESULTS

The Testing Firm shall provide and install labels on the project electrical equipment for personnel protective clothing requirements as specified in Section 16431.

END OF SECTION

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SECTION 16176

LOCAL CONTROL PANELS

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies local control panels used for housing electrical power and control equipment per Panel Schedule herein. Local control panels that include motor controllers and control devices/instruments shall be located in separate compartments.

Vendor and Manufacturer panels specification Sections specify specific requirement for these panel. Contractor custom panels are specified herein and shown on the drawings.

The Vendor / Manufacturer package equipment and Contractor custom field panels shall adhere to the requirements in specifications Sections 16000 for motor starters, controllers, and devices and the circuits shall be arranged for Fail-Safe wiring and electrical operation, as defined hereinafter.

Refer to Instrument and Control Panels – Section 17110 for electronic types of panels that do not contain motor controllers.

Refer to Division 17 for instrumentation included in the panel. Refer to process equipment control descriptions in the Equipment Sections or in Division 17 for system operation and interlock requirements.

B. PANEL SCHEDULE:

Refer to Control Panels – Section 17110 for types of panels that contain motor controllers. Any/all power requirements associated with those panels shall conform to this specification.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references and information from the following documents. They are a part of this section as specified and modified. Where a referenced

document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).

If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
NFPA 79	NFPA 79 Electrical Standard for Industrial Machinery
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 6	Industrial Control and Systems: Enclosures
NFPA 70	National Electrical Code (NEC)
UL 508A	Industrial Control Panels
UL 698A	Industrial Control Panels Relating to Hazardous (Classified) Locations

B. ASSEMBLY:

The assembled panels and individual components shall be UL Listed and labeled.

Equipment and components shall be Underwriters Laboratory (UL) listed for the purpose per Section 16000 or UL recognized.

The control panels shall have factory applied UL 508A labels.

The intrinsic safety barriers required within a control panel shall be provide per UL 698A with factory applied labels as required by UL.

C. FACTORY TESTING:

Prior to shipment, test the functional operation of the panel, as shown on the drawings, specified in other Divisions, as described in the sequence of operation in the Control Description where provided in Division 17.

1.03 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

   A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

   The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

   Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Arrangement drawings of the panel enclosure indicating the front door and panel equipment arrangement and dimensions, and enclosure type.

3. List of materials and components with the layout drawings.

4. Data on all materials and components.

5. Heat calculations.

6. Nameplate schedule with character size and nameplate size.

7. Submittal drawing required:

   a. Elementary/schematic diagrams.
   b. Internal wiring connection diagrams.
   c. External wiring interconnection diagrams including interlocks.
   d. Power and control single line diagrams, where motor controllers are included.

8. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required".

PART 2 – PRODUCTS

2.01 GENERAL

Panels shall comprise cabinet enclosures with power products, control products, and instrumentation products as specified in Divisions 11, 13, 14, 15 and herein.

Provide:

1. Separation between the power components (over 120Vac) and the control / instrument components (120Vac and less) by locating the power components and the control / instrument components in separate sections of the cabinet enclosure.

2. Power cabinet section and the control / instrument cabinet section with separate door handles.

3. Separation between the power components and the control / instrument components using barriers.

4. External lockable circuit breaker handle for the main panel disconnect.

5. Individual power and control components with internal circuit breakers, as required.

6. Motor controllers, as required by the equipment specifications.

7. Displays with door-in-door construction accessible by opening the cabinet outer door.

8. Face-mounted equipment flush or semi-flush with flat-black escutcheons.

9. Panel tops of wall-mounted panels: mounted at the same elevation.

10. Panel inner door contains a copy of the record elementary and wiring diagrams.

11. Panel inner door contains a drawing holder.

12. Panel drawings enclosed in a transparent, protective jacket.

13. Panel functions as specified.

14. Panels with floor stands, to raise the top of the panel to 60 inches above the floor or work platform.

15. Wall mounting of panel weighs less than 100 pounds, where wall space is available,

2.02 ENCLOSURES

A. GENERAL:

Panel enclosures shall comply with the requirements of NEMA 250.

B. MANUFACTURER:

The enclosures shall be made by:

1. Hoffmann Enclosures, Inc.
2. Rittal.
3. or equal.

C. PANEL CLASSIFICATION:

Enclosures and Devices:

1. NEMA Type-12: Installed indoors shall be a modified NEMA 12 with:

    a. Piano hinge doors
    b. Breather drains
    c. Fans and filters
    d. Sealing washers for mounting hardware

2. NEMA Type-4X: Installed outdoors or in corrosive areas shall be a modified NEMA 4X stainless steel or non-metallic as shown with:

    a. Piano hinge doors
    b. Breather drains
    c. Sealing washers for mounting hardware

3. NEMA Type-7: Installed in Hazardous Areas shall be NEMA 7 with devices per NEC Article 500 requirements for the hazardous area classification.

D. SIZE:

The minimum enclosure area, height by width, shall be twice the sum of the area of the individual components mounted on the back panel. The enclosure depth shall depend on the type of components used but shall be no less than 6 inches.

E. COLOR:

Exterior: ANSI 61 grey; NEMA Type 4X stainless steel unpainted with smooth, brushed finish.

Interior: White

2.03 HEATING, VENTILATING AND AIRCONDITIONING

Forced air ventilation shall be provided for where specified or shown.

Fans shall be equipped with UL-approved washable filters and provide at least 240 cubic feet per minute (cfm). Noise level at 3 feet from exterior wall and 30 degrees off axis shall not exceed 60 NC units. Fans shall be thermostatically controlled.

Air-conditioners shall be provided where indicated. Supply voltage shall be as specified or as shown on the Drawings.

Closed loop systems will be used where ambient air is excessively hot, humid, dusty or contains other contaminants. Refrigerant shall be environmentally safe.

Air-conditioner NEMA rating shall match the enclosure rating it is installed in. Air-conditioners shall be equipped with UL-approved washable filters.

Outdoor cabinets shall also be provided with thermostatically controlled space heaters. If space heater surface temperature exceeds 120 degrees F, an expanded metal guard shall be provided.

Thermostat manufacturer and model:

1. Hoffman A-TEMNO
2. Honeywell T631B1013
3. Penn Controls A28AA-4
4. Or equal.

2.04 PANEL WIRING

A. INTERNAL WIRING:

Internal wiring shall be single conductor 90 degree C copper wire and UL listed for panel wiring. Wire size shall be in accordance with NEC. Internal wiring shall be color coded as specified in Section 16000.

B. WIRE MARKERS:

Wire markers shall comply with the requirements specified in Section 16000.

C. WIRING METHODS:

Plastic wireway with covers shall be used to route groups of wires. Wireway fill shall be sized to provide 75% maximum fill. Plastic spiral wrap shall be used for exposed wires. Wires that cross door hinges shall be enclosed in plastic spiral wrap.

D. FAIL-SAFE WIRING

Fail-safe wiring of control relay or other on/off device or instrument provides the condition that will occur upon loss-of-power or internal failure in the device such that the relay is de-energized in the failure or loss-of-power condition such that the control relay contact operation provides for equipment failing in a safe mode.

2.05 ALARM AND TROUBLE DETECTION

The equipment control system shall incorporate a non-energized, open-state, output contact to activate on an alarm or trouble condition or on loss-of-power. Detection of a critical alarm or trouble condition shall cause the control system to initiate the shutdown or the operation of the equipment's controlled components to achieve a "Fail-Safe" condition.

Devices that signal an alarm or a trouble conditions shall latch in the alarm position and require a manual reset at the equipment control panel.

A. Alarm and trouble output shall:

1. Open an output dry-contact.

2. Remain open until manually reset.

3. Not indicate abnormal condition when the equipment shutdown manually or automatically.

4. Indicate the alarm at the equipment control panel.

B. Fail-Safe Design and Operation:

1. Failure of part of a system shall not result in the failure of the rest of the system.

2. Failure of equipment or process shall not propagate beyond the failing device or equipment component.

3. Control design and operation shall prevent improper system functioning due to a circuit malfunction or operator error.

4. Control system design shall cause the controlled equipment to operate in a safe mode in the event of loss-of-power or the failure of a control system

component.

2.06 CONTROL DEVICES

Control devices shall comply with Section 16000.

2.07 INDICATING LIGHTS

Indicating lights shall be equipped with colored lenses as specified in Section 16000.

2.08 SURGE PROTECTION

Surge protectors shall be provided at panel external terminal blocks signal circuits which extend to field devices. Surge protectors shall be Joslyn Model 1663-08, Taylor 1020FA, Transector, or equal.

2.09 TERMINAL BLOCKS

Terminal blocks shall be provided in accordance with Section 16000. The terminal block assembly shall be mounted on channel standoffs. Provide 15 percent, but no less than 8, spare terminals available for future use.

2.10 LABELING AND NAMEPLATES

A. LABELING:

Panel components shall be labeled to match the description on the elementary diagram. Internal components of the panel on the back side of the door shall be labeled with the same description as provided on the front side.

Labeling shall be permanently marked on or near each component. Plastic embossed labels such as "Dymo" tape will not be accepted.

B. NAMEPLATES:

External door-mounted components and the panel description shall be identified with plastic nameplates provided in accordance with Section 16000.

Machine engraved laminated black phenolic nameplates with white lettering shall be provided for panel mounted equipment. Nameplate engraving shall be as specified and shall carry the instrument tag number in 3/32-inch minimum size lettering on the bottom line Nameplates shall be attached to the panel with a minimum of two self-tapping 316 stainless steel screws.

The supplier agrees that nameplate wording may be changed without additional cost or project time extension, if changes are during the submittal process and made prior to commencement of engraving.

Machine embossed metallic adhesive labels shall identify tag number of instruments inside panels. Nameplates shall be attached to panel surfaces, not to instruments.

2.11 GROUNDING

Panels shall be provided with two copper ground bars:

A. One bar bonded to the panel frame and to the station ground system, typically located in the power section.

B. Second (signal) ground bar mounted on insulated stand-offs and bonded to the frame ground bar at one point only, typically located in the control section and bonded to the signal ground bar:
   1. Signal circuits
   2. Signal cable shields
   3. Low-voltage direct current (24Vdc) power supply commons

Surge protectors and separately derived AC power supplies, such as 120Vac receptacles, shall be bonded to the frame ground bar. In panel line-ups exceeding 30-inches width, ground bars shall be 1/4- by 1-inch copper bars extending the entire length of the panel.

Neutrals of locally derived control circuits shall be grounded to the mounting plate using a copper bus or grounding lug.

Provide a grounding lug for a size No. 2 AWG bare copper conductor to connect the panel to the facility ground grid system.

2.12 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Operations and maintenance information as specified in Section 01730.

PART 3 – EXECUTION

3.01 GENERAL

Field verify the following:

1. Panel control circuits grounded with one terminal of each load device connected to the grounded conductor.

2. Panel signal and control wiring separated and installed in separate wireways with barriers between the power wiring and the signal and control wiring.
3. Panel connected to the plant grounding system as specified.
4. Panel tops of wall-mounted panels shall be mounted at the same elevation.
5. Panel inner door contains a copy of the record elementary and wiring diagrams.
6. Panel inner door contains a drawing holder.

7. Panel drawings enclosed in a transparent, protective jacket.
8. Panel functions as specified.
9. Panel mounted with stainless steel unistrut, fittings, and fasteners.

3.02 MOUNTING

Control panels supported directly by concrete or concrete block walls shall be spaced out not less than 5/8 inch by framing channel between instrument and wall. Sills shall be leveled so panel structures will not be distorted. Panels shall be shimmed to precise alignment so doors operate without binding and mounted where shock or vibration will impair its operation.

Support systems shall not be attached to handrails, process piping or mechanical equipment. Control panels supported directly by concrete or concrete block walls shall be spaced out from the wall to provide for air circulation around the panels.

Steel used for support of equipment shall be 316 stainless steel. Support systems including panels shall be designed to prevent deformation greater than 1/8 inch under the attached equipment load and an external load of 200 pounds in any direction.

Floor-mounted cabinets, except in dry control rooms or electrical equipment rooms, shall be mounted on 3-1/2-inch minimum height concrete pads or grouted bases as specified.

Panels shall be shimmed to precise alignment so doors operate without binding. Sealant shall be provided under panels not located in dry control or electrical equipment rooms.

Terminals and terminal blocks shall be sprayed with a silicone resin similar to Dow Corning R-4-3117 conformal coating, after all terminations and testing have been completed.

3.03 FACTORY TESTING

The control panel shall be assembled, interconnected, and functionally tested at the assembly shop prior to shipment.

The Owner/Engineer/Construction Managers shall have the option of witnessing the functional shop test. The Contractor shall notify the Owner/Engineer/Construction Manager at least two weeks in advance prior of the scheduled functional shop test.

3.04 FIELD TESTING

Panels shall be tested in accordance with Section 16030.

END OF SECTION

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SECTION 16262

MANUAL TRANSFER SWITCHES

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies manual-transfer-switches (MTS) rated 600 volts or less for lighting, HVAC, and motor loads with ratings specified on the drawings. Double throw switches will not be acceptable.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid or on the effective date of the Agreement if there were no Bids.

If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
NEMA ICS 6	Enclosures for Industrial Controls and Systems
NEMA ICS 10-1993	AC Transfer Switch Equipment
NEC Article 702	National Electrical Code: Optional Standby Systems
NFPA 70	National Electrical Code
NFPA 110	Standby Power Systems
UL 508	Industrial Control Equipment
UL 1008	Standard for Manual Transfer Switches

Reference	Title
UL 1087	Molded Case Switches

1.03 QUALITY ASSURANCE

A. LISTING, LABELING, AND MANUFACTURING:

The MTS shall conform to Underwriters Laboratory's UL 508 for Industrial Control Equipment and listed or labeled per UL 1008 and 1087. The MTS enclosure shall be per NEMA Standards ICS 6 and ICS 10. The MTS shall conform to NFPA 110 for Emergency and Standby Power System components.

B. TESTS AND CERTIFICATION

The complete MTS shall be factory tested to ensure proper operation of the individual components are in compliance with the specification requirements.

C. SUBMITTALS:

The following submittals shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

   A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

   The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

   Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2 Arrangement drawings of the transfer switch enclosure indicating the front door and rear panel equipment arrangement and dimensions.

3. List of materials and components shall accompany the arrangement drawing.

4. Elementary and internal connection diagrams.

5. Manufacturers' data marked to indicate momentary, interrupting, and continuous current ratings.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

The Owner and Construction Manager believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section.

This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section.

Candidate manufacturers include Emerson (ASCO), Cummins, Caterpillar, GE-Zenith, or equal.

2.02 RATING

The voltage, current, frequency and number of poles shall be as specified and shown.

The MTS shall be rated 600 Vac or less and rated to close onto and withstand a fault of 65,000 symmetrical amperes. The MTS shall be labeled with ratings. Series rating components are not acceptable.
Withstand and Closing Ratings: The MTS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the MTS terminals with the type of overcurrent protection shown on the plans.

Provide the following MTS withstand and closing ratings for circuit breakers systems:

MTS Current Rating	Withstand & Closing Rating MCCB	With Current Limiting Fuses
30 – 200	22,000A	200,000
225 – 400	42,000A	200,000
600 – 1200	65,000A	200,000
1600 – 2000	85,000A	200,000

2600 – 3000	100,000A	200,000

2.03 FACTORY TESTS

The MTS shall be factory tested to ensure proper operation.

2.04 MONITORING (NOT USED)

2.05 TERMINATIONS

Arrange internal equipment items for power cable top entry and top exit.

Provide copper bus, terminations and connections.

Standard switch configuration:

1. Standby power source lugs: Top
2. Power load lugs: Top
3. Normal power source lugs: Bottom

Provide ground bus and connection lugs.

2.06 ENCLOSURE

The enclosure shall be floor or supported from the floor mounted and shall be suitable for locations as indicated on the drawings and as described below:

1. NEMA 1 general purpose enclosure: Surface or flush mounted general purpose enclosures primarily intended for indoor use.

2. NEMA 12 dust-tight enclosures intended for indoor use primarily to provide protection against circulating dust, falling dirt and dripping non-corrosive liquids.

3. NEMA 3R rain-tight enclosures intended for outdoor use primarily to provide protection against rain, sleet and damage from external ice formation.

4. NEMA 4 and NEMA 4X (stainless steel) watertight enclosures intended for indoor or outdoor use primarily to provide protection against windblown dust and rain, splashing rain, hose-directed water, and damage from external ice formation.

The enclosure painted finish shall be per Section 09900, ANSI-61 Gray. Stainless steel enclosures shall not be painted.

2.07 NAMEPLATES

The switch shall be identified as indicated on the drawings and nameplates shall be provided in accordance with the requirements of Section 16000.

2.08 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Operating and maintenance information including product data specified in Section 01730.
2. Final reviewed submittal, record drawings, MTS factory and field test included in the O&M data.

2.09 OPTIONS (NOT USED)

PART 3 – EXECUTION

3.01 FIELD TESTS

The following tests shall be performed on the equipment provided under this section. Tests shall be in accordance with the latest version of UL and NEMA standards.

1. Electrical insulation check to verify the integrity and continuity of the system

2. Visual inspection to ensure that the switch matches the specification requirements and to verify fit and finish meet quality standards

3. Mechanical tests to verify that the switch's power sections are free of mechanical hindrances

The manual transfer switch shall be acceptance field tested in accordance with Section 16030.

END OF SECTION

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SECTION 16431

ARC FLASH ANALYSIS, SHORT CIRCUIT STUDY,
AND PROTECTIVE DEVICE COORDINATION REPORT

PART 1 – GENERAL

1.01 DESCRIPTION

A. GENERAL:

This section specifies that the Contractor subcontract an independent full member NETA Engineering and Study Firm / Testing Firm to prepare:

1. Electrical equipment short circuit study (SCS) for all facility new and existing equipment.

2. Protective device coordination study (PDCS) report for all equipment in the facility electrical distribution power system.

3. Arc flash analysis (AFA) and labeling for all equipment**.**

The Testing Firm shall be as described in Section 16030 and shall also be responsible for the electrical testing described therein.

B. SCOPE:

Report shall also include analysis of the equipment's short circuit ratings, protective device ratings and protective device settings affected by the installed equipment.

Report shall include the results of the arc flash hazard analysis study for energized electrical equipment in accordance with the methods outlined in IEEE Standard 1584 and stated hereinafter.

Work shall include the fabrication of signs with the arc flash hazard study results and the installation of the signs on the equipment in accordance with NFPA 70E Table 3-3.9.3 that includes the personnel protective equipment (PPE) risk category, the energy available, and the clothing recommendation.

Scope of work described above and herein shall utilize standard industry power distribution modeling software ETAP to provide analysis and produce reports. The Engineering and Study Firm shall use the latest version of ETAP power system analysis software.

The plant has an existing Short Circuit, Coordination, and Arc Flash Studies report using ETAP power system analysis software prepared by Carollo, Sarasota, Florida. The scope of work will include updating the existing report and including installing revised Arc Flash Labels at the whole plant. A copy of the existing report will be made available for updating for this project. The bid documents only show new areas of work.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.software

Reference	Title
IEEE 141	Recommended Practice for Electric Power Distribution for Industrial Plants
IEEE 242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
NETA ATS	Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, 1999

1.03 SCHEDULE

The report shall be completed, submitted to the Engineer for acceptance and reworked to include the Engineer comments and corrections, as required. The report shall be approved by the Engineer prior to purchase and fabrication of electrical equipment including switchgear.

A copy of the Construction Manager accepted report shall be sent by the Contractor to all affected manufacturers prior to fabrication.

1.04 SUBMITTALS

The report specified in this Section shall be provided in accordance with Section 01300.

PART 2 – PRODUCTS

2.01 REPORT

The product shall be a certified report summarizing the short circuit and coordination study and conclusions or recommendations which may affect the integrity of the electric power distribution system. As a minimum, the report shall include the following:

1. The equipment manufacturer's information used to prepare the study.

2. Power Utility Company system information applicable to the project.

3. Short circuit calculations listing short circuit levels at each bus. Provide a sketch of the bus and use both the project term and the bus-code-name to identify the bus, branches, sources, loads. Base the system on the Project One-Line diagram.

4. Coordination study time-current curves including the instrument transformer ratios, model numbers of the protective relays, and the relay settings associated with each breaker.

5. Comparison of short circuit duties of each bus to the interrupting capacity of the equipment protecting that bus.

6. Data used as input to the report that includes cable impedances, source impedances, equipment ratings for the equipment being purchased for the project, etc.

7. Assumptions made during the study. Provide three (3) copies of the final ETP model (all ETAP and associated files) of the system as a part of the report on CD/DVD.

PART 3 – EXECUTION

3.01 GENERAL

Provide a short circuit and coordination study on the electrical power distribution system as specified and as described in Section 6.1 of NETA ATS. The studies shall be performed in

accordance with IEEE Standards 141 and 242 and shall utilize the ANSI method of short circuit analysis in accordance with ANSI C37.010.

The studies shall be performed using actual equipment data for both existing and new equipment. The coordination study shall use the data from the same manufacturer of protective relay devices as being provided by the switchgear manufacturer.

For new equipment, the Contractor shall provide copies of final reviewed equipment submittals upon request by the Study Firm.

For existing equipment, the Study Firm shall provide **all** onsite investigation to identify loads and power distribution equipment data.

Any power distribution equipment outages shall be scheduled in advance and coordinated with the Owner to limit process outages as required per plant process capacities, refer to Sections 01015, 01040, and 16000.

3.02 QUALIFICATIONS

The short circuit and coordination report shall be performed by the Testing Firm as described in Section 16030. The studies shall be signed by the professional electrical engineer responsible for the studies and registered to practice engineering in the state in which the project is located.

3.03 SHORT CIRCUIT STUDY

The Contractor shall be responsible to obtain and verify all data needed to perform the study. As a minimum, the short circuit study shall include the following:

A. One-Line Diagram

1. Location and function of each protective device in the system, such as relays, direct-acting trips, fuses, etc.

2. Type designation, current rating, range or adjustment, manufacturer's style and catalog number for all protective devices.

3. Power, voltage ratings, impedance, primary and secondary connections of all transformers.

4. Type, manufacturer, and ratio of all instrument transformers energizing each relay.

5. Nameplate ratings of all motors and generators with their subtransient reactances. Transient reactances of synchronous motors and generators and synchronous reactances of all generators.

6. Sources of short circuit currents such as utility ties, generators, synchronous motors, and induction motors.

7. Significant circuit elements such as transformers, cables, breakers, fuses, reactors, etc.

8. Emergency as well as normal switching conditions, as applicable.

9. The time-current setting of existing adjustable relays and direct-acting trips, as applicable.

B. Impedance Diagram

1. Available MVA, voltage, and impedance from the power utility company.

2. Local generated capacity impedance.

3. Bus impedance.

4. Transformer and/or reactor impedances.

5. Cable impedances.

6. Equipment impedances.

7. System voltages.

8. Grounding scheme for the project: resistance grounding, solid grounding, or no grounding.

C. Calculations

1. Determine the paths and situations where short circuit currents are the greatest.

2. Study shall address bolted faults and calculate the 3-phase and line-to-ground short circuits of each case.

3. Calculate the maximum and minimum fault currents.

3.04 ARC FLASH ANALYSIS

The Contractor shall be responsible to obtain and verify all data needed to perform the study. The arc flash analysis study shall include the following IEEE Standard 1584 nine step analysis process:

1. Collect system and installation data.
2. Determine modes of operation.
3. Determine bolted fault current.
4. Determine arc fault current.
5. Determine protective device characteristic and arc fault duration.
6. Document system voltages and equipment class.

7. Select working distances.
8. Calculate incident energy.
9. Calculate the arc flash protection boundary.

3.05 PROTECTIVE DEVICE COORDINATION STUDY

As a minimum, the coordination study for the power distribution system shall include the following on 5-cycle, log-log graph paper:

1. Time-current for each protective relay or fuse showing graphically that the settings will provide protection and selectivity within industry standards. Each curve shall be identified, and the tap and time dial settings shall be specified.

2. Time-current curves for each device shall be positioned to provide for maximum selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, the Construction Manager shall be notified as to the cause.

3. Time-current curves and points for cable and equipment damage.

4. Circuit interrupting device operating and interrupting times.

5. Indicate maximum fault values on the graph.

6. Sketch of bus and breaker arrangement.

3.06 IMPLEMENTING PDCS SETTINGS AND ARC FLASH SIGN INSTALLATION

The Testing Firm shall implement the protective device coordination study settings on new and existing equipment as required in Section 16030, based on the Engineers accepted Protective Device Coordination Report specified herein and submit a final amended report

of the Record As-Built electrical equipment protective device settings subsequent to start-up and testing.

The Testing Firm shall work with the Contractor and the Study Firm for implementing the Arc Flash Hazard sign installation requirements for electrical equipment as specified in NEC Article 110.16 Flash Protection and NFPA 70E.

END OF SECTION

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SECTION 17000

GENERAL REQUIREMENTS FOR
INSTRUMENTATION AND CONTROL

EPART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE

This section specifies general requirements which are applicable to providing a complete, functional process control system for the NRF Belt Filter Press Rehabilitation. The requirements of this section are applicable to all work specified in Division 17 of these specifications.

Electrical requirements applicable to this work include those specified in Section 16000 for general electrical requirements; and Section 16176 for control panels.

B. DESCRIPTION OF WORK

1. INSTRUMENTATION AND CONTROL SYSTEM: Currently there are (3) individual BFP control panels which utilize relay logic to start and stop the booster pumps, hydraulic pumps, belt drives, washwater solenoid, and sludge feed pumps. The work at NRF consists of replacing the existing Belt Filter Control Panels with new Control Panels, new Catwalk BFP panel, new control panel for the Cake pumps, demo of Belt Press/ Sludge feed pump interface panel, new Dry Polymer System control panel, and new control panel for the Polymer pumps VFDs. The New NR85-VCP-101 and NR85-VCP-102 Panels located in the Electrical Room will have PLCs that will take the place of the existing relay logic and be capable of starting and stopping all of the BFPs (and associated pumps/solenoids/drives), sludge feed pumps, conveyors, polymer feed pumps, and new truck load out valves. NR85-VCP-101 and NR85-VCP-102 shall be located where the existing BFP control panels are and each shall have a maximum width of 54”. At least one BFP shall be fully operational at all times during installation/startup. NR85-VCP-101 and NR85-VCP-102 shall include motor starters and VFDs for the BFP equipment and also motor starters for the conveyors. NR85-VCP-102 shall have reserved space (including space for additional PLC I/O cards) for future fourth BFP. The PLCs shall be Allen Bradley Compactlogix PLC with Ethernet Communication. The Control Panels will not include an HMI since the nearby Scada Panel SP-3 has a Vijeo Citect Scada Client. NR85-VCP-101 shall include a Fiber Ethernet Managed switch. NR85-

VCP-103 shall be located on the catwalk near the Belt Filter Presses and shall include a Vijeo Citect Scada Client. The Plant operator shall be able to view and control the process from the Scada Client. NR85-VCP-103 will not include a PLC. SI shall supply and install (5) new security cameras to provide live monitoring of the BFPs and the Truck Loading Area. The cameras shall be similar to the existing Axis Communications cameras at the SEWRF. With these security cameras, an operator shall be able to view the truck load area and actuate specific truck load out valves (total of eight) from SCADA. These security cameras shall all connect to the NR85-VCP-101 48VDC Power Over Ethernet Network Switch (provided by the SI to the Panel Vendor for installation) in NR85-VCP-101. Vendor shall provide minimum 8"x8" clear space and 48VDC power for the POE switch. SI and Vendor shall coordinate in regard to the POE switch prior to FAT. Fiber and Copper Ethernet connections between equipment located inside the VCP shall be by the Vendor. NR85-VCP-101 and NR85-VCP-102 shall include undercurrent sensing relays for each conveyor motor starter with time delay to alarm if an undercurrent is sensed on the conveyor motor starter. A new polymer pump control panel NR85-LCP-301 shall replace the existing Polymer Pump control panels. NR85-LCP-301 shall include (3) VFDs with Ethernet Communication cards and space for future fourth VFD. The Polymer Pump VFDs shall each have a CAT 6 ethernet connection to a new fiber managed switch installed in NR85-LCP-301. The new cake pump control panel, NR85-VCP-400 shall include separate controllers/ control systems for the new cake pumps. Two new Cake Pump VFDs shall be installed in MCC-5 and MCC-6. The Cake Pump Vendor's programmer, BFP Vendor programmer, SI, and Owner shall coordinate to fully integrate the new cake pumps and new truck load out valves into the conveyance system for a fully functional system. The electrical room has an existing panel labeled "Belt Press/ Sludge Panel Interface Panel". This panel shall be demoed and a new junction box NR85-JBOX-101 (with terminals) shall be installed. Wires from the existing sludge feed pump high pressure switch alarms previously terminated in the Belt Press/ Sludge Panel Interface Panel shall be terminated in the new Jbox terminals. SI shall provide and install two new 65" Smart TVs in the Admin Building operator room (SI and Owner shall coordinate regarding desired location). SI shall provide and install a new fiber optic ethernet switch for connection and new camera workstation in Admin Building operator room. The new fiber optic ethernet switch shall connect to the existing operator room fiber optic patch panel. A new polymer system panel (NR85-VCP-302) shall replace the existing polymer system control panel. The SI and Owner shall coordinate with the Vendor for required signals to SCADA.

The Systems Integrator/Vendors shall field verify and match BFP, Sludge Feed Pump, and Polymer Pump control panels functionality in the new control panels to provide a fully functional system to replace the existing systems. The SI/Vendors shall field verify all I/O prior to doing

submittals and shall provide CAD files. The Contractor shall prepare a construction sequence plan to remove the existing systems and keep systems running as required by the Owner, while the new systems are built.

2. PROGRAMMING: General programming requirements description shall be provided per Section 17995 and 17315. BFP Vendor shall provide programming control strategy documents for the new BFP control panel PLCs. New BFP control panel PLCs shall be programmed by the BFP Control Panel Vendor and shall be coordinated with the Owner for seamless operation with Plant SCADA. New Cake Pumps control panel controllers/plcs shall be programmed by the Cake Pump Control Panel Vendor and shall be coordinated with the Owner and BFP Control Panel Vendor for seamless operation with Plant SCADA. PLC Programming shall include logic to monitor fault status of the respective Control Panel managed network switches and additional managed switch configurations required by the Owner. The existing Vijeo Citect Scada screens and Historian shall be updated by the Owner to include any alarms, equipment status, controls, and tags from the BFPs and ancillary equipment. Owner shall install the SCADA software, load the Owner provided updated SCADA Screens to all new SCADA clients, and update any existing SCADA clients with the updated screens. BFP vendor shall coordinate with owner for the SCADA application for NR85-VCP-103 Plant SCADA HMI. Vendor programmers, SI, and Owner shall all coordinate for fully functional system. Owner shall update the SCADA system with alarms/status from the Polymer System. The SCADA system will pull this information directly from the Polymer System Panel PLC. Owner and Vendor Programmer shall coordinate regarding tagging and alarms/status/controls between SCADA and the Polymer System PLC. SI shall install and configure the camera software on the new Admin Building Camera Workstation for camera image display on the two new 65” TVs.SI shall modify existing SP-3 PLC programming as required for coordination with the new control panels e.g. Messaging to share sludge flows to BFP control panels for sludge feed pump controls. Owner and SI shall coordinate regarding acquiring the existing PLC program.VFD programming within vendor supplied control panels shall be by the Vendor. VFD programming shall match agreed upon configuration between Vendors, SI, and Owner. VFD programming outside of Vendor Supplied Control Panels shall be by the SI. SI, Vendors, and Owner shall coordinate regarding the data exchange between the VFDs and PLCs.

C. DEFINITIONS

1. GENERAL: Definitions of terminology related to Instrumentation and Industrial Electronic Systems used in the specifications shall be as defined in IEEE 100, ISA S51.1, and NEMA ICS 1.

2. TWO-WIRE TRANSMITTER: A transducer which derives operating power supply from the signal transmission circuit and requires no separate power supply connections. A two-wire transmitter produces a 4 to 20 milliampere current regulated signal in a series circuit with a 24 volt direct current driving potential and a maximum circuit resistance of 600 ohms.

3. FOUR-WIRE TRANSMITTER: A transducer which derives operating power from separate power supply connections. A four-wire transmitter produces a 4 to 20 milliampere current regulated signal in a series circuit with a maximum circuit resistance of 600 ohms. Four-wire transmitters typically require 120Vac or 24Vdc input power supply.

4. GALVANIC ISOLATION: Electrical node having no direct current path to another electrical node. Galvanic isolation refers to a device with electrical inputs and/or outputs which are isolated from ground, the device case, the process fluid, and separate power supply terminals. Inputs and/or outputs may be externally grounded without affecting the characteristics of the devices or providing path for circulation of ground currents.

5. PANEL: An instrument support system which may be a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems including consoles, cabinets and racks. Panels provide mechanical protection, electrical isolation, and protection from dust, dirt, moisture, and chemical contaminants which may be present in the atmosphere.

6. DATA SHEETS: Data sheets shall refer to ISA S20 or ISA TR20.00.01.

7. SIGNAL TYPES: Used in systems specified in Division 17:

    a. LOW-LEVEL ANALOG: Signal with full output level of 100 millivolts or less including thermocouples and resistance temperature detectors.

    b. HIGH-LEVEL ANALOG: Signals with full output level greater than 100 millivolts but less than 30 volts, including 4 20 mA transmission.

    c. DIGITAL CODE: Coded information from the output of an analog to digital converter or digital transmission terminal.

    d. PULSE FREQUENCY: Counting pulses emitted from speed or flow transmitters.

e. MODULATED SIGNALS: Signals from modems or low level audio signals. Normal signal level: plus 4 dBm to minus 22 dBm. Frequency range is 300 to 10,000 Hertz.

f. DISCRETE CONTROL OR EVENTS: Dry contact closures and signals monitored by solid state equipment, relays, or control circuits.

g. LOW VOLTAGE DISCRETE CONTROL OR EVENTS: Dry contact closures and signals monitored by solid state equipment, relays, or control circuits operating at less than 30 volts and 250 milliamperes.

h. HIGH-LEVEL AUDIO SIGNALS: Audio signals exceeding plus 4 dBm, including loudspeaker circuits.

i. RADIO FREQUENCY SIGNALS: Continuous wave alternating current signals with fundamental frequency greater than 10 kilohertz.

8. SYSTEMS INTEGRATOR: A firm engaged in the business of detailed control system design and engineering, instrumentation component purchase, system and panel assembly, programming, and implementing the specified process control and industrial automation systems.

1.02 QUALITY ASSURANCE

A. REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).

If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
IEEE 100	Standard Dictionary of Electrical and Electronics Terms
ISA S5.4	Instrument Loop Diagrams
ISA S20	Specification Forms for Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA S51.1	Process Instrumentation Terminology
ISA TR20.00.01	Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations
NEMA ICS 1	General Standards for Industrial Control and Systems

B. SYSTEMS INTEGRATOR RESPONSIBILITY

1. GENERAL

a. The specified control system and instrumentation integration including panel building, instrument calibration, testing, start-up, operational testing, and training shall be performed by a Systems Integrator staffed with qualified personnel, possessing necessary equipment and experience in performing similar installations.

b. The control system components shall, as far as practical, be of one manufacturer.

c. The components, modules, devices, and control system equipment shall be recognized industrial quality products. Recognized commercial or office grade products are prohibited.

d. The overall system performance shall be demonstrated to and accepted by Owner.

e. The application software packages shall be latest versions available, or compatible with existing software currently in use, as specified in Section 17316.

2. SYSTEMS INTEGRATOR QUALIFICATIONS

a. The following Systems Integrators are pre-qualified to perform the work specified in Division 17 without the need to provide Evidence of Experience:

1) BCI, Tampa FL
2) CEC, Bradenton, FL
3) Curry Controls, Lakeland FL
4) Southern Flow, Alpharetta, GA
5) Revere Controls, Birmingham AL

b. Contractor-proposed PCSI shall be evaluated based on submittal of the following Evidence of Experience:

1) Submit evidence of experience in performing three similar successful projects in the last five years with one project currently in progress or competed within the last two years.

2) Submit project descriptions with contact names, addresses, and telephone numbers from the project Owner, General Contractor, and Principal Design Firm.

3) Submit organization chart and resumes for proposed project personnel.

4) Submit Training and Certification information. Completion of the following training courses or appropriate portions thereof or possession of the following certifications included with the Systems Integrator's personnel experience requirements described above:

a) Project manager: Control System Engineer (CSE) registration, Professional Engineer (PE) registration.

b) Systems engineer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration, or completion of the relevant core courses in the Engineering Skills Training program.

c) Programmer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration.

d) Field instrument technician: Certified Control Systems Technician (CCST) registration or

completion of the relevant core courses in the Technical Skills Training program.

e) Certified training programs, as offered by ISA.

5) Submit financial data for Systems Integrator division when subsidiary to a parent corporation. Include two years of financial data.

a) Financial Statement.

b) Balance Sheet.

c) Dun & Bradstreet Report.

3. PRE-SUBMITTAL CONFERENCE

a. Schedule a pre-submittal conference with the Owner and Construction Manager within 30-calendar days after Contract award to discuss the work, equipment, submittal format, and establish the framework for project coordination and communication between Owner, SI, and Vendors.

b. Provide materials 10-days prior to the conference:

1) Instrument Index that lists the devices and instruments specified in Division 17 identify each by tag number, description, function, manufacturer, and model number.

2) Product descriptive literature with a statement that the item is as specified.

3) Proposed equal products with comparative listing of the published specifications for the specified item and the proposed item.

4) Project schedule with deliverables and milestones.

5) Project Control System Block Diagram, when specified.

6) Sample portion of documented PLC and Operator Interface program, when specified.

7) Sample Spec. 16176 and 17110 control panel schematic diagram proposed for this project, when specified. Sample can be a copy from a previous project provided that it represents the format being proposed for this project.

8) Sample analog and discrete loop diagrams proposed for this project, when specified. Sample can be a copy from a previous project provided that it represents the format being proposed for this project.

9) A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each requested deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

c. The pre-submittal conference will not replace the Product and Shop Drawing Submittal review process.

C. PROCESS EQUIPMENT COORDINATION

1. Division 17 specified equipment shall be coordinated for proper operation with equipment related process equipment specified in other Divisions.

2. Equipment shall be integrated, furnished, and installed in conformance with the drawings, specifications, and the recommendations of the equipment manufacturer and the related processes equipment manufacturers.

3. Systems Integrator shall obtain manufacturer's technical information for items of equipment not provided with, but directly connected to, the control system. Provide the necessary coordination and components for correct signal interfaces between specified equipment and the control system.

4. Systems Integrator shall coordinate with project subcontractors and equipment suppliers.

5. Systems Integrator shall provide installation supervision for the duration of the project.

6. Conflicts between the plans, specifications, manufacturer/vendor drawings and installation instructions, etc., shall be presented to the Construction Manager for resolution before proceeding.

D. FACTORY ACCEPTANCE TEST (FAT)

Refer to Section 17030.

1.03 ENVIRONMENTAL CONDITIONS

A. GENERAL

Specified data communication and process control equipment shall suitable for operation in indoor locations and in outdoor locations. Ambient conditions are specified in Section 01800.

B. CORROSIVE LOCATIONS

Corrosive locations shall be as specified in Division 16.

C. HAZARDOUS (CLASSIFIED) AREAS

Hazardous areas shall be as specified in Division 16.

D. SEISMIC

Equipment and supports shall be braced per Section 01900.

1.04 FUNCTIONAL REQUIREMENTS

A. GENERAL

The instrumentation and control system functions are shown on the drawings and specified in subsequent sections of Division 17. The Systems Integrator drawings and integration practices shall be as defined in IEEE 100, ISA S51.1, and NEMA ICS 1. The Systems Integrator shall match the functionality of the existing systems and shall coordinate with the vendors to provide the required process functions for their equipment.

B. SUBMITTAL DRAWINGS

1. GENERAL: The drawings included in the project manual are functional in nature and do not show exact locations of equipment or interconnections between equipment. The Contractor's Systems Integrator shall prepare detailed installation drawings as specified below.

   Drawings prepared in AutoCAD version 2017 with borders and title blocks identifying the project, system, revisions to the drawing, and type of drawing. Each revision of a drawing shall include the date and description of the revisions. Drawing prints shall be 11" x 17" with a minimum lettering size of 1/8".

   Diagrams shall carry a uniform and coordinated set of wire numbers and terminal block numbers in compliance with panel wiring, Section 16176 and Section 17110, to permit cross-referencing between contract documents and the drawings prepared by the Contractor.

2. CONNECTION DIAGRAMS: Show components of a control panel in an arrangement similar to the actual layout of the panel including internal wiring between devices within the panel. Show terminal blocks used for internal wiring or field wiring, identified as such. Indicate insulation color code, signal polarities, and wire numbers and terminal block numbers.

3. INTERCONNECTION DIAGRAMS: Show panels, panel devices, and field devices with wire numbers, cable numbers, raceway numbers, terminal box numbers, terminal block numbers, panel numbers, and field device tag numbers.

4. ELEMENTARY OR SCHEMATIC DIAGRAM: Shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. Provide schematics for internal panel power distribution, lighting, and any panel HVAC.

5. ARRANGEMENT, LAYOUT, OR OUTLINE DRAWINGS: Show the dimensioned external and interior control panel views with components and Bill of Material. Provide panel heat load calculations and indicate cooling or ventilation provisions as required.

6. NETWORK BLOCK DIAGRAM: A network block diagram is a diagram of the overall SCADA system, with annotated boxes to show the primary network components (controllers, hubs, switches, computers, displays), and annotated interconnecting lines that show the system communication media and communication protocols.

1.05 SUBMITTALS

The following information shall be provided in accordance with and Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole.

   If deviations from the specifications are indicated, and therefore requested by the Contractor, each requested deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

   The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

   Failure to include a copy of the marked-up specification sections, along with justification for requested deviations from the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Detailed product literature, showing product specifications and model number breakdown. Mark to denote features and options included. Include only the applicable pages.

3. Manufacturer's installation manual excerpts, as to be used for this project:

   a. Installation details/drawings.
   b. Electrical connection diagrams
   c. Calibration procedures.

4. Drawings and diagrams specified in paragraph 17000-1.04 B.

5. Nameplate list with material, tag number and description as specified herein.

6. Systems Integrator Evidence of Experience per paragraph 17000-1.02B.

7. Data Sheets in accordance with ISA 20 for each instrument. Identical instruments may be submitted with one common ISA Data Sheet and accompanying tag list.

Review the submittal requirements specified in other Division 17 Sections.

PART 2 – PRODUCTS

2.01 GENERAL

A. MATERIALS AND QUALITY

Equipment material shall be new, free from defects, and industrial-grade, as specified. Each type of instrument, instrument accessory, and device used throughout the work shall be manufactured by one firm, where possible.

Electronic equipment shall be of solid-state construction with printed or etched circuit boards of glass epoxy of sufficient thickness to prevent warping.

B. ENCLOSURES

Table A specifies the instrument and control panel enclosure material and minimum NEMA rating for the location and application.

Table A

Location	Enclosure Material and NEMA Rating
Indoor: Architecturally Finished Area	NEMA 12: mild steel
Indoor: Electrical Room	NEMA 12: mild steel
Indoor: Process Areas	NEMA 4X: 316 Stainless Steel
Indoor: Corrosive Area	NEMA 4X: 316 Stainless Steel
Outdoor: Corrosive Area	NEMA 4X: 316 Stainless Steel
Outdoor: Non-Corrosive Areas	NEMA 4X: 316 Stainless Steel
Corrosive Area (Hypochlorite)	NEMA 4X: Non-metallic
Hazardous Area:	NEMA 7: Galvanized Malleable Iron or Aluminum or NEMA 4X and UL listed or FM Approved for the Hazardous Area.
Hazardous and Corrosive Area	NEMA 7: Iron or Aluminum with factory applied corrosion resistant coating or NEMA 4X and UL

	listed or FM Approved for the Hazardous Area.

2.02 NAMEPLATES

Nameplates shall be provided for all field mounted instrument, analyzer, or equipment specified in Division 17. Nameplate lettering shall include the equipment or instrument loop title and the instrument or equipment tag number, where nameplate engraving is not specified or shown. Nameplates shall be machine engraved black phenolic with white 5/32-inch high lettering, as minimum, unless otherwise specified or shown. Nameplate wording may be changed without additional cost or time, if changes are made prior to commencement of engraving.

Nameplates shall be attached to support hardware with a minimum of two self-tapping type 316 stainless steel screws in a readily visible location so the nameplate will remain to identify the service when the device is removed. Field instrument nameplates shall be attached with braided stainless steel straps where not stand mounted.

2.03 PRODUCT DATA

The following Product Data shall be provided in accordance with Section 01300.

1. Record drawings specified by paragraph 17000-1.04 B and the schedules included in Division 17 shall be provided in accordance with Section 01720 in the latest AutoCAD format and PDF format on CD.

   Provide record drawing prints of all drawings following project start-up, but prior to acceptance of the work showing the final constructed state of the instrumentation and control systems.

2. Operating and maintenance information shall be provided in accordance with Section 01730. Include the following in each Operation and Maintenance manual:

   a. Final reviewed Submittals, including revised as-built record drawings.

   b. Manufacturer's operation and maintenance instructions, edited for this project.

   c. Written record of menu configuration, jumpers, switch settings, and other configurable parameters for each instrument.

PART 3--EXECUTION

3.01 INSTALLATION

A. GENERAL

Equipment shall be installed in locations that are accessible for operation and maintenance services. Equipment not accessible shall be reinstalled at no cost to the Owner.

Installation, calibration, settings, and testing procedures are specified in Section 17000, Section 17200 – Instrument Index Part 3 Execution, and subsequent sections of Division 17

B. FIELD EQUIPMENT

Equipment shall be provided with ports and adjustable items accessible for in-place testing and calibration. Install equipment between 48 inches and 60 inches above the floor or permanent work platform. Equipment shall be mounted to avoid shock or vibration that may impair operation. Equipment shall be mounted for unobstructed access and walkways. Equipment support systems shall not be attached to handrails, process piping or mechanical equipment.

Instruments and cabinets supported by concrete walls shall be spaced 5/8 inch by framing channel between instrument or cabinet and wall. Block wall shall have additional installation supports, as required, to avoid damage to the wall. Equipment supports shall be hot-dip galvanized after fabrication or shall be 316L stainless steel, as shown or specified.

Support systems including panels shall be designed in accordance with Section 01900 to prevent deformation greater than 1/8 inch in any direction under the attached equipment load and under an external load of 200 pounds.

In wet or outdoor areas, conduit penetrations into instrument housing shall be made through the bottom (preferred) or side of enclosures to minimize water entry from around or from inside of conduits. Provide conduit hubs for connections and waterproof mastic for moisture sealant.

Nameplates shall be provided for all field mounted equipment. Nameplates shall be attached to support hardware with a minimum of two self-tapping Type 316 stainless steel screws in a readily visible location, but such that if the field device is changed out, the nameplate will remain to identify the service.

C. ELECTRICAL POWER CONNECTIONS

Equipment electric power wiring shall comply with Division 16. Power disconnect switches shall be provided within sight of equipment and labeled to indicate the specific equipment served and the power source location. "Within sight of" is defined as having an unobstructed view from the equipment served and within 50 feet of the equipment served.

Equipment power disconnect switches shall be mounted between 36 inches and 72 inches above the floor or permanent work platform. Where equipment location requirements cannot be met by a single disconnect switch, provide two disconnect switches: one at the equipment and one at the work platform.

Provide a surge arrestor on each 120 volt AC disconnect switch serving equipment located outdoors. Surge arrestor shall be Telematic, LP Series or equal.

D. SIGNAL CONNECTIONS

Equipment electric signal connections shall be made on terminal blocks or by locking plug and receptacle assemblies. Flexible cable, receptacle and plug assemblies shall be used where shown or specified.

Jacketed flexible conduit shall be used between equipment and rigid raceway systems. Flexible cable assemblies may be used where plug and receptacle assemblies are provided, and the installation is not subject to mechanical damage in normal use. The length of flexible conduit or cord assemblies shall not exceed 2 feet except where sufficient length is required to allow withdrawal of instruments for maintenance or calibration without disconnection of conduit or cord assemblies.

3.02 FIELD TESTS AND INSPECTIONS

A. DELIVERY INSPECTION

The Contractor shall notify the Owner's Representative upon arrival of any material or equipment to be incorporated into the work. The Contractor shall remove protective covers or otherwise provide access in order that the Owner's Representative may inspect such items.

B. INSPECTION AND INSTALLED TESTS

Refer to Section 17030 – Process Instrumentation and Control System Testing.

C. CLEANING

1. Execute final cleaning prior to final project assessment.

2. Clean surfaces exposed to view, remove temporary labels, stains, and foreign substances.

3. Replace filters of operating equipment.

4. Remove waste and surplus materials, rubbish, and construction facilities from site.

END OF SECTION

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SECTION 17030

PROCESS INSTRUMENTATION AND CONTROL SYSTEM TESTING

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies Contractor and Systems Integrator performance in testing and documentation of process instrumentation and control system materials and equipment (PICS).

The term instrumentation covers field and panel instruments, analyzers, primary sensing elements, transmitters, power supplies, and monitoring devices.

Provide the labor, tools, material, power, and services necessary to provide the process instrumentation and control system inspection and testing specified herein:

A. Factory Acceptance Testing (FAT)

B. Pre-Operational Performance Testing Sequence:

1. Wiring Testing
2. Network and Bus Cable System Inspection and Testing
3. Piping Testing
4. Installation Inspection
5. Instrumentation Calibration
6. Loop Testing

C. Functional Testing Sequence:

1. Process Control Strategy Testing
2. Control System Closed Loop Commissioning
3. Functional Checkout

D. Operational Testing:

1. System Acceptance Testing (SAT)

1.02 QUALITY ASSURANCE

A. PICS TESTING MANAGER:

Not Required

B. REFERENCES:

This section contains references to the following documents with additional references listed in Section 17000.

All references shall be to the current edition of the document unless specifically stated otherwise. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no bids). If referenced documents have been discontinued by the issuing organization, reference to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ISA RP7.1	Pneumatic Control Circuit Pressure Test
ISA S51.1	Process Instrumentation Terminology

C. PROJECT LABELING

The items specifying project labeling herein shall include the following as a minimum: Owner's name, facility name, project name, and project number.

1.03 SUBMITTALS

Submittal material, to be submitted in accordance with Section 01300, shall consist of the following:

A. QUALIFICATION SUBMITTAL:

Provide the following submittal in accordance with Section 01300-Submittals:

1. Proposed process area and process system breakdowns.

2. Example test forms per paragraph 17030-3.01 D, revised to show Project Labeling per paragraph 17030-1.02 C.

3. Example I/O interface summary per paragraph 17030-2.02 D.

B. NETWORK TESTING QUALIFICATION SUBMITTAL:

1. Qualifications of independent industrial network testing firm and staff performing the inspection and testing.

C. DEFINITION SUBMITTAL:

Provide the following submittal after review of the Qualification Submittal. Separate submittals may be provided for each process area:

1. Control descriptions per paragraph 17030-2.01 A.

2. I/O Interface Summaries per paragraph 17030-2.01 B.

3. Testing status spreadsheets per paragraph 17030-2.01 B.

4. Test procedures per paragraph 17030-3.01 D.

5. Proposed test forms per PART 3 of this Section 17030, detailed for each test for this project.

6. Certified Factory Calibration Reports.

7. Provide a copy of this specification and the referenced and applicable sections with addenda updates included with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

8. Provide a copy of Section 17200 Instrument Index with Addenda updates included, marked to indicate requested deviations from specified requirements.

9. Provide a copy of all referenced and applicable Instrumentation Drawings with addenda updates included, marked to indicate requested deviations from specified requirements.

10. Provide a copy of all referenced and applicable Electrical Drawing's Control Diagrams with addenda updates included, marked to indicate requested deviations from specified requirements.

11. Failure to include a copy of the specifications and drawings with the submittal shall be cause for rejection of the entire submittal with no further consideration.

PART 2 – PRODUCTS

2.01 TESTING DOCUMENTATION

A. CONTROL DESCRIPTION

Provide a control description outlining operation for each process area's system.

B. I/O INTERFACE SUMMARY

Provide I/O spreadsheets for each process area's system. Spreadsheets to include the following for each I/O point:

1. Signal number/tag

2. Annotation description that may be logically abbreviated and that is subject to approval.

3. Complete physical I/O channel designation and addressing or communication I/O register designation.

4. True/False status designations for digital I/O.

5. Process range; engineering units and any multipliers; and raw signal range count for analog I/O.

6. Signals: Fixed point and scaled at the Controller with minimum four significant implied digits of scaling. E.g.: 0 to 1400 at Controller for a pH range of 0 to 14 at Operator Interface.

7. Provide Operator Interface scaling to display decimal digits required.

C. INSTRUMENT INDEX

Provide a detailed Instrument Index. The Instrument Index from Section 17200 may be used as a basis. Provide details on calibration ranges, setpoints, and deadbands.

2.02 PRODUCT DATA

Provide the following product data submittal after completion of testing.

The following information shall be provided in accordance with specification Section 01300:

1. Completed test forms per PART 3. Separate submittals may be provided for each process area.

2. Documentation of network data communication nodes for network type instruments, devices, and variable frequency drives.

PART 3 – EXECUTION

3.01 GENERAL

A. GENERAL REQUIREMENTS:

Materials, equipment, and construction included under this specification shall be inspected in accordance with this section and subsequent sections of this division. Testing shall be performed by the Contractor in accordance with this and subsequent sections of this division.

No required test shall be applied without prior notice to the Construction Manager. Between 60 and 70 days before the commencement of any testing activity, the Contractor shall provide a detailed step-by-step test procedure complete with forms for the recording of test results, testing equipment used, and a place for identification of the individual performing or, if applicable, witnessing the test.

Provide detail assistance to the Contractor in generating form 01660-A, customized for this project. Submit detailed form prior to testing per the requirements of Section 01660.

B. TECHNICIAN QUALIFICATIONS:

Field instruments and analyzers shall be calibrated and set up by a certified instrument technician qualified to calibrate the instrumentation.

Technicians shall be qualified by completion and certification from training courses offered by The Instrumentation, Systems, and Automation Society (ISA), the instrumentation and analyzer manufacturer's training courses, or technician training courses at a recognized trade school that specializes in instrumentation calibration.

C. TEST EQUIPMENT AND MATERIALS:

Provide test equipment to conduct the specified tests that simulate inputs and read outputs with a rated accuracy at the point of measurement at least three times greater than the component under test.

Test instruments shall have a current calibration sticker showing date of calibration, deviation from standard, name of calibration laboratory and technician, and date recalibration is required. Certified calibration reports traceable to the National Institute of Standards and Technology shall be included with the final test report.

Provide a documenting calibration system to conduct process instrumentation calibration activities that consist of a documenting process calibrator and an instrumentation data management software system that captures the calibration results and electronically document instrument data, date of calibration, calibration procedures, and as-found and as-left instrument calibration data.

Calibration files shall be submitted with the final test report in hard copy and electronic formats that does not require specialized equipment or software to read and print the files.

Provide buffer solutions and reference fluids for tests of analytical equipment.

Provide a communications and software package to record final configuration parameters and settings for variable frequency drives with the parameters acquired by connection to the network that record the configuration settings without manual data entry or transcription of values.

Vendor software tools may document the systems where a licensed copy of the identical software including connectors, cables, keys, interface cards and devices required for operation is submitted with the final documentation files.

D. FIELD TEST PROCEDURE DOCUMENTATION:

Test procedures submitted for approval between 60 and 70 days before the commencement of testing activity, complete with forms for the recording of test results, testing equipment used, and a place for identification of the individuals performing and witnessing the test.

Test procedures for each analog and discrete loop in the process control system shall be organized and assembled in separate volumes for each process area. Final test records shall be submitted in electronic form by scanning and converting the records and files to Adobe PDF format, to preserve actual signatures and signoffs.

Test procedure documentation shall include a detailed, step-by-step description of the required test procedure, panel and terminal block numbers for points of measurement, input test values, expected resultant values, test equipment required, process setup requirements, and safety precautions.

Test report forms for each loop, including forms for wiring, piping, and individual component tests, shall be included with the test procedure documentation. The actual test results shall be recorded on these forms and a final test report assembled as specified in paragraph 17030-3.05.

Test report forms shall be preprinted and completed to the extent possible prior to commencing testing. Test report forms that document the field test procedures shall include the following information:

1. Project name

2. Process area associated with the equipment under test.

3. Instrument loop description.

4. Instrument loop identification number.

5. Instrument nameplate data.

6. Instrument setup and configuration parameters.

7. Time and date of test.

8. Inspection checklist and results.

9. Reference to applicable test procedure.

10. Expected and actual test results for each test point in the loop including programmable controller data table or register values.

11. Test equipment used.

12. Space for remarks regarding test procedure or results, unusual or noteworthy observations, etc.

13. Name, date, and signature of testing personnel.

E. PERFORMANCE DEVIATION TOLERANCES:

Tolerances shall be specified in Division 17. Where tolerances are not specified, refer to the manufacturer's published performance specifications.

Overall accuracy requirements for loops consisting of two or more components shall be the root-summation-square (RSS) of the component accuracy specifications. Tolerances for each required calibration point shall be calculated and recorded on the associated test report form.

F. INSTALLED TESTS:

The Contractor’s Quality Assurance Manager shall coordinate, manage, and supervise the quality assurance program that includes:

1. Testing plan with the sequence for the test work.
2. Calibration program for all instruments and analyzers.
3. Documentation program that records tests results.
4. Performance testing program systems.

Test forms provided shall conform to the requirements of reference forms 17000-A through 17000-K included in Section 01999. Additional or detailed forms shall be developed as necessary to suit complex instrumentation. Usage of terms used on test forms shall comply with ISA S51.1.

G. WITNESSING:

The Engineer reserves the right to observe factory and field instrumentation testing and calibration procedures. The Engineer shall be notified prior to testing, as specified herein.

3.02 FACTORY TEST

A. FACTORY ACCEPTANCE TEST (FAT):

1. GENERAL: Control system equipment shall be subject to a Factory Acceptance Test with the factory acceptance tests and subsequent retests witnessed by the Construction Manager and Owner. FAT required for NR85-VCP-101, NR85-VCP-102, and NR85-VCP-103. Control system panel programmable logic controllers shall be loaded with the PLC software, Operator Interface software and the programming and graphic configuration application software at the control system equipment supplier's factory prior to the FAT.

   Equipment, panel instruments, panels, or cabinets shall be inspected with factory testing performed. Provide written notice to the Engineer thirty working days before the commencement of the FAT activity and include:

   a. Schedule for the FAT.

   b. Location of the FAT.

   c. Testing equipment used.

   d. Detailed test procedure with forms for the recording of test results.

   e. Sign-off spaces for the individuals performing and witnessing the tests.

2. FACTORY ACCEPTANCE TEST PROCEDURES: Panels provided shall be interlocked or networked as applicable, operated, and checked-out by the equipment supplier prior to the FAT. Submit certification indicating that the panels are ready for the FAT.

   The FAT shall include the following:

   a. Visual inspection of equipment, instruments, control panels, and graphic displays.

   b. Validation of each input loop and output loop by simulated signals for analog inputs and by shorting discrete inputs.

   c. Validation shall include:

      1) Monitoring state changes on operator interface screens based on the inputs state change.

      2) Observation of online PLC programming application software with the associated PLC outputs state change.

3) Outputs triggered by operator interface software devices (pushbuttons, sliders, manually-entered values, etc.)

4) Calibration and operation of instruments on or in the control panels.

d. Repair of loops which do not pass validation.

e. Retest of the FAT at no additional cost.

Panels that pass the FAT may be shipped to the site upon shipping schedule and storage accommodation approval by the Construction Manager.

3.03 PRE-OPERATIONAL PERFORMANCE TESTING

A. GENERAL REQUIREMENTS:

In general, tests shall be performed in the following order:

B. WIRING TESTS:

Electrical power and signal cable ring-out and resistance testing. Conducted in accordance with Sections 16000 and 16030. Wiring tests shall not be conducted until cables
have been properly terminated, tagged and inspected.

1. Power and Control: Per Section 16030.

2. Signal: Test form 17000-A.

C. NETWORK AND BUS CABLE INSPECTION AND TESTING:

Inspected and tested by independent industrial network testing firms.

Proprietary bus systems may be tested by the manufacturer's qualified field services technician. Manufacturer’s sales personnel are not considered to be qualified technicians unless qualifications are documented and certified by the manufacturer.

Standardized networks and buses may be tested by a qualified independent network testing service. The following types of cabling and networks shall be tested and certified by the independent industrial network testing firm:

1. Ethernet system cabling

2. Other networks provided as a part of a packaged monitoring or control system.

Control and instrumentation bus cabling shall be tested and verified using the standards that apply to the specific cable and bus type as follows:

1. Ethernet Category 6: per TIA/EIA-568B standards

PRE-ACTIVE TESTING: Prior to energizing, cabling shall be inspected and tested to verify the following:

a. Media type and specifications.

b. Physical routing and project specific cable identification tagging.

c. Correct termination installation and connection of conductors to pins at terminations.

d. Record cable run length and compare to the manufacturer or industry standards to verify lengths are within specifications.

e. Locations and values of network termination resistance.

f. Integrity and grounding of cable shields.

g. Values of transient protection (surge) elements.

h. Firmware revision level of network devices available prior to energization.

i. Settings of dip switches and configuration parameters.

ACTIVE SYSTEM TESTING: After the cable or network system has been activated for testing, provide diagnostic monitoring and signal analysis for the bus network system to evaluate network and bus integrity and data transfer quality. The following parameters shall be measured, verified, and recorded:

a. Node addressing.

b. Signal attenuation before and after any repeater device and at the farthest point in the network.

c. Total network trunk voltage and current loading as applicable.

d. Baud rate, message traffic rate, percent bandwidth used, error rate, lost packet count.

e. Firmware revision level of the network devices.

f. Pre-active and active testing shall fall within the specified range of values established by the referenced standards.

g. Correct the functionality of networks and devices connected to the network.

D. PIPING TESTS:

1. Pneumatic Piping Systems: Pneumatic piping systems shall be tested for leaks in compliance with ISA RP7.1, except performed at ten times the normal system operating pressure. Test form 17000-B.

2. Liquid Piping Systems: Tested for leaks in compliance with Section 15050.

E. INSTRUMENT AND COMPONENT INSPECTION:

1. Compare and validate instrument type and nameplate data with the drawings, specifications, and data sheet.

2. Validate instrument identification tag.

3. Confirm instrument installation conforms to drawings, specifications, and manufacturer’s instructions.

4. Verify proper conductor termination and tagging.

5. Visual check for physical damage, dirt accumulation, and corrosion.

6. Verify including isolation amplifiers, surge protection, and safety barriers are properly installed.

7. Report deficiencies identified within 24 hours of discovery. No instrument or system component shall be tested until all deficiencies are addressed.

F. INSTRUMENTATION CALIBRATION:

1. Instruments and final elements shall be field calibrated in accordance with the manufacturer's recommended procedures and tested in accordance with the Contractor's test procedure.

2. Individual Component Calibration and Testing shall not commence until Instruments and Component Inspections are completed and documented to the satisfaction of the Engineer.

3. Analog instrument calibrated at 0, 10, 50, 90, and 100 percent of the specified full-scale range. Each signal sensing trip and process sensing switch shall be adjusted to the required setting. Test data recorded on test forms as specified herein

4. Final element alignment tested and adjusted to verify that each final element operates smoothly over the full range in response to the specified process control signals

5. Test data shall be entered on the applicable test forms at the time of testing: Alarm trips, control trips, and switches shall be set to initial values specified in Section 17200 Instrument Index at this time. Final elements shall be checked for range, dead-band, and speed of response.

6. Any component that fails to meet the required tolerances shall be repaired or replaced by the manufacturer. Repeat the specified tests until the component is within tolerance.

7. Install a calibration sticker on each instrument following successful calibration that indicates the date of calibration, the name of the testing company, and personnel who calibrated the instrument.

8. Test forms 17000-C through 17000-I.

9. CERTIFIED TEST REPORTS: Field test and inspection activities include verification of instrument parameter setup, verification of instrument zero, and performance at three operating points within the instrument range. Instrument which fail to demonstrate proper performance shall be returned for re-calibration or replaced as agreed depending on the impact to the project as determined by the Construction Manager.

Where instrument field calibration is not feasible, certified factory calibration reports may be submitted that includes the name and address of the laboratory that conducts the calibration testing. Certified factory test reports may be submitted for the following instrument types in lieu of field calibration:

F. LOOP TESTING:

1. Loop Testing shall not commence until the Individual Component Calibration and Testing has been completed and documented to the satisfaction of the Engineer.

2. Each instrument loop shall be tested as an integrated system. Check operation from field instruments to transmitter to receiving components to the vendor panel or the Plant Control System Operator Interface Station. Test signals shall be injected at the process impulse line connection where the measuring technique permits, and otherwise at the most primary signal access point.

3. Testing of loops with an interface to a programmable logic controller shall include verification of the programmable logic controller input/output assignment and verification of operation of the input/output system and processor. Inspect the data table or register in the programmable logic controller memory to verify proper operation.

4. If the output control or monitoring device fails to indicate properly, corrections to the loop circuitry or device shall be made. The test shall be repeated until devices and instruments operate as required.

5. Correct loop circuitry and repeat the test until the instruments operate properly.

3.04 FUNCTIONAL TESTING

A. PROCESS CONTROL STRATEGY/FUNCTIONAL TESTING:

1. Control Strategy Testing shall not commence until the Loop Testing has been completed and documented to the satisfaction of the Engineer.

2. Control Strategy Testing is performed by the Programmer and consist of installing and debugging the PLC control logic program, verifying the interface points between the PLCs and field devices and equipment, and exercising the control strategies. Control Strategy Testing will be performed on one PLC at a time.

3. Provide qualified personnel to immediately correct any deficiencies in the Work that may be encountered during Control Strategy Testing. Failure of the Contractor to provide such personnel in a timely manner may prolong the time allotted to complete Control Strategy Testing.

B. CONTROL SYSTEM CLOSED LOOP TESTING:

1. Closed-Loop Commissioning shall not commence until the Control Strategy Testing has been successfully completed and documented to the satisfaction of the Engineer

2. Closed-loop commissioning tests, performed as part of the system tests, shall demonstrate stable operation of each loop under operating conditions. Tests shall include adjustment of loop tuning parameters.

3. Tuning parameters: gain (or proportional band), integral time constant, and derivative time constant for each control loop, adjusted to provide 1/4-amplitude damping, unless otherwise specified.

4. The loop response to a step disturbance shall be provided for each loop. Two graphs shall be made for cascaded control loops, one showing the secondary loop response with its set point in manual, and the second showing overall loop response.

5. Control loops with "batch" features shall be adjusted to provide optimum response following start-up from an integral action saturation condition.

6. Graph recording shall be provided showing the response and made at sufficient speed and amplitude to show 1/4 amplitude damping. Label to show loop number and title, and settings of parameters and set point.

7. Where a loop is controlled under the direction of a programmable logic controller, the Engineer will perform the necessary adjustment of loop tuning parameters and setpoints; Contractor shall record the loop response, adjusting final elements, and assuring total integrated loop performance as specified.

C. FUNCTIONAL CHECKOUT:

Conducted to verify the operation of discrete and hardwired control devices. Exercise the operable devices and energizing the control circuit. Operate control element, alarm device, and interlocks to verify the specified action occurs.

3.05 OPERATIONAL TESTING

System Acceptance Test (SAT) shall be performed after component and subsystem tests have been completed. The test of the completed system shall be performed in full operation and shall demonstrate that all functional requirements of this specification have been met. SAT shall demonstrate the following:

1. Each component of the system operates correctly with all other components of the system.

2. Analog control loops operate in a stable manner.

3. Hard-wired and software equipment interlocks perform correctly.

4. Process control sequences perform correctly.

5. PLC application program performs monitoring and control functions correctly.

6. Operator interface graphics represent the monitoring and control functions correctly.

END OF SECTION

SECTION 17110

INSTRUMENT AND CONTROL PANELS

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies requirements for panels, cabinets, and consoles for instrument, and control equipment for the NRF Belt Filter Press Improvements Project per the Panel Schedule herein.

Provide the instrument, control, and monitoring features indicated on the P&ID and electrical drawings. Panels shall be arranged to separate control and instrument devices from power wiring. Panel shall be arranged for dedicated field wiring terminations rated for 600 Vac or less for power, control, and instrument signal wiring shall be fabricated by a UL-508A recognized facility and shall bear the appropriate UL 508A Industrial Control Panel label. Panels for Hazardous (Classified) Locations shall bear the appropriate UL 698A label.

Transmitters, Analyzers, signal conditioning modules and other equipment or devices as specified in the other Division 17 sections.

Panels that contain programmable logic controllers (PLC) and operator interface terminal (OIT) units shall be as indicated in the Panel Schedule. Specific panel devices are specified herein and in Section 16000.

PLC and OIT shall comply with the specified products in Division 17. Panels that do not comply with the specified products and specified logic method, hardwired or PLC logic, shall not be accepted. Cost to retrofit the panel as specified shall be borne by the panel supplier. Corrections or modifications to UL 508A Industrial Control Panels shall be transported to the panel supplier's facility for corrections, testing, relabeling and inspection.

Field modifications require a UL inspector site inspection for approval of panel corrections and to re-label the panel after the field modifications are completed.

Refer to Section 16000 for requirements for VFDs, motor controllers, and motor starters located inside of Control Panels as shown on the electrical drawings and P&IDs.

B. PANEL SCHEDULE:

	Panel No.	Spec / P&ID	Features *	Enclosure Type	Panel Title	Notes
1	NR85-VCP-101	17110 / I-10-601, 602 & 605	1, 4, 5, V	NEMA-12	SP-13 (NR85-VCP-101)/BFP 1&3 Control Panel	Dewatering Bldg Elec Room; 65KA SCCR
2	NR85-VCP-102	17110 / I-10-603, 604 & 606	1, 4, V	NEMA-12	SP-14 (NR85-VCP-102)/BFP 2&4 Control Panel	Dewatering Bldg Elec Room; 65KA SCCR
3	NR85-VCP-103	17110 / I-10-602	6, V	NEMA-4X	NR85-VCP-103/Local BFP Control Panel	Dewatering Bldg BFP Catwalk
4	NR85-LCP-301	17110 / I-10-602/ I-10-604	3	NEMA-4X	NR85-LCP-301/Polymer VFDs Control Panel	Dewatering Bldg Polymer Room; 65KA SCCR
5	NR85-VCP-302	17110 / I-10-604	1, 2, 4, V	NEMA-4X	NR85-VCP-302/ Polymer System Control Panel	Dewatering Bldg Polymer Room; 65KA SCCR
6	NR85-VCP-400	17110/ I-10-602/ I-10-604	1, 2, 4, V	NEMA-4X	NR85-VCP-400/Cake Pumps Control Panel	Dewatering Bldg Conveyance Area

*FEATURES Legend
V* - Vendor/ Manufacturer Panel per equipment specification requirements

1* - Programmable Logic Controller (PLC) or Remote I/O devices
2* - Panel mounted Operator Interface Terminal (OIT)
3* - Hardwired control logic required
4* - Laptop Shelf
5* - 48VDC Power Supply (200-watt minimum) for POE switch.
6* - Plant SCADA

C. PANEL DESIGN:

1. GENERAL: Panel hardware and software is specified in other Division 17 sections.

2. CONTROL POWER DISTRIBUTION: Panel containing 120-volt powered equipment shall use the din-rail power distribution method with fuses and blown fuse indication. Power is restricted to 120 Vac and 24 Vdc.

3. POWER SUPPLIES: Panel containing direct current powered instruments or serving as the termination point for transmission loop powered field instruments shall contain direct current power supply system as specified herein.

4. AIR SUPPLIES: Not Used.

5. ELECTRICAL CONTROL DEVICES: Pushbuttons, indicating lights, relays, and similar equipment located in panels specified in this section shall comply with the requirements of Section 16175.

6. UNINTERRUPTIBLE POWER SUPPLIES: Panel mounted 120 Vac input and 120 Vac output are specified herein. Each PLC shall include a UPS in the respective Control Panel.

1.02 QUALITY ASSURANCE

A. REFERENCES

This section contains references to the following documents that are part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid or on the effective date of the Agreement if there were no Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
EIA RS-310C	Racks, Panels, and Associated Equipment
NEMA 250	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 508A	Industrial Control Panels
UL 698A	Industrial Control Panels Relating to Hazardous (Classified) Locations

This Section references other sections with associated work specified therein:

1. Section 01660 specifies Equipment and System Performance and Operational Testing with reference to Contractor's Quality Assurance Manager that is responsible for startup commissioning of system including mechanical, HVAC, electrical, and instrumentation system.

2. Section 16000 specifies raceways, conductors, and device requirements.

3. Section 17030 Instrumentation and Control System Testing

4. Section 17310 Programmable Logic Controller, Operator Interface Stations, and software requirements.

B. LISTED PRODUCTS:

Equipment and components shall be Underwriters Laboratory (UL) listed for the purpose per Section 16000 or UL recognized.

C. FACTORY TESTING:

Prior to shipment, the manufacturer shall test the functional operation of the control panel as described in the control description Section 17030.

D. SHIPMENT, PROTECTION AND STORAGE:

Equipment shipment, protection and storage shall conform to the requirements specified in Section 01605.

E. WARRANTY:

As specified in the General Conditions.

1.03 SUBMITTALS

A. GENERAL:

Submittals and transmittal procedures for submittals are defined in Section 01300. Submit In accordance with the procedures set forth in Sections 00710 and 01300 that include drawings, information and technical data for equipment and as required in Section 17000. Submittal information shall be included in one complete submittal.

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

   A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

   The Owners Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

   Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. A marked copy of specification section 17000.

3. A marked copy of specification section 17030.

4. A marked copy of specification section 16176.

5. A copy of the contract document Process and Instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required".

Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

6. Marked contract document Control Schematic diagrams related to the submitted equipment.

7. Marked contract document Control Single Line diagrams related to the submitted equipment.

8. Marked product literature of all the enclosure electrical devices and components mounted on or within the control panel.

9. List of miscellaneous items, cables, spare and replenishment parts, and chemicals to be provided, including MSDS information.

10. Dimensioned drawings:

    a. Exterior panel and layout
    b. Interior devices and layout
    c. Door-in-door construction devices, where required

11. Panel assembly drawings including sections showing clearances between face and rear mounted equipment.

12. Nameplate engraving schedule:

    a. Indicate engraving by line
    b. Character size
    c. Nameplate size
    d. Panel and equipment tag number and description

13. Heat load calculations for each cabinet based on the highest ambient temperature listed in Section 17000 for the area in which the subject panel will be located.

14. Wiring drawings:

    a. Schematic diagrams
    b. Internal wiring diagrams
    c. Connection diagrams

1.04 ENVIRONMENTAL CONDITIONS

Refer to Section 17000.

PART 2 – PRODUCTS

2.01 FABRICATION

A. GENERAL:

Panels shall be designed for the seismic requirements of Section 17000. Structures, equipment, and devices shall be braced to prevent damage from specified forces. Equipment panels shall be capable of operation following a disturbance.

Nameplates with tag number and equipment description shall identify face-mounted instruments. Instruments shall be mounted for access to components and ease of removal. Cutouts for future equipment shall be blanked off with suitable covers. Instrument tag numbers shall be identified on the panel rear.

Face-mounted equipment shall be flush or semi-flush with flat-black escutcheons. Face-mounted instruments that are more than 6 inches deep, weigh more than 10 pounds, or exert more than a 4 ft-lb moment force on the face of the panel shall be supported underneath at the rear by a 1-inch x 1/8-inch thick steel angle.

Panels less than 60 inches high shall be provided with floor stands to raise the top of the panel to 60 inches above the floor or work platform. Panels that weigh less than 100 pounds may be wall mounted.

Panels with specified requirements including stainless steel or aluminum mounting requirements that are indicated on the project drawings or on the project details take precedence over the panel types or panel features indicated herein.

B. PANEL LAYOUT:

1. Provide minimum of 20 percent spare terminal blocks, with a minimum of 10 analog, discrete, power.
2. Separation between the power components (over 120Vac) and the control / instrument components (120Vac and less) by locating the power components and the control / instrument components in separate sections of the cabinet enclosure.
3. Separation between the power components and the control / instrument components using barriers.
4. External lockable circuit breaker handle for the main panel disconnect for 3-phase panels.
5. Individual power and control components with internal circuit breakers, as required.
6. Motor controllers, as required by the equipment specifications.
7. Face-mounted equipment flush or semi-flush with flat-black escutcheons.

8. Panel tops of wall-mounted panels: mounted at the same elevation.
9. Panel inner door contains a copy of the record elementary and wiring diagrams, or reference as allowed per NEC Article 409.
10. Panel inner door contains a drawing holder.
11. Panel drawings enclosed in a transparent, protective jacket.
12. Panel functions as specified.
13. Panels with floor stands, to raise the top of the panel to 60 inches above the floor or work platform.
14. Wall mounting of panel weighs less than 100 pounds, where wall space is available.

C. ENCLOSURES:

1. Panel enclosures shall comply with the requirements of NEC Article 409 and NEMA 250.
2. Manufacturer:
   a. Hoffmann Enclosures, Inc.
   b. Rittal
   c. or equal.

2.02 HEATING, VENTILATING AND COOLING

Forced air ventilation shall be provided for panels where indicated in the Panel Schedule and if the cabinet's heat load calculations indicate that the interior temperature of the cabinet will exceed 115 degrees-F, under worst case conditions.

Ventilation for panel racks shall be venturi fans provided on 5-1/2-inch high-notched panel. Ventilation for consoles shall be similar to that for panel racks except EIA RS-310 mounting is not required. Fans shall be equipped with UL-approved washable filters and provide at least 240 cubic feet per minute (CFM). Fans shall be thermostatically controlled. Noise level at 3 feet from exterior wall and 30 degrees off axis shall not exceed 60 NC units.

Outdoor panels shall also be provided with thermostatically controlled space heaters. Space heater surface temperature that exceeds 120 degrees F requires an expanded metal guard. Thermostats shall be Honeywell T631B1013, Penn Controls A28AA-4, or equal.

Panel air conditioning cooling requirements shall be a cooling system that does not exchange cabinet interior air with ambient air. The cooling system shall be either a closed glycol loop heat exchange system or a CFC-free refrigeration system as required for the specified equipment and instrument complement and ambient temperature conditions.

Panel air conditioner shall be NEMA rated based on the installed area environment and the coils shall be Heresite, or equal coated and protected from corrosion.

2.03 PROTECTION COATING AND FINISH

Panels located outdoors or located in corrosive areas shall be bottom coated with waterproof coatings.

2.04 NAMEPLATES

External door-mounted components and the panel description shall be identified with plastic nameplates. Machine embossed metallic adhesive labels shall identify tag number of instruments inside panels. Nameplates shall be attached to panel surfaces, not to instruments.

The machine engraved laminated black phenolic nameplates with white lettering shall be provided for panel-mounted equipment. Nameplate engraving shall include the instrument tag number and description in 3/32-inch minimum size lettering.

The machine embossed metallic adhesive labels shall identify tag number of instruments inside panels. Nameplates shall be attached to panel surfaces, not to instruments.

The nameplates shall be attached to the panel with a minimum of two self-tapping 316 stainless steel screws. Provide RTV sealant for nameplates for NEMA-4X stainless steel panels.

The nameplate wording may be changed without additional cost or time prior to commencement of engraving. Submit nameplate legend with the panel submittal.

2.05 PANEL FEATURES

A. INTERCONNECTION WIRING:

Panel Interconnecting Wiring:

1. Panel control wiring: Single conductor stranded copper NFPA No. 70 Type MTW.

2. Panel instrument wiring: Twisted No. 16 AWG shielded pair or tri conductors.

3. Panel power wiring: Conductors specified in Division 16 and meet the NFPA No. 70 NEC requirements for power including phase, grounded, and grounding conductors.

4. Wiring shall be supported independently of terminations by lacing to panel support structure or by slotted flame-retardant plastic wiring channels.

5. Wiring channels shall comply with UL 94, Type V.

6. Wiring channel fill shall not exceed 50 percent.

7. Plastic spiral wrap shall be used for exposed wires. Wires that cross door hinges shall be enclosed in plastic spiral wrap.

B. CONDUCTOR IDENTIFICATION:

Wiring shall be tagged at terminations with machine printed plastic sleeves with three-part wire numbers for instrument and control panel internal conductors:

1. Part-1: Prefix of the wire number shall be the instrument loop number or equipment tag number.

2. Part-2: Code letter and wire colors per the following tables.

3. Part-3: Number that identifies individual circuit conductor Rung Number.

Code	120 Vac Conductor	Color
L	Power	Black
C	Control	Red
N	Neutral	White
PG	Ground	Green

Code	V dc Conductor	Color
PS	24 Vdc Power	Blue
PS	12 Vdc Power	Violet
S+	Signal (+)	Black
SG	Signal Ground	White
EG	Equipment Ground	Green
FV	Panel Foreign Voltage	Yellow

C. CONDUCTOR INSTALLATION AND PROTECTION:

1. Power and control wiring shall be carried in covered channels separate from low voltage signal circuits. An interior steel barrier shall be provided between AC control devices and the electronic equipment.

2. Terminal blocks shall be strap screw type rated for 600 volts. Each terminal trip shall have a unique identifying alphanumeric code at one end and a vinyl-marking strip running the entire length of the terminal strip with a unique number for each terminal. Numbers shall be machine printed and 1/8 inch high.

3. No more than two connections shall be made to one terminal.

4. Wire connectors shall be locking fork tongue or ring tongue insulated crimp type terminals.

5. Terminal blocks shall be;

   a. Buchanan 0621-1
   b. Allen-Bradley 1492-HM1 600 V 30-amperes, finger-safe terminal block.
   c. Allen-Bradley 1492-CD3 600 V 35-amperes with #8 screw terminal block for ring or spade terminals.
   d. Phoenix Contact or Weidmuller equal products.

D. FIELD WIRING:

Field wiring shall be connected to separate dedicated terminal blocks in a dedicated part of the panel where the field cables enter the panel.

E. FUSE AND FUSE HOLDERS:

1. Fuses for 120 Vac circuits shall have a minimum of 12,000-amperes interrupting capacity and blown fuse indicators.

2. Fuses for 24 Vdc circuits shall be fast acting glass tube type rated 1/8 or 1/10 amp for 4-20 mA loops.

3. Fuses for 24 Vdc circuits shall be 1/2 amp for the power supply to individual instruments.

4. Fuse holders shall be tip-out or draw-out type.

5. Provide Phoenix Contact or equal products.

F. CONTROL POWER:

120 Vac control power source: Single power source for all control and DC power. Dual power sources, one for PLC and DC power and one for PLC output and input control power.

1. Provide control power transformers, as required for the load.

2. Provide direct current power supplies, as required for the load.

3. Provide UPS for PLC and derived loop power as defined above, as required for the load.

G. PANEL POWER:

Panel power source:

1. Provide a 120 Vac circuit for the panel light, receptacle, heating, fan, heat exchanger, or air conditioner cooling load as required.

2. Provide a 120 Vac circuit for air conditioning load as required.

H. ACCESSORIES:

1. Panels greater than 24" high x 24" wide shall include GFCI convenience receptacles and fluorescent utility lights.

2. Receptacles and utility lights shall not be powered by the UPS, where included.

3. Print pocket.

4. Fold-up shelf of sufficient size, sufficient weight capacity, and the proper angle for supporting a laptop computer.

I. Fail-Safe Wiring:

Fail-safe wiring of control relay or other on/off device or instrument provides the condition that will occur upon loss-of-power or internal failure in the device such that the relay is de-energized in the failure or loss-of-power condition such that the control relay contact operation provides for equipment failing in a safe mode.

2.06 ALARM AND TROUBLE DETECTION

A. The equipment control system shall incorporate a non-energized, open-state, output contact to activate on an alarm or trouble condition or on loss-of-power. Detection of a critical alarm or trouble condition shall cause the control system to initiate the shutdown or the operation of the equipment's-controlled components to achieve a "Fail-Safe" condition.

B. Devices that signal an alarm or a trouble conditions shall latch in the alarm position and require a manual reset at the equipment control panel.

C. Alarm and trouble output shall:

1. Open an output dry-contact.
2. Remain open until manually reset.
3. Not indicate abnormal condition when the equipment shutdown manually or automatically.
4. Indicate the alarm at the equipment control panel.

D. Fail-Safe Design and Operation:

1. Failure of part of a system shall not result in the failure of the rest of the system.
2. Failure of equipment or process shall not propagate beyond the failing device or equipment component.
3. Control design and operation shall prevent improper system functioning due to a circuit malfunction or operator error.
4. Control system design shall cause the controlled equipment to operate in a safe mode in the event of loss-of-power or the failure of a control system component.

2.07 SURGE PROTECTION

A. Surge protectors shall be multi-stage, plug-in type selected to protect the equipment. Surge protectors shall be removable without changing the impedance of the circuit. Surge protector's product manufactures shall be:

1. Circuit Components Inc: Din Rail SDD-400 Series for Data or Analog Signals.

2. Joslyn Model 1663-08

3. Taylor 1020FA

4. Phoenix Contact

5. Telematic

6. Edco

7. Or equal.

B. Provide Type 1 surge protective devices, per NEC Article 285, at the power feed to the panel. Surge Protective Devices (SPD) shall be designed to provide transient voltage protection for a service entrance panelboard. SPD units shall comply with UL 1449 3rd Edition and shall be listed for such use. SPD units shall be rated for the voltage and phase service of the panel at 120 kA per phase. SPD units shall have a built-in diagnostic package with flashing trouble indicator, a display for the status of each phase, and a counter and display to indicate the number of surges that have caused the device to operate.

1. SPD units shall be Eaton Clipper Power System, Visor Series, Circuit Components Inc, SPD-Series or approved Equal.

C. Surge arrestors and capacitors shall be provided on the primary winding of isolation transformers supplying power to solid state systems. Surge protectors shall be mounted in a separate, NEMA 1 enclosure adjacent to the transformer and the incoming line passed through this enclosure. Surge arrestors shall be General Electric 9L15EC or equal. Surge capacitors shall be General Electric 9L18B, or equal.

2.08 PANEL GROUNDING

A. Each panel shall be provided with two copper ground bars.

1. One bar (NEC required) shall be bonded to the panel or panel frame or back-plate and to the facility grounding system.

2. Second (signal) ground bar shall be mounted on insulated stand-offs and shall be bonded to the panel ground bar only at one point.

B. Signal circuits, signal cable shields, and low-voltage DC power supply commons shall be bonded to the signal ground bar.

C. Field analog wiring shields shall only be grounded at the signal ground bar. Test to verify that single ground point at panel signal ground bar.

D. Surge protectors and separately derived AC power supplies shall be bonded to the frame ground bar.

E. Panels exceeding 36-inches width shall contain ground bars shall be 1/4- by 1-inch copper bars extending the entire length of the panel interior at the bottom of the panel.

2.09 PANEL DRAWING PROTECTION

Provide wiring diagrams in accordance with Section 01300. Provide a panel-wiring diagram and schematic for each panel in a plastic bag or plastic container to avoid water damage and aging.

2.10 DIRECT-CURRENT POWER SUPPLIES

Nominal 24-volt direct-current instrumentation and control power supply:

1. Convection-cooled linear type or switching type.
2. Line regulation: 0.4 percent for line variations from 105 to 132 volts
3. Load regulation: 0.4 percent for load variations from 0 to full load.
4. Ripple and noise: Not exceed 100 mV peak-to-peak.
5. Hold-up time at maximum load: Not less than 16 milliseconds.
6. Continuous duty from 0 to 50 degrees C at rated load.
7. Output electronically current limited.
8. Over-voltage crowbar shutdown.
9. Output voltage:
   a. Rated 28 Vdc
   b. Adjustable plus or minus 5 percent
   c. Set to provide 26.4 volts to the panel direct current bus.
10. Power Supply: TDK-Lambda LZSA series, or equal.
11. Provide dry contact for failure alarm. Dry contact to be wired to input in nearest PLC

2.11 UNINTERRUPTIBLE POWER SYSTEM (UPS)

The UPS shall be on-line, computer-grade with electrical isolation including output neutral. UPS shall be packaged for panel enclosure mounting using a back-panel bracket or holder:

1. Nominal input voltage: 120Vac.
2. Nominal output voltage: 120Vac.

The online UPS system shall be provided with integral sealed no maintenance batteries, sized to provide full capacity backup power for 10 minutes minimum at connected load with integral battery charger.

The panel supplier shall calculate the required kVA rating at 150 percent of connected load. Submit load calculations, schematic diagrams, and wiring connection diagrams. Provide battery cabling and other required cabling for a complete system.

The UPS shall be mounted within the panel on a pedestal or tray with stainless-steel legs to provide space for wire entry and passage.

The UPS shall be configured with a maintenance bypass switch to allow ease of removal from the panel; to allow the panel to operate on utility power.

Uninterruptible power supply systems shall be as manufactured by Best Power Technology, Inc., Necedah, American Power Conversion, Wisconsin, or equal.

2.12 UNDERCURENT SENSING RELAY

Undercurrent sensing relays shall be provided and installed inside the BFP Control Panels for each of the Conveyor Motor Starters. Undercurrent sensing relay shall meet the following requirements:

1. Adjustable current switch.
2. Power induced from monitored conductor.
3. Temperature range 5° to 140° F.
4. UL Listed
5. Status LEDs for local indication.
6. Low setpoint, minimum trip as low as .5Amps
7. Max Status Output N.O. 1Amp @ 30VAC/DC
8. Veris H608 Series, or equal.

2.13 FIBEROPTIC MANAGED SWITCH

1. Industrial Managed switch support layer 2 switching and layer 3 routing
2. Gigabit Ethernet, 1 spare copper port minimum. Fiber ports to match existing plant fiber.
3. Temperature range -40° to 140° F.
4. UL Listed
5. Studio 5000 Add-on Profiles
6. Predefined Logix Tags for monitoring and port control.
7. Rockwell Automation Stratix 5400, 5700, or equal.

2.14 SPARE PARTS

The following spare parts shall be provided:

1. Ten each of each type of light bulb used in the panels.
2. Five each of each type and rating of fuse used in the panels.
3. Five each of each type primary protector surge suppressor used in the specified panels.
4. Two each of each type of surge protective device used in the specified panels.

2.15 PRODUCT DATA

The following data shall be provided in accordance with Section 01300:

1. Manufacturer's operation and maintenance information as specified in Section 01730. Manual shall include final reviewed submittal and separate record of all final configuration, jumper, and switch settings.

2. Test results as specified in Section 17030-Part 2.

3. Manufacturer's certification for the performance of features of the specified equipment that cannot be readily inspected.

4. Special requirements for delivery of the information such as time, manner, place, or quantity.

5. Installation and training forms specified in Part 3.

PART 3 – EXECUTION

3.01 GENERAL

Floor mounted cabinets shall be mounted and shimmed to precise alignment, so doors operate without binding. Sealant shall be provided for conduit entering the panels.

Floor-mounted panels except in dry control rooms or electrical equipment rooms shall be mounted on 3-1/2-inch minimum height concrete pads or grouted bases as specified. Coating shall be provided for outdoor panels in contact on concrete. Field panels and cabinets shall be mounted in compliance with paragraph 17000-3.01 B.

Terminals and terminal blocks shall be sprayed after all terminations have been completed with a silicone resin similar to Dow Corning R-4-3117 conformal coating.

Provide panels with the Record As-built schematic, connection, and interconnection diagrams mounted behind plexiglass holder on the inside of the door. Place documentation in a waterproof clear bag in the panel document holder.

Verify that all panels have been labeled with Arc Flash warning labels per NEC 110.16. Provide labels, with Arc Flash protection boundary and PPE levels.

Panel Mounted network switches shall be configured by the Vendor. New network switch in Admin Building Operations Room shall be configured by the SI. Vendor, SI, and Owner shall coordinate regarding network settings and other configuration requirements.

3.02 OUTDOOR PANEL SHADE COVERS: Not Used

3.03 PANEL POWER SUPPLY

Power supply and conditioning equipment shall be mounted and connected in compliance with the manufacturer's instructions.

Line side disconnect switches shall be provided for power supply and conditioning equipment. Line and load side overcurrent protection shall be provided for power supply and conditioning equipment in compliance with NFPA 70. Disconnect switches shall comply with Section 16175.

Small power supply and conditioning equipment may be mounted in the panel served. Larger units shall be mounted adjacent to the equipment served. Where unconditioned power is brought into control panels, it shall be enclosed in metallic raceways within the panel.

Power supply and conditioning equipment larger than 5 kVA load capacity supported from surfaces other than concrete shall be provided with sound isolators.

Final raceway connections shall be a flexible conduit in compliance with Division 16.

3.04 MOUNTING

A. Control panels supported directly by concrete or concrete block walls shall be spaced out not less than 5/8 inch by framing channel between instrument and wall. Sills shall be leveled so panel structures will not be distorted. Panels shall be shimmed to precise alignment so doors operate without binding and mounted where shock or vibration will impair its operation.

B. Support systems shall not be attached to handrails, process piping or mechanical equipment. Control panels supported directly by concrete or concrete block walls shall be spaced out from the wall to provide for air circulation around the panels.

C. Steel used for support of equipment shall be 316 stainless steel. Support systems including panels shall be designed to prevent deformation greater than 1/8 inch under the attached equipment load and an external load of 200 pounds in any direction.

D. Floor-mounted cabinets, except in dry control rooms or electrical equipment rooms, shall be mounted on 3-1/2-inch minimum height concrete pads or grouted bases as specified.

E. Panels shall be shimmed to precise alignment, so doors operate without binding. Sealant shall be provided under panels not located in dry control or electrical equipment rooms.

F. Center-line of wall-mounted panels shall be 48 inches above the floor.

G. Panel tops of wall-mounted panels shall be mounted at the same elevation.

3.05 FACTORY TESTING

The control panel shall be assembled, interconnected, and functionally tested at the assembly shop prior to shipment. The Owner/Engineer shall have the option of witnessing the functional shop test. The Contractor shall notify the Owner/Engineer at least two (2) weeks in advance prior of the scheduled functional shop test. Refer to Specification 17030 Process Instrumentation and Control System Testing for further information.

3.06 FIELD TESTING

Field verify the following for Instrument and Control Panels:

1. Control circuits grounded with one terminal of each load device connected to the grounded conductor.

2. Control contacts installed in the ungrounded side of the circuit.

3. Signal and control wiring installed in separate wireways.

4. Barriers between the power wiring and the signal and control wiring.

5. Connected to the plant grounding system, as specified.

6. Inner door contains a copy of the Record elementary and wiring diagrams.

7. Inner door contains a protected drawing holder.

8. Drawings enclosed in a transparent, protective jacket.

9. Panel Functions as specified.

10. Mounted with stainless steel unistrut, fittings, and fasteners.

11. Tested in accordance with Section 16030 and Section 17030.

END OF SECTION

SECTION 17200

INSTRUMENT INDEX

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies the Instrument Index and general requirements applicable to process instrumentation and analyzer systems consisting of process sensors, process indicators, signal conditioning module, control and monitoring devices, transmitters, and accessories.

The Contractor shall provide, calibrate, and test the complete process instrumentation and analyzer systems and place in operation and test the system. Testing includes tuning loops and making final adjustments to instruments and analyzers during facility start-up.

The Contactor shall provide the services of certified instrument technicians for testing and adjustment activities as specified in Section 17000.

The Contractor shall examine the mechanical drawings and specifications to determine actual locations, sizes, materials and ratings of process connections. Process taps shall be indicated on pipe shop drawings as specified in paragraph 15050-2.04.

1.02 REFERENCES

Refer to Section 17000 – General Requirements for Instrumentation and Control.

Refer to Section 17030 – Process Instrumentation and Control System Testing.

1.03 SUBMITTALS

Refer to Sections 17000 and 17030.

PART 2 – PRODUCTS

2.01 INSTRUMENT INDEX

The Instrument Index, paragraph 17200-3.03, lists instruments and analyzers required for the project. Instrument functions specified on this list shall be provided by the Contractor.

Additional instrumentation devices such as process taps, seals, and other items required to complete the instrument loops due to characteristics of the equipment selected by the Contractor and not specified in the instrument index or on the contract drawings shall be provided at no additional cost to provide a complete working system.

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS

Materials, equipment, and installation shall be tested and inspected per Sections 17000, 17030, and this section.

Provide buffer solutions and reference fluids for analytical equipment test procedures.

3.02 INSTALLED EQUIPMENT - TESTS AND INSPECTION

A. Refer to Section 17030 – Process Instrumentation and Control System Testing.

3.03 INSTRUMENT INDEX

The following is an index of the instrumentation equipment, analyzers, and devices.

A. DESCRIPTION OF HEADINGS:

1. TAG NUMBER:
   Tag Number appears as a heading (PREFIX and NUMBER) and consists of a two, three or four letter prefix indicating the instrument function followed by a number identifying the process loop with which the instrument is associated. Tag Number provides an identification of the instrument, analyzer, or device.

2. DESCRIPTION:
   Provides the functional description of the instrument, analyzer, or device.

3. P&ID NUMBER:
   Lists the Process and Instrumentation Diagram on which the instrument, analyzer, or device appears.

4. SPECIFICATION:
   Provides the specification reference and “INSTRUSPEC” designation for the instrument, analyzer, or device.

5. RANGE:

Provides the calibrated instrument range for each application.

6. SETPOINT:
Provides the calibrated switch setpoint.

7. COMMENTS:
Provides the features, interlocks, and information applicable to the instrument, analyzer, or device.

TAG NO.	DESCRIPTION	P&ID	SPEC	RANGE	SETPOINT	COMMENTS
NR85-PSH-401	CAKE PUMP 1 PRESSURE SWITCH	I-10-602	17216/PS	N/A	VENDOR DETERMINED	VENDOR SUPPLIED, DIAPHRAGM SEAL REQUIRED
NR85-QSH-401-1	CAKE PUMP 1 PRESENCE DETECTOR 1	I-10-602	VENDOR SPECIFIED	N/A	N/A	VENDOR SUPPLIED
NR85-QSH-401-2	CAKE PUMP 1 PRESENCE DETECTOR 2	I-10-602	VENDOR SPECIFIED	N/A	N/A	VENDOR SUPPLIED
NR85-PI-401	CAKE PUMP 1 PRESSURE GAUGE	I-10-602	17211/PG	0-60 PSI	N/A	VENDOR SUPPLIED, DIAPHRAGM SEAL REQUIRED
NR85-LT-401	CAKE PUMP 1 LASER LEVEL TRANSMITTER	I-10-602	VENDOR SPECIFIED	VENDOR DETERMINED	VENDOR DETERMINED	VENDOR SUPPLIED
NR85-MSL-401	CAKE PUMP 1 DRY RUN SENSOR	I-10-602	VENDOR SPECIFIED	N/A	N/A	VENDOR SUPPLIED
NR85-PSH-402	CAKE PUMP 2 PRESSURE SWITCH	I-10-604	17216/PS	N/A	VENDOR DETERMINED	VENDOR SUPPLIED, DIAPHRAGM SEAL REQUIRED
NR85-QSH-402-1	CAKE PUMP 2 PRESENCE DETECTOR 1	I-10-604	VENDOR SPECIFIED	N/A	N/A	VENDOR SUPPLIED
NR85-QSH-402-2	CAKE PUMP 2 PRESENCE DETECTOR 2	I-10-604	VENDOR SPECIFIED	N/A	N/A	VENDOR SUPPLIED
NR85-PI-402	CAKE PUMP 2 PRESSURE GAUGE	I-10-604	17211/PG	0-60 PSI	N/A	VENDOR SUPPLIED, DIAPHRAGM SEAL REQUIRED
NR85-LT-402	CAKE PUMP 2 LASER LEVEL TRANSMITTER	I-10-604	VENDOR SPECIFIED	VENDOR DETERMINED	VENDOR DETERMINED	VENDOR SUPPLIED
NR85-MSL-402	CAKE PUMP 2 DRY RUN SENSOR	I-10-604	VENDOR SPECIFIED	N/A	N/A	VENDOR SUPPLIED

TAG NO.	DESCRIPTION	P&ID	SPEC	RANGE	SETPOINT	COMMENTS
NR85-PSH-303	POLYMER PUMP 3 PRESSURE SWITCH	I-10-604	17216/PS	N/A	VENDOR DETERMINED	VENDOR SUPPLIED, DIAPHRAGM SEAL REQUIRED

END OF SECTION

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SECTION 17211

PROCESS TAPS AND PRIMARY ELEMENTS

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies requirements for instrumentation elements that quantitatively convert the measured variable energy into a form suitable for measurement and process measurement accessories. Application requirements are specified in Section 17200.

A. SCOPE

1. This section specifies requirements for instrumentation elements which form a part of the process control systems specified in Section 17000 and Section 17200 – Instrument Index. Application requirements are specified in the instrument schedule, paragraph 17200-3.03.

B. OPERATING REQUIREMENTS:

1. The devices specified in this section quantitatively convert the measured variable energy into a form suitable for measurement and process measurement accessories.

1.02 REFERENCES

References are listed in Section 17000. They are a part of this section as specified and modified.

1.03 SUBMITTALS

Submittals shall be provided as specified in paragraph 17200-1.03.

PART 2 – PRODUCTS

2.01 INSTRUMENTATION SPECIFICATION SHEETS (INSTRUSPEC)

General requirements for primary elements specified in this section are specified on the INSTRUSPEC sheets in paragraph 17211-3.04.

2.02 VALVES

A. ISOLATION VALVES

1. Valves shall be full port ball valves with ASTM A276, Type 316 stainless steel trim and body and with Teflon seats and packing. Valves shall be Parker CPI, Whitey, Hoke, or equal.

B. GAGE VALVES

1. Gage valves shall be machined from ASTM A276, Type 316 stainless steel bar stock and shall be provided with 1/2-inch NPT connections and integral bleed plug. Valves shall be Anderson, Greenwood & Company M9 VIS-44, Hoke 6801L8Y, or equal.

C. ROOT VALVES

1. Root valves shall be ASTM A276, Type 316 stainless steel bar stock with 1/2-inch NPT male process connection and three 1/2-inch NPT female instrument connections. One instrument connection shall be provided with an ASTM A276, Type 316 stainless steel bleed valve. ASTM A276, Type 316 stainless steel plugs shall be provided for unused ports.

2. Lagging type units shall be provided for insulated vessels and pipes.

3. Root valve manufactures: Anderson, Greenwood & Company M5 VIS-44, Hoke 6802L8Y, or equal.

D. MANIFOLDS

1. Manifolds shall be three-valve bar-stock type. Manifold body shall be machined from ASTM Type 316 stainless steel bar stock. Valves shall be globe configuration with 316 stainless steel ball seats and Teflon stem packing.

2. Manifolds shall be designed for direct mounting to differential pressure transmitters in place of the flanges normally furnished. Fabricated manifolds or manifolds employing needle or soft seat valves are not acceptable. Purge taps, 1/8-inch NPT shall be furnished on manifolds where water purge is specified.

3. Manifold manufacturers: Anderson Greenwood AX3T VIS-4, Hoke GP831211F8YL, or equal.

2.03 TUBING AND TUBING FITTINGS

A. STAINLESS STEEL TUBING

1. Tubing shall be seamless annealed ASTM A269 Type 316 stainless steel 1/2-inch and 3/8-inch tubing shall have a wall thickness of 0.035 inches and 1/4-inch tubing shall have a wall thickness of 0.028 inches.

B. PLASTIC TUBING

1. Tubing shall be extruded from high molecular weight, low density polyethylene compound. Tubing shall be 1/4-inch outside diameter and shall be black, unless otherwise specified or shown. Tubing shall meet the standard ASTM #D-1693 test for stress cracking of base materials. Wall thickness shall be 0.040 inches plus or minus 0.005 inches. Maximum working pressure shall be 80 psig, at 100 degrees F, or higher.

2. Tubing manufacturers: Dekoron "P", Parker Hannifin "E", or equal.

C. TUBING FITTINGS:

1. Tubing fittings shall be Type 316 stainless steel and shall be the double-ferrule swage type. Flare, ball sleeve compression or single-ferrule swage type are not acceptable.

2. Fitting manufactures: Crawford "Swagelok", Hoke "Gyrolok", or equal.

2.04 CHEMICAL SEALS

A. DIAPHRAGM SEALS

1. Seal shall be the diaphragm type with flushing connection, Type 316 stainless steel body and Type 316L diaphragm with 1 inch process connection unless otherwise specified.

2. Diaphragm seal manufactures: Mansfield and Green Type SG, Ashcroft Type 101, or equal.

B. ANNULAR SEALS

1. Seal shall be the in-line full stream captive sensing liquid type. Metallic wetted parts shall be Type 316 stainless steel. Flexible cylinder shall be Buna-N unless otherwise specified. Seals shall be rated 200 psig with not more than 5-inch water column (WC) hysteresis.

2. Annular seal manufactures: Ronningen-Petter Iso-Ring, Red Valve series 40, or equal.

C. FILL FLUID

1. Chemical seals and associated instruments shall be factory filled as follows:

2. Instrument side of seal, capillary tubing, and instrument shall be evacuated to an absolute pressure of 1.0 Torr or less; filled; and sealed. Provide silicone oil fill fluid, unless otherwise recommended by the seal manufacture.

3. Chemical seal manufacture: Dow Corning DC200, Syltherm 800, or equal.

2.05 BUSHINGS AND THERMOWELLS

Bushings or thermowells shall comply with ASME B40.200. Temperature taps shall be 1/2-inch NPT, and lagging extensions shall be provided on insulated vessels or pipes. Thermowells and bushings shall be machined from Type 316 stainless steel bar stock unless otherwise specified.

2.06 PURGE ASSEMBLIES

The purge assembly for air or water for flushing seals on sludge level measurement applications with a choice of Buna, Viton, Etylene Propylene O-Rings.

A. AIR

1. Air purge assembly shall consist of a constant-differential relay, needle valve, check valve and 0.2 to 2.0 standard cubic feet per hour rotameter.

2. Assembly manufacturer: ABB Purgemaster Series 10A6100, or equal.

B. WATER

1. Water purge assembly shall consist of a strainer, constant-differential regulator, needle valve, check valve, and 20 to 200 cc/m rotameter. Provide 155 micron wye-type strainer.

2. Strainer manufacturer: ASCO 8600A2, Crane, or equal.

3. Assembly manufacturer: ABB Purgemaster Series 10A6100, or equal.

2.07 PRODUCT DATA

A. GENERAL

1. In accordance with drawings, information, and technical data for all equipment as, required in Section 17000 and this section shall be provided. All required product data for this section shall be included in one complete package.

B. ADDITIONAL INFORMATION

The following product data shall be provided:

1. Flow calculation for each differential-type flow element.

2. Record documentation shall include the data sheets specified in this section.

PART 3 – EXECUTION

3.01 INSTALLATION

A. GENERAL

1. General requirements for the installation of primary elements specified in this section are listed on INSTRUSPEC sheets and the specific application specified in Section 17200 – Instrument Index.

B. PROCESS CONNECTIONS

Where process taps are not readily accessible from instrument locations, an isolation valve shall be provided at the instrument.

Isolation valves shall be provided for each instrument where multiple instruments are connected to one process tap.

Pipe between the process connection and instruments shall be 1/2-inch stainless steel with treatment material for easy removal, as specified herein.

1. SAFETY INSTRUMENTS: No valves shall be installed at pressure taps for safety instruments. Safety instruments shall not be connected to the same process tap as instruments used for control, indication, or recording except when annular chemical seals are used.

2. ROOT VALVES: Root valves shall be provided at all process taps, except as follows:

    a. Temperature taps, where valves are unnecessary.

    b. Pump discharge pressure taps where no instrument is permanently installed.

    c. Isolation valves shall be provided.

    d. Process taps for safety instruments.

    e. Where gauge valves are provided.

    f. Where chemical seals are used.

3. GAUGE VALVES: Gauge valves shall be provided for each pressure gauge tap except where chemical seals are used.

C. TUBING

1. Tubing shall be installed on supports spaced not more than 3 feet apart and shall run parallel of perpendicular to walls structural members, or intersections of vertical planes and the ceiling. Unless otherwise shown, tubing shall follow building surfaces closely or shall be carried in trays or conduit.

2. Tubing shall not be supported from piping or equipment except at process taps or connections to the device served. Tubes supported directly on concrete surfaces shall be spaced at least 1/8 inch from the concrete. Tubing support shall be one-hole malleable iron clamps with clamp backs as required. Bends shall be formed to uniform radii without flattening.

3. Ends of tubing shall be square-cut and de-burred before installation in fittings. Fittings shall be used for splices, connections, and turns near final connections. Bulkhead fittings shall be used when tubing enters a panel.

D. ELECTRICAL CONNECTIONS

1. Final connections between rigid raceway systems and instruments shall be made with jacketed flexible conduit with a maximum length of 2 feet.

3.02 TESTING

Applicable testing requirements are specified in paragraph 17200-3.02.

3.03 PROCESS CONNECTIONS

Process connection piping and tubing shall be tested in accordance with Section 15050.

3.04 INSTRUSPECS

Instrument Specification Sheets (INSTRUSPECS) included in this Section 17211 are shown below.

3.05 INSTRUMENT SPECIFICATION SHEET--INSTRUSPEC

A. Instrument Identification: PG

B. Instrument Function: Pressure measurement

C. Instrument Description: Pressure gauge

D. Power Supply: N/A

E. Signal Input: N/A

F. Signal Output: N/A

G. Process Connection: 1/2-inch male NPT

H. Product Requirements: Pressure gages shall be 4-1/2-inch premium grade with bourdon tube element, 270-degree milled stainless steel movement, phenolic case, and shatterproof glass window. Accuracy shall be 1 percent of span or better. All exposed metal parts shall be stainless steel. Gauges located on a pump discharge shall include a snubber.

I. Pressure gage manufactures:

1. Ashcroft Duragauge Figure 1279

2. Ametek 1981L

3. or equal.

3.06 EXECUTION

A. Installation: Install in accordance with manufacturer's instructions and the recommendations of API RP551 to the specified requirements.

1. Root valves shall be provided at all process pressure taps except taps made for safety instruments. Gage valves shall be provided at the instrument where the instrument is not within sight of the root valve or where two or more instruments are connected to a single tap.

2. Safety instruments shall not be connected to the same process tap as instruments used for control, indication, or recording. Unless otherwise specified, pressure instruments shall be located as close as practical to the process tap but shall be positioned to permit observation and maintenance. Pressure gages may be supported from the process tap if this location permits observation from the floor or a permanent work platform. Pressure instruments shall be installed in such a manner that blowout discs are not obstructed.

B. Application/Calibration: Application, calibration, and set points shall be as specified in paragraph 17200-3.03.

END OF SECTION

SECTION 17216

PROCESS SWITCHES

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies requirements for process activated switches, devices, and accessories.

A. SCOPE

This section specifies requirements for instrumentation devices, which form a part of the process control systems. Application requirements are as specified in the Instrument Index, paragraph 17200-3.03.

B. OPERATING REQUIREMENTS

The devices specified in this section quantitatively convert the measured variable energy into a form suitable for process measurement and control.

1.02 QUALITY ASSURANCE

A. MANUFACTURER

Equipment furnished under this section shall be the products of firms regularly engaged in the design and manufacture of such equipment for a minimum of five years.

B. INSTALLER

Installation, calibration and testing of equipment furnished under this section shall be performed by qualified, skilled, Certified Technicians specified in Section 17000, who are regularly engaged in such activities involving systems of similar complexity.

C. REFERENCES

References are listed in Section 17000 and are a part of this section as specified and modified.

1.03 ENVIRONMENTAL CONDITIONS

Equipment provided under this section shall be suitable for operation under ambient conditions described in paragraph 17000-1.03.

1.04 SUBMITTALS

Submittals shall be provided as specified in Sections 01300 and 17000, including:

1. A copy of this specification referenced and applicable sections, with addendum updates included and with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Referenced and applicable sections to be marked up and submitted include:

   a. Section 01664 - Training

   b. Section 01730 - Operating and Maintenance Information

   c. Section 17200 - Instrument Index

   A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Systems Integrator, then each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

   The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Systems Integrator with the specifications.

   Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. A copy of the contract document Control Diagrams and Process and Instrumentation Diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal.

   If no changes are required, the drawing or drawings shall be marked "no changes required". *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*

3. Marked Contract Document Mechanical and/or Electrical Plan drawings, sections, and details showing sensor installation locations and details. *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*

4. Marked product literature of all equipment and features.

5. Installation details for the process switches and mounting accessories.

6. Electrical and signal connection drawings for process switches and devices.

PART 2 – PRODUCTS

2.01 GENERAL

Process switches and devices shall comply with the following requirements:

1. Contact outputs used for alarm actuation shall be normally-closed or normally-opened as required by the process condition to open to initiate the alarm.

2. Contact outputs used to control equipment shall be normally-opened and shall close to start the equipment.

3. Contacts monitored by solid state equipment such as programmable controllers or annunciators shall be hermetically sealed and rated for switching currents from 20 to 100 mA at 24 volts DC.

4. Contacts, monitored by electromagnetic devices such as mechanical relays, shall be rated as NEMA ICS 2, designation B300.

5. Double barriers provided between switch elements and process fluids such that failure of one barrier will not permit process fluids into electrical enclosures.

6. Switch electrical enclosures rated as NEMA 250, Type 4 minimum.

7. Switch contacts located in Class I, Division 1 areas and monitored by solid-state circuits shall be made safe by intrinsic safety barriers as specified in paragraph 17120-2.04.

8. Switch range shall be selected so that the specified set point is at least 30 percent but not more than 70 percent of the span, between the upper range limit and the lower range limit.

2.02 INSTRUMENTATION SPECIFICATION SHEETS (INSTRUSPEC)

General requirements for instruments specified in this section are listed on INSTRUSPEC sheets in paragraph 17216-3.03.

Application requirements are specified in the Instrument Index, paragraph 17200-3.03, and/or on the drawings.

2.03 PRODUCT DATA

The following data shall be provided in accordance with Section 01300:

1. Operating and maintenance information as specified in paragraph 17000-2.03. Include final reviewed submittal and separate record of all final and switch settings.

2. Test results as specified in Section 17030-Part 2.

PART 3 – EXECUTION

3.01 INSTALLATION

Installation requirements are specified in paragraph 17000-3.01.

3.02 TESTING

Testing requirements are specified in Section 17030.

3.03 INSTRUMENT SPECIFICATION (INSTRUSPEC) SHEETS

General requirements for instrumentation specified are listed on INSTRUSPEC sheets herein. INSTRUSPEC sheets for the process switches listed in the following Table A are included in this paragraph:

Table A: Process Switches

INSTRUSPEC Symbol	Instrument Description	Instrument Function
PS	Pressure Switch	Pressure Measurement

3.04 INSTRUMENT SPECIFICATION SHEET--INSTRUSPEC

Instrument Identification:	PS
Instrument Function:	Pressure Measurement
Instrument Description:	Pressure Switch
Signal Input:	Process
Signal Output:	As specified in paragraph 17216-2.01
Process Connection:	1/2-inch female NPT
Product Requirements:	Pressure switch shall consist of a pressure transducer and a precision switch. Pressure transducer shall be the diaphragm piston type with wetted materials as recommended by the switch manufacturer. Piston backed by a cylinder disc to permit 10 times over-range pressure without affecting calibration. Range spring and piston shall be isolated from process fluids by the diaphragm. Switch provided with two 3/4-inch conduit connections. Switch assembly housing shall be cast aluminum rated types 3, 4, and 7D per NEMA ICS6. Systems Integrator shall select pressure transducer so that set point falls between 30 and 70 percent of maximum range. Approximate set point and, if applicable, reset point indicated on calibrated scales. Repeatability and sensitivity shall be 1.0 percent of operating range. Unless otherwise specified, switches nonadjustable deadband type.
Approved Manufacturers:	Ashcroft, United Electric or equal.
Execution:	
	Installation: Install in accordance with manufacturer's instructions and to the specified requirements.
Application/Calibration:	Application, calibration, and set points as specified in paragraph 17200-3.03.

END OF SECTION

SECTION 17310

PROGRAMMABLE LOGIC CONTROLLER (PLC)

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE

This Section specifies requirements for small programmable logic controllers (PLC) designed to execute discrete and continuous control logic with high reliability in industrial applications. Enclosures and components are specified in Section 17110 – Instrument and Control Panels.

All PLCs provided for this project shall comply with the requirements of this Section. The exception is the model of the Cake Pumps PLCs; which are vendor specific Controller/PLC (Unitronics V570) and Compactlogix 1769-L18ER PLC. PLCs are provided and programmed by their respective Vendor/ Control Panel Supplier.

B. GENERAL REQUIREMENTS

General requirements shall be as specified in Sections 17000 and 17110.

1.02 QUALITY ASSURANCE

A. REFERENCES

This Section contains references to the following documents or documents listed in Sections 16000, 17000, and 17110. They are a part of this Section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this Section as if referenced directly. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).

If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
IEC 61131-3	Programmable Controllers – Part 3: Programming Languages
NEMA IA 2.2	Programmable Controllers – Equipment Requirements and Tests
NEMA IA 2.3	Programmable Controllers – Programming Languages

B. SYSTEMS INTEGRATOR

Responsibilities and qualifications shall be as specified in Section 17000.

C. FACTORY ACCEPTANCE TESTS

Factory Acceptance Tests are specified in Section 17030 and scheduled in Paragraph 1.01 B.

1. Submit factory test forms for approval prior to tests.

2. Provide all expenses for one Owner staff member and one Engineer staff member to witness factory testing. Travel shall be during business hours on weekdays.

1.03 SUBMITTALS

The following information shall be provided in accordance with Sections 01300 and 17000:

A. SHOP DRAWINGS

Submit under Section 17110, including:

1. A copy of this Specification Section, with addendum updates included, and all referenced and applicable Sections, with addendum updates included, with each paragraph check-marked to indicate Specification compliance or marked to indicate requested deviations from Specification requirements. A check mark shall denote full compliance with a paragraph as a whole.

If deviations from the Specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the Specifications.

Failure to include a copy of the marked-up Specification Sections, along with justification(s) for any requested deviations to the Specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Submittal requirements per Section 17110 for the equipment specified herein.

3. PLC Input/Output (I/O) loop diagram drawings.

4. Internal power distribution schematic diagram drawings.

5. PLC power supply loading calculations.

6. List of spare parts to be provided.

B. FACTORY ACCEPTANCE TEST SCHEDULE AND FORMS

Submit under Section 17030 and per the requirements of this Section.

C. OPERATING AND MAINTENANCE INFORMATION

Operating and maintenance information shall be provided in accordance with Section 01730, including the following for the PLC system:

1. Manufacturer, Representative, and Supplier contact information.

2. Manufacturer instruction manuals shall include only the following as applicable to the PLC system:

   a. Safety Precautions.

   b. Environmental Conditions.

   c. Troubleshooting guides and diagnostic techniques.

d. Component connection diagrams.

e. Removal and replacement instructions.

3. Warranty information.

4. Final reviewed submittal.

5. As-built drawings with record of switch and jumper settings for all components.

6. PLC and VFD I/O Tag List with detailed descriptions.

7. List of spare parts provided.

PART 2 – PRODUCTS

2.01 GENERAL

A. MANUFACTURER

The Owner and Construction Manager require the specified Manufacturer to provide the equipment and/or products to be furnished under this Section. The Owner and Construction Manager believe the Manufacturer is capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed to mean that the named Manufacturer's standard product will comply with the requirements of this Section.

Manufacturers and models shall be as specified for the purpose of compatible and efficient utilization of existing equipment, supplies, and personnel training and experience, no substitutions are permitted.

B. MATERIALS

Equipment and/or products shall be new and unused at the time of system assembly.

C. Controller conforming to NEMA IA 2.2, and with required memory and functional capacity to perform specified sequence of operation with scheduled input and output points.

1. RFI/EMI Susceptibility: MIL STD 461B CS02.
2. Showering Arc Test: NEMA Pub No ICS2-230.42.

3. Surge Withstand: ANSI C37.90a.
4. RFI Immunity: IEC 801-3.
5. Ground Continuity: IEC 801-5.
6. Electrostatic Discharge: IEC 801-2.
7. Electromagnetic Field: IEC 61000-4-3.
8. Fast transients: IEC 61000-4-4.

2.02 PROGRAMMABLE LOGIC CONTROLLER

A. Manufacturer: Allen-Bradley Compactlogix.

B. NEMA IA 2.3 and IEC 61131-3 compliant program editor with program written in Ladder Logic or Function Block Language. Program to be written using the same type of software as is specified below.

C. Networking Connections: As shown. Provide all communication interfaces, network cables, taps, terminators, power supplies, and accessories for a complete operating network.

1. Ethernet/IP

D. Processor: 1769-L33ER with Ethernet port and serial port dedicated solely for programming use, minimum 200k bytes (8 bit) for IEC 1131 control programs, and 24k words (16 bit) for storage of data in battery-backed RAM memory. Provide additional serial communications adapters required for other serial interfacing. Include real-time clock.

E. Input and Output Modules:

1. Discrete Inputs: 120 Vac, 16 channel.

2. Discrete Outputs: Relay output, 16 channel isolated

3. Analog Inputs: 4-20 mAdc/1-5 Vdc, isolated channel-to-channel, 4 channel.

4. Analog Outputs: 4-20 mAdc, 4 channel.

5. I/O module terminations: By Manufacturer to match module.

6. I/O module interface modules: Provide as necessary including cabling to interface all I/O to processor.

7. Spare Input/Outputs: The greater of a minimum one channel or 15 percent of each type provided per control panel.

F. Power Supplies: 24 Vdc. Refer to Section 17110 for power supply.

G. Miscellaneous: Provide all cables, taps, terminators, power supplies, and accessories for a complete operating PLC system.

2.03 PROGRAMMING SOFTWARE

A. PROGRAMMABLE LOGIC CONTROLLER

1. Manufacturer: Allen-Bradley Studio 5000 Ver. 24, RSLinx, and network module software.

2. Licenses: SI shall provide (1) Rockwell Automation Studio 5000 Standard License; part number 9324-RLD300NXENE. Request Owner / City licensee information prior to ordering for registration. Provide one PC to PLC programming cable for each license

2.04 SPARE PARTS

The following spare parts shall be provided:

A. PROGRAMMABLE LOGIC CONTROLLER

1. One of each unique processor.

2. One of each unique communication card.

3. One for each ten, minimum of one for each unique I/O card.

4. One of each unique power supply.

5. One of each unique pre-fabricated cable.

2.05 CONTROL PANEL FABRICATION

A. Refer to Section 17110.

B. Detail shop drawings showing field connections and any terminal block jumpering required.

C. Terminate all used and spare I/O wiring to terminal blocks.

D. Create wire markers with “to-from” component name, PLC slot/base, or terminal column number and terminal number information identical at each end.

E. Provide terminal Blocks for field connections to PLC Discrete Inputs:

1. One fused terminal with LED for each group of 8 inputs, connected to control power.

2. Fused terminal connected to eight terminal blocks to provide power to each field input circuit.

3. One terminal per PLC input.

4. One common terminal for each group of 8 inputs, connected to control power common.

5. Two surge protecting terminals for each discrete input, grounded to the frame ground bus. Phoenix Contact PT 2x2 24dc-st 2838228 Plugtrab surge or equal.

F. Provide terminal Blocks for field connections to PLC Discrete Outputs:

1. One fused terminal with LED for each output, connected to control power.

2. Two terminals per PLC relay output. Provide interposing relay for each solid-state PLC output. Connect output and control power common to relay coil. Provide two terminals for relay contact, normally opened unless otherwise noted.

3. One common terminal for each output, connected to control power common.

G. Provide terminal Blocks for field connections to PLC Analog Inputs:

1. One fused terminal with LED for each input, connected to +24 Vdc.

2. Two terminals per PLC input.

3. One common terminal for each input, connected to 24 Vdc common.

4. One ground terminal for each input shield, connected to signal ground bus.

5. Two surge protecting terminals for each analog input, grounded to the frame ground bus. Phoenix Contact or equal.

H. Provide terminal Blocks for field connections to PLC Analog Outputs:

1. One fused terminal with LED for each output, connected to +24 Vdc.

2. Two terminals per PLC output.

3. One common terminal for each output, connected to 24 Vdc common.

4. One ground terminal for each output shield, connected to signal ground bus.

5. Two surge protecting terminals for each analog output, grounded to the frame ground bus. Phoenix Contact or equal.

2.06 PRODUCT DATA

The following Product Data shall be provided in accordance with Section 01300.

A. FACTORY ACCEPTANCE TEST RESULTS

Submit under Section 17030 and per the requirements of this Section.

B. PLC PROGRAM

Provide the as-built programmable controller program on a flash drive prepared using the software type specified in Part 2. Provide 2 copies. Label the flash drive to include:

1. Owner's name, facility name, project name and project number as shown on the drawings.

2. "Application Programs For (equipment and/or PLC name)".

3. Programming software name and revision.

4. Supplier name and program revision date.

PART 3 – EXECUTION

3.01 INSTALLATION

Refer to Section 17110.

Connect input and output devices to the PLC via control panel terminal blocks, not directly to the PLC.

3.02 FIELD INSPECTION AND TESTING

Refer to Section 17110.

A. EQUIPMENT MANUFACTURER

The supplier of each PLC system shall provide a qualified service representative to perform the following:

1. Inspect the PLC installation including I/O and network systems, hardware configuration switch and jumper settings.

2. Monitor all PLC system diagnostic indicators, both hardware and software, and certify that the PLC system performance meets or exceeds the Manufacturer's published specifications.

3. Assist in all testing.

4. Modify PLC programs as required.

5. Certify in writing to the Construction Manager that the PLC system has been installed and configured in accordance with the Manufacturer's published guidelines. Equipment Manufacturer certification requirements are per the associated equipment Specification.

B. CONTRACTOR

Fault or trouble conditions shall be investigated and resolved by the Contractor to the satisfaction of the Owner.

3.03 TRAINING

A. OPERATIONS AND TROUBLESHOOTING

Equipment Manufacturer training is per the associated equipment Specification.

END OF SECTION

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SECTION 17315

PROCESS CONTROL SYSTEM
DEVELOPMENT AND PROGRAMMING

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies the general requirements applicable to the development and programming of the process control system graphical operator interface, historical data management system, and process control logic.

See Section 17000 1.01 B.2 for programming requirements.

1.02 QUALITY ASSURANCE

A. IMPLEMENTATION PLAN MEETINGS:

The Systems Integrator shall include as work of this section of the specifications the requirement for two (2) meetings to be held at the project site. The primary function of the meetings shall be to facilitate coordination between the Owner, SI and Vendor programmers regarding the implementation of the process control system.

The BFP Vendor PLC Programmer and Cake Pump Vendor PLC programmer are required at these meetings for proper coordination between the SI, Owner, and Vendors. The BFP Vendor shall have in attendance at each meeting a representative who is responsible for the preparation of the Process Control System Implementation Plan. The preliminary schedule and agenda for each of the meetings shall be as described below. The specific dates for each of the meetings shall be scheduled by the Systems Integrator and approved by the Construction Manager.

The Construction Manager shall be provided with two (2) weeks minimum advanced written notice of proposed scheduled meeting dates. The System Integrator shall prepare a detailed meeting agenda and submit it to the Construction Manager with the notice of proposed scheduled meeting dates.

1. Meeting-1 shall be held within sixty (60) days of receipt of Notice to Proceed. The purpose of this meeting shall be to begin preparation of the Process Control System Implementation Plan. The BFP and Cake Pump Vendors shall be prepared to present the capabilities of the proposed process control system software and the alternatives available for each of

the major areas of implementation described by the Process Control System Implementation Plan.

2. Meeting-2 shall be held within thirty (30) days of completion of the Engineer's review of the Process Control System Implementation Plan submittal. The purpose of this meeting shall be to discuss the submittal review comments and resolve any related issues.

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Process Control System Implementation Plan

PART 2 – PRODUCTS

2.01 PRODUCT DATA

The following data shall be provided in accordance with Section 01300:

A. PROCESS CONTROL SYSTEM DEVELOPER'S GUIDELINES:

The Process Control System Implementation Plan shall be modified and updated during the course of development of the process control system control logic to reflect the conventions and standards used in the final system development. Upon final acceptance of the work, the updated implementation plan shall be re-published and submitted as the Process Control System Developer's Guidelines.

B. PROCESS CONTROL SYSTEM CONFIGURATION REPORT:

Report documenting the final configuration of the process control system including the following:

1. Hardware Configuration: Final switch settings and jumper positions shall be documented for all process control system components including processors, communications adapter modules, motor controllers and adjustable frequency drives, power metering systems, etc.

2. Process Control Logic: Bound hard copy of the annotated process controller program listing. The program listing for each processor shall be separately bound and shall have tab dividers for each program file listing. Program listing shall include cross references.

PART 3 – EXECUTION

3.01 PROCESS CONTROL SYSTEM IMPLEMENTATION PLAN

A. GENERAL:

The BFP Vendor shall prepare an implementation plan for the process control system development and programming work. The implementation plan shall establish guidelines for development of programmable logic controller (PLC) process control logic and shall insure the consistent application of conventions and methods through the course of development. The implementation plan shall specifically address the following:

1. Tag database structure and configuration.
2. Tag naming conventions.
3. Process control system configuration.
4. PLC program file organization.
5. PLC data file organization.
6. Messaging communication standards including communication heartbeat alarms between PLCs.
7. PLC to VFD communication convention and standardization.

B. TAG DATABASE STRUCTURE AND CONFIGURATION:

The implementation plan shall define how the tag database will be organized to logically associate tags with specific input/output types, functions, or process areas.

C. TAG NAMING CONVENTIONS:

A tag naming convention shall be established which provides a structured organization to the tag database facilitating tag searches and substitutions during system development and provide for effective and efficient design, management and operation of the process control system. The tag naming convention shall be developed to take full advantage of the capabilities of the process control system software and not impose any artificial constraints in the operation or management of the process control system. Tag names shall minimally be comprised of the following information:

1. Equipment type designation.
2. Equipment loop number.
3. Signal type designation.

D. GRAPHICAL OPERATOR INTERFACE STANDARDS:

Not Required since Owner is responsible for the SCADA Graphics Updates.

E. PROCESS CONTROL LOGIC CONFIGURATION:

Guidelines shall be developed which define the organization and structure of the process control logic and data memory within the process controller. These guidelines shall address the following:

1. Structure of the control logic including the use of subroutines and the allocation of memory to accommodate modifications and expansion of the control logic.

2. Methodology for handling common control functions shall be standardized such that similar functions are implemented in a consistent manner across the entire project. Standardized routines for motor control, VFD control, instrument data handling, alarm management, etc. shall be developed and reviewed by the Owner prior to final programming.

3. Assignment of data storage memory including data formats and method of documenting memory mapping.

4. Methodology for implementing peer to peer communications including allocation of memory or register addresses is such a way as to organize data for optimum efficiency of data exchanges between peer processors.

F. PROCESS CONTROL STRATEGIES:

Process control strategies shall be reviewed with the Owner and refinements made as agreed to by the Vendor Programmers, SI, and Owner. Modifications to the control strategies that are determined to be a change in scope will be addressed by change order. The final process control strategies shall be incorporated into the Implementation Plan.

3.02 TAG DATABASE DEVELOPMENT

A tag naming convention shall be established which provides a structured organization to the tag database facilitating tag searches and substitutions during system development and provide for effective and efficient design, management and operation of the process control system. The tag naming convention shall be developed to take full advantage of the capabilities of the process control system software and not impose any artificial constraints in the operation or management of the process control system. Tag names shall minimally be comprised of the following information:

1. Equipment type designation.
2. Equipment loop number.
3. Signal type designation.

3.03 GRAPHICAL OPERATOR INTERFACE DEVELOPMENT

Not Required since Owner is responsible for the SCADA Updates.

3.04 PROCESS CONTROL LOGIC DEVELOPMENT

The process control system control logic development shall include the preparation of control logic required to implement the specified control strategies and support the specified operator interface functions.

A. ORGANIZATION:

The control logic shall be organized in a hierarchical structure which correlates to the actual process relationships. Individual control logic program files shall be prepared for each system or equipment item and shall be organized by process area. Data table files shall be similarly organized by process area. Data types shall be consistently applied throughout the control logic in accordance with the Process Control System Implementation Plan.

The control logic and data table organization shall facilitate the addition of future control logic.

B. DOCUMENTATION:

All control logic shall be completely annotated down to and including the instruction level. Each rung or statement of control logic shall be provided with annotation specific to its function. Each program file shall have a title and a detailed description of the control strategy represented by the control logic. Terminology consistent with the Process Control System Implementation Plan shall be applied throughout.

END OF SECTION

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SECTION 17316

PROCESS CONTROL SOFTWARE SYSTEMS

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies software systems for the process control system real-time human-machine interface (HMI) and historical data management system. The programming and configuration of these software systems shall be performed in accordance with Specification 17315.

1.02 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Manufacturer's product literature for all software systems.

2. Manufacturer's recommended hardware requirements for optimum operation of each software system.

3. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

PART 2--PRODUCTS

2.01 ACCEPTABLE PRODUCTS

This specification is based on Vijeo Citect products and, by virtue of this reference, establishes the level of performance, functionality, and quality for any products offered in lieu of the referenced products including the named manufacturers. Upon election to use products of another manufacturer, named or otherwise, the Contractor shall be responsible for all changes required in hardware and software configuration to provide the established level of performance and quality.

The process control software systems are listed in the "Proposed Major Equipment Supplier List" in the Contract Documents. The acceptable manufacturers of process control software systems are as follows:

A. Real-time Human-Machine Interface

1. Vijeo Citect Version 8

B. Process Database System

1. Confirm existing database system with owner.

2.02 SOFTWARE LICENSING

All process control system software products shall be licensed in the Owner's name and supplied by the Systems Integrator. The number of licenses for each process control system server application including communication drivers shall be as required to implement the process control system as specified herein and detailed on the Drawings. The number of licenses for process control system client applications shall be as specified in Table 2.02:

Table 2.02

Software Application	Number of Licensed Copies	Notes
Citect Control Client Softkey License from BCI (Site ID 35189). Part number CT102014	1	5000 Tag count, for new Plant SCADA HMI in NR85-VCP-103; confirm software with BCI.

Table 2.02

Software Application	Number of Licensed Copies	Notes
Citect Control Client Redundant. Part number CT102088	1	5000 Tag count, for new Plant SCADA HMI in NR85-VCP-103; confirm software with BCI.

PART 3--EXECUTION

3.01 PROCESS CONTROL SOFTWARE SYSTEM PROGRAMMING

Process control system software shall be programmed and configured by the Owner.

3.02 TRAINING

Not Required since SCADA programming is by the Owner.

END OF SECTION

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SECTION 17318

INDUSTRIAL COMPUTER WORKSTATIONS AND DISPLAYS

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies industrial computer software and hardware systems for Vendor Supplied Control Panels and SI supplied Camera Workstation.

1.02 QUALITY ASSURANCE

A. REFERENCES:

Refer to paragraph 17000-1.03 A.

B. SYSTEMS RESPONSIBILITY:

Refer to paragraph 17000-1.03 B.

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Manufacturer’s product literature for all software systems, marked to show products included.

3. Manufacturer's product literature for all hardware components, marked to show products included.

4. Proposed schedule of procurement, installation, and testing of products provided.

5. List and quantities of spares if applicable.

PART 2 – PRODUCTS

2.01 INDUSTRIAL COMPUTER WORKSTATIONS

A. Heavy Duty Industrial Panel Mounted PC Hardware:

Panel Vendor shall provide a panel mounted Phoenix Contact workstation with factory installed components, licensed in the Owner's name:

1. IP65 (front), IP20 (back)

2. Operating temperature: 0 to 50 degrees C.

3. Processor Controller:

   a. 2.10/2.9 GHz I5 Processor with fully sealed IP20 convection booster.

   b. 8 GByte DDR4 RAM.

   c. 128 GByte Hard Disk Drive, solid state.

   d. Two Gigabit Ethernet LAN port.

   f. Four USB ports.

   g. Two RS-232 serial ports.

4. Minimum 17" SXGA diagonal color display, 1280 by 1024-pixel resolution.

5. Resistive touchscreen.

6. Power: 24 Vdc.

7. Battery Backed Realtime Clock

8. Quantity of 1: One workstation required for NR85-VCP-103.

B. Desktop PC Hardware (Qty. of 1 for Administrator Building Operator Room):

SI shall provide a desktop camera workstation with factory installed components, licensed in the Owner's name:

1. Tower-style case
2. Office grade enclosure
3. Intel Core i7 Processor 2.8 GHz or equal
4. 8.0 GB of DDR4 RAM or better
5. Graphics processor with 256MB RAM, multi-monitor capable or equal graphics card
6. HDMI video connection capable of 1920 x 1080 resolution
7. One (1) 1TB SATA 3.0Gb/s 7200 RPM hard drive
8. One (1) 1000 Base-T Ethernet network interface cards
9. Six (6) USB 2.0 / 3.0 ports
10. USB, Optical, 3 button mouse with scroll
11. USB keyboard
12. Onboard AC97 or equal sound card with dual speakers
13. Microsoft Windows 10 Professional 64-bit operating system software

C. Desktop Monitor (Qty. of 1 for Administrator Building Operator Room):

SI shall provide 24-inch desktop monitor with following minimum features:

1. 24 inch diagonally measured display
2. 16:9 aspect ratio
3. Minimum 1920 x 1080 resolution
4. HDMI video connection
5. 1,000 to 1 contrast ratio
6. 350cd/m2 brightness
7. 178 degree horizontal and vertical viewing angle
8. Built in speakers or external undermount soundbar
9. Microsoft Windows 10 compatible
10. Dell UltraSharp UP2516D or approved equal

D. PANEL MOUNTED OPERATING SYSTEM SOFTWARE:

Provide one of the following for each workstation, licensed in the Owner's name**.** Request licensee name and address from the Construction Manager prior to ordering.

1. Windows 10 IOT Enterprise (64-Bit) for Panel Mounted PC Hardware.

2.02 WORKSTATION SOFTWARE

A. GENERAL:

All software products shall be licensed in the Owner's name. Request licensee name and address from the Construction Manager prior to ordering. Provide latest versions.

B. SCADA SOFTWARE:

Refer to Specification 17316 for required SCADA Software. Note that the SCADA Software is only required for the Panel Mounted Workstation in NR85-VCP-103. No SCADA software is required for the new Admin Building Desktop PC.

C. OFFICE SOFTWARE:

Not Required

2.03 SOURCE QUALITY CONTROL

The Owner and Construction Manager require the specified manufacturers to provide the equipment and/or products to be furnished under this section. The Owner and Construction Manager believe the manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed to mean that the named manufacturer's standard product will comply with the requirements of this Section. Manufacturers shall be as specified for the purpose of compatible and efficient utilization of existing equipment, supplies, and personnel training and experience.

2.04 PRODUCT DATA

The following data shall be provided in accordance with Section 01300.

A. OPERATION AND MAINTENANCE INFORMATION:

One set of all software and hardware manuals shall be provided at time of delivery to the Owner, including maintenance information. Include written warranty and final reviewed submittal.

PART 3 – EXECUTION

3.01 GENERAL

Provide workstations and equipment as shown. Troubleshoot and repair any intermittent or inoperative network connections.

3.02 SOFTWARE INSTALLATION

A. Industrial Computer Workstation (ICW) operating system software shall be pre-loaded by the workstation manufacturer.

3.03 APPLICATIONS CONFIGURATION

A. ICW operating system software on Panel Mounted Workstations shall be configured by the Vendor. ICW operating system software on the desktop workstation shall be configured by the SI.
B. Vendor, SI, and Owner shall coordinate regarding SCADA software/license and SCADA runtime application prior to FAT.

3.04 SPARE WORKSTATION: Not Required

END OF SECTION

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SECTION 17715

SECURITY SURVEILLANCE SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies requirements for providing the security video surveillance system for the NRF Belt Filter Press Rehabilitation project by the Systems Integrator (SI). The SI shall utilize a qualified approved camera vendor for aid in installation, configuration, training, etc.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
IEEE 100	Standard Dictionary of Electrical and Electronics Terms
NEMA ICS 1	General Standards for Industrial Control and Systems
NECA-1	National Electrical Contractors Association – Standard Practices for

	Good Workmanship in Electrical Contracting
NFPA-70	National Electrical Code (NEC)
NEMA 250	Enclosures for Electrical Equipment (1000 Volt Maximum)
NEMA WD-1	General Requirements for Wiring Devices
UL 67	Panelboards

B. WARRANTY:

In addition to the guarantee specified in the General Conditions.

1.03 SUBMITTALS

Submittals and transmittal procedures for submittals are defined in Section 01300.

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

   A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.

   The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

   Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration."

   Referenced and applicable sections to be marked up and submitted include: Sections: 01660, 01664, 16030, 17030.

2. A copy of the contract documents and drawings relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review. Drawings to be marked up and submitted include:

a. I-00-601 Network Diagram

3. Marked Product literature showing features, options provided, dimensions, clearances, and installation instructions.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

Camera Model:

1. Axis Communications Model M3026-VE 3MP Outdoor Dome Camera
2. Approved equal.

Approved Vendors:

1. Convergint Technologies
2. Approved equal.

2.02 SYSTEM EQUIPMENT

A. SURVEILLANCE SYSTEM EQUIPMENT

The security video surveillance system shall incorporate the following hardware and software:

1. Video Control Center (VCC): Software shall be latest version of Axis Companion to manage configuration and monitor system. Contractor to field verify existing Camera software/setup at SERF and implement similar at NRF. SI shall provide new camera workstation in Admin Building Operations Room. Reference Specification 17318 2.01B for requirements. Camera Vendor shall install and configure software on new Camera Workstation in Admin Building Operations Room for live viewing on (2) new 65” displays. Coordinate installation and configuration with Owner.

2. The surveillance system shall provide single mode of video image collection:

   a. Live Mode: On demand video streaming from all of the new cameras to the VCC.

1) Supports video streaming over low bandwidth networks beginning at 2400 baud.

3. 48VDC Industrial Gigabit Ethernet POE managed switch din rail mounted with fiber ports to match existing fiber. Include sufficient POE ports for all new cameras plus minimum one spare POE port. Provide Stratix 5400 series, Moxa or equal.

2.03 CAMERA EQUIPMENT

A. Quantity of Cameras: 5. See Drawings for locations.

B. Camera features

1. Fixed Iris, IR corrected 2.0mm, 106º Viewing Angle
2. f/2.0 Aperture
3. Angle Adjustment Pan: +/- 175º, Tilt: 70º, Rotation +/- 175º
4. 2048 x 1536 to 160 x 120 Resolution
5. H.264 Main Profile, MJPEG Compression
6. IP66 and Nema 4X rated
7. -22 to 122ºF Operating Range
8. Power Over Ethernet IEEE 802.3af/802.3a Type 1, Class 2

2.04 ELECTRICAL ENCLOSURES AND AUXILIARY DEVICES (NOT USED)

2.05 CAMERA DISPLAYS

A. NRF Operations Office Displays and accessories:

1. 65” 4K UHD 7 Series Smart TV 2018. Quantity of 2 Displays. Samsung UN65NU7100, or equal
2. Streamvault SV-100E HDMI Extenders over CAT6 Ethernet Cable, Quantity of 2. Mount behind displays.
3. Echogear full motion articulating TV wall mount bracket. Model EGLF2 or equal. Quantity of 2.
4. HDMI cables and CAT6 Ethernet cables, lengths as required.

2.06 MANUFACTURER OR VENDOR SERVICES

A. Provide Manufacturer’s or Vendor’s personnel to provide on-site services to the Contractor.

B. Provide expenses for onsite services to include:

1. Installation supervision
2. Testing
3. Commissioning
4. Training: Specified in 3.03.

C. Provide Extended Warranty and Support to include:

1. Annual hardware and software maintenance program.
2. Periodic software updates to the Video Control Center software and REV firmware.
3. Factory telephone support.

2.07 SPARE PARTS

Not Required.

2.08 PRODUCT DATA

A. Manufacturer's operation and maintenance information as specified in Section 01730. Manual shall include final reviewed submittal and separate record of all final configuration, jumper, and switch settings.

B. Test results.

C. Installation and training forms specified in Part 3.

PART 3 – EXECUTION

3.01 INSTALLATION

The equipment shall be installed and tested in accordance with the manufacturer’s written recommendations by a qualified, factory trained manufacturer's representative.

The equipment shall be fabricated in accordance with NEMA ICS and installed in accordance with NECA-1 procedures.

Install cameras similar to existing camera installation at SEWRF. See picture below for installation example. Coordinate with Owner and adjust camera position/angle as required for optimum viewing as determined by Owner.

Camera displays shall be mounted in the NRF Operations Office. SI and Owner shall coordinate regarding the installation and configuration of the displays and accessories for fully functional system. Cameras shall connect to NR85-VCP-101 POE switch via CAT 6 Copper Cable. SI shall provide a new Fiber Optic switch in the Administrator Building Operations Room for the Camera Displays to connect via CAT 6 Copper Cable. The new ethernet switch shall connect to the existing Admin Building Operator Room Fiber Optic Patch Panel. SI shall coordinate with Owner regarding correct fiber pairs to Admin Building as well as location of existing Fiber Optic Patch Panel.

SI to supply the 48VDC POE managed switch mentioned in 2.02 A.3 of this section to the BFP Vendor for installation inside NR85-VCP-101 by the BFP Vendor. POE switch configuration by the SI. SI and BFP Vendor shall coordinate installation.

3.02 FIELD TESTING

Testing shall conform to the requirements of Section 01660.

Performance tests shall be conducted during field testing to measure the following characteristics camera control, alarms, etc.

3.02 TRAINING

Approved camera vendor shall provide 1-hour onsite training with Plant Operations after installation is complete.

END OF SECTION

SECTION 17765

FIBER OPTIC COMMUNICATION EQUIPMENT

PART 1 – GENERAL

1.01 SCOPE

Provide the fiber optic appurtenances required to complete the fiber optic cabling system. Refer to Specification 16000 for additional information regarding requirements for fiber optic data communication cables including installation, terminations, and testing.

1.02 QUALITY ASSURANCE

A. REFERENCES:

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/ICEA S-87-640	Standard for Optic Fiber Outside Plant Communications Cable.
BELLCORE GR-20-CORE	Generic Requirements for Optical Fiber and Optical Fiber Cables
BELLCORE GR-409-CORE	Generic Requirements for Intrabuilding Fiber Cable
BELLCORE GR-487-CORE	Generic Requirements for Electronic Equipment Cabinets
BELLCORE GR-771-CORE	Generic Requirements for Fiber Optic Splice Closures
ISO-9001	Quality Management Systems
NFPA 70	National Electric Code (NEC)
TIA/EIA-455-86	FOTP-86 Fiber Optic Cable Jacket Shrinkage
TIA/EIA-455-107A	FOTP-107 Determination of Component Reflectance or Link/System Return Loss Using a Loss Test Set
TIA/EIA-492AAAC	Detail Specification for 850 nm Laser-Optimized, 50µm Core Diameter/125 µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers
TIA/EIA-598-B	Standard for Optical Fiber Cable Color Coding

1.03 SUBMITTALS

The following information shall be submitted for review in accordance with Section 01300:

A. Product literature, submit complete under Section 17110:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.

Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. A copy of the contract document drawings showing fiber optic system terminations and appurtenances, marked to show specific changes necessary for the supplied equipment.

   If no changes are required, the drawings shall be marked "*No Changes Required."*

3. Manufacturer's catalog literature and catalog data sheets for the following items, marked to indicate products proposed, as applicable to the project:

   a. Fiber optic patch cords

   b. Fiber optic termination panels

4. Shop drawings:

   a. Termination panel fabrication and layout drawings with complete list of materials and nameplate engraving list.

   b. Interconnection cable diagrams for the complete system, showing each fiber and color in each cable. Each termination point shall be clearly marked.

PART 2 – PRODUCTS

2.01 FIBER OPTIC CABLE PATCH CORDS

A. GENERAL:

Provide preparation for the connections including polishing, connectors, hardware, cleaving tool, continuity tester, visual fault locator, and supplies for installation of connectors. Terminations shall be ST type. Fusion-spliced pigtails are acceptable.

Fiber optic cable connections shall be provided with ceramic ferrules; polycarbonate not acceptable.

B. MULTIMODE PATCH CORD CHARACTERISTICS:

A. Description:
1. Patch cords shall be 3.0 mm single coated duplex fiber with jacket and connectors on both ends. Attenuation shall be a maximum of 0.3 dB. Provide length required for connection from patch panel to equipment.

2. Outdoor; Heavy Duty-MFPT; Cable Tray Rated.
3. Loose tube construction. Optical fibers shall not adhere to the inside of the buffer tube.
4. Fibers and buffer tubes shall be color coded with distinct and recognizable colors in accordance with EIA/TIA-598-B.

B. Material:
1. 62.5/125/250 micron.

C. Jacket:
1. Chlorinated Polyethylene (CPE); Color: Orange
2. Mark the exterior sheathing with the manufacturer's name, month and year of manufacture, and sequential meter or foot markings for easily determining the length of the cable at all points along the cable run.
3. Provide a telecommunication handset symbol as required by Section 350G of the National Electrical Safety Code® (NESC®), fiber count, and fiber type.

D. Type:
1. OFNR with industrial cable tray rating and IEEE flame test rated: 802.3Z
2. Fiber Type: Multimode
3. Clad Diameter: 125 ± 2.0 µm
4. Coating Diameter: 245 ± 5 µm
5. Core Diameter: 62.5 ± 2.5 µm
6. Attenuation:

≤ 3.5 dB/km @ 850 nm

≤ 1.0 dB/km @ 1300 nm
7. Maximum Bandwidth: 200 MHz-km @ 850 Nm
8. Operating Temperature Range: -40 to +70 Deg C
9. Maximum Tensile Loading: 180 lbf
10. Minimum Cable Bending Radius: 10 x diameter

E. Manufacturers:
1. Alcoa Fujikura
2. Optical Cable Corporation
3. Corning Cable Systems
4. or approved equal

2.02 FIBER OPTIC PANELS

A. GENERAL:

Fiber optic patch panels shall consist of a system of components for routing, supporting, and terminating the fiber optic cables specified herein. Terminations shall be ST type. Fiber optic cable connections shall be provided with ceramic ferrules, polycarbonate not acceptable.

B. DESCRIPTION:

Provide the following:

1. Wall-mounted type fiber optic patch panels constructed of aluminum or steel with removable hinged metal doors.

2. Mounting hardware, cable clamps and grommets, cable routers, storage decks, connector racks, and items for a complete system.

3. With a machine printed port labeling system.

4. Cable routers and storage decks to retain cables' minimum bending radius.

5. Sufficient quantity of ports to terminate the number of fiber strands specified and blank covers for unused port spaces.

6. One port for each fiber in accordance with the specified cable type.

Panel shall be Corning Cable Systems ICH or equal.

2.03 PRODUCT DATA

The following information and product data specified under individual specification sections shall be provided in accordance with Section 01300.

1. Manufacturer's operation and maintenance information as specified in Section 01730. Manual shall include final reviewed submittal.

PART 3 – EXECUTION

3.01 FIBER OPTIC CABLE TERMINATIONS

A. Prior to beginning the splicing, provide a work area to protect the cable splices from physical damage.

B. Work shall be performed by trained and qualified technicians in accordance with the manufacturer's recommendations in the performance of installation, splicing and termination work.

C. Active and spare fiber optic cables fibers shall be provided with a breakout kit, terminated with ST type terminations, and connectors finished with an automatic polishing machine such as Corning SP500 Automatic Polisher or equal.

1.02 FIELD TESTS

A. General:
   1. Perform field tests on each fiber of each cable and tested for breaks, abnormalities, and attenuation characteristics for the attenuation specifications specified herein.
   2. Construction Manager shall witness testing and final checkout of the fiber optic system to determine fiber-optic cable system acceptability.
   3. Submit the testing report.

B. Test Equipment:
   1. Test equipment shall have a calibration sticker indicating the equipment has been calibrated within the preceding 6 months and the other requirements in accordance with Section 01410.
   2. Equipment for testing of the fiber optic cable; testing equipment shall be supplied and will remain the property of the Contractor unless otherwise specified:
      a. Fiber Optic Test Set:
         1) Corning Cable Systems Multimode MD55, LTK-400MD, or equal.
      b. Optical Time Domain Reflector (OTDR):

1) GNNettest Mini-OTDR Model 7500, Corning Cable Systems OTDR Plus 838-MD55-SRSD55 with plug-in module for multi-mode cable, or equal.

c. Fiber Optic Telephone Set:

1) Corning Cable Systems FTS-110, or equal.

d. Jumpers, connectors, adapters, 1-km backscatter suppression kit, attenuators, and miscellaneous items.

C. Pre-Installation Test:

1. After delivery and before cable installation, generate an end-to-end OTDR trace for each multimode fiber at 850 Nm wavelengths using the index of refraction for that fiber.
2. Use a 1-kilometer backscatter suppression fiber with a splice index-matching gel and submit traces that for the total optical length.
3. Submit test documentation within 5 days after the delivery test.
4. Replace cables that do not meet the performance levels of the manufacturer's factory tests at no additional cost or change in the completion schedule.

D. Post-Installation Tests:

1. Fibers shall be tested end-to-end after cable installation with an end-to-end OTDR trace made at 850 Nm wavelengths and record total optical length.
2. Use a 1-kilometer backscatter suppression fiber for OTDR testing.
3. For each 850 nm installed multimode optical fiber, the measured optical power loss in dB shall not exceed the following:
   a. Measured loss less than: (0.0030) L + (0.30) N + (0.4) C + 3.00 dB
4. Fiber optic cables containing fibers not meeting the specified power loss shall be repaired or replaced.

E. End-To-End Olts Attenuation Verification:

1. Test each optical fiber for end-to-end attenuation with an Optical Loss Test Set (OLTS) after the cable is installed with a stabilized optical source and power meter.
2. Test shall be conducted per TIA/EIA 526-14 Method "B."
3. Measured loss: Value of the reference measurement minus the algebraic average of the separate measurements.
4. Fiber optic cables containing fibers not meeting the specified optical power loss shall be repaired or replaced.

F. Site Acceptance Inspection: Perform inspection of the following:

1. Fiber splices:
   a. Neatly organized.
2. Connectors:
   a. Capped and undamaged.

3. Cabling:
    a. Organized with no excessive bending.
4. Cable entrances to the cabinets secured.
5. Unused cable delivered to the Owner.

G. Identify cables with the directories installed in each fiber cabinet. Label/identify fiber pairs to describe the function and destination or origin. Discrepancies found during the inspection of the fiber installation shall be noted. Inform the Construction Manager upon resolution and completion of the noted items.

END OF SECTION

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SECTION 17995

CONTROL STRATEGIES

PART 1 – GENERAL

1.01 DESCRIPTION

A. These control strategies are not intended to apportion work or responsibility for work among subcontractors, suppliers and manufacturers, but are offered as a guide for programming, startup, and checkout. They describe how the system is to operate, and do not necessarily include every component required to make the system function.

B. For the purposes of this section, "Existing" refers to those structures, devices, or items of equipment which were a part of the process system prior to the work done under this Contract.

C. Control strategies describe sequential and interlocking control functions, analog control functions, color-graphic video display HMI Computers and Operator Interfaces and alarm and event logging. All control functions shall be programmed in the PLCs and HMI computers/ OITs shall perform supervisory functions.

D. The Owner will configure and update HMI computer screens/ SCADA System to match the existing HMI process graphic displays, equipment status and alarming requirements for the abnormalities of the process and malfunctions of equipment.

E. BFP programmer shall coordinate with Owner regarding reusing and modifying the final SERF BFP plc programs for this project.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 CONTROL STRATEGIES

The following control strategies are included in this section and describe general control features for all systems.

1 Discrete Point Status
2 Analog Point Status

3 General Ready, Running and Failure System
4 SCADA Inputs and Outputs Distribution and Control Requirements
5 General Recording System
6 General Contact/Logic System
7 General Process Control Function (Analog) System
8 Trend Plots
9 Color Notation for Dynamic Objects on Control Graphic Display Screens
10 Digital Alarm System
11 Digital Status System
12 Adjustable Frequency Drive Alarms
13 Belt Filter Press/ Washwater Valve/ Booster Pump/ Hydraulic Pump
14 Polymer Pumps
15 Sludge Feed Pumps
16 Conveyors and Truck Load Out Valves
17 Cake Pumps

CONTROL STRATEGY 1

DISCRETE POINT STATUS

Reference Drawings

All P&IDs.

System Components

In accordance with P&IDs.

Description

The status of each discrete input point shall be maintained in the SCADA system database. The status of each logical discrete point shall also be maintained in the SCADA system database. Logical points are points which depend upon the status of one or several discrete input points.

For example, an equipment failed logical status will result from a loss of ready status when running. Loss of ready status when NOT running will not result in a failed logical status.

SCADA

Calculate and maintain the status of all discrete and logical discrete status points in the SCADA system database.

END OF CONTROL STRATEGY 1

CONTROL STRATEGY 2

ANALOG POINT STATUS

Reference Drawings

All P&IDs.

System Components

In accordance with P&IDs.

Description

Analog input points shall be checked for the following status conditions:

Failed:	Point value is less than or greater than the specified value range typically, less than 3.6 milliamps (mA) and greater than 21.6 mA.
Low Alarm:	Point value is equal to or less than a predetermined alarm value.
High Alarm:	Point value is equal to or greater than a predetermined alarm value.
Normal:	Point value is within the predetermined low and high alarm values.

An analog point which is in alarm status shall not be changed to normal status until the point value changes by the predetermined deadband value for the point.

SCADA

Failed, high alarm, low alarm, and deadband values shall be maintained in the SCADA system database. These limits may be changed via the SCADA programmer.

Point status shall be maintained in the SCADA system database. Discrete alarm outputs shall be driven from the point status.

END OF CONTROL STRATEGY 2

CONTROL STRATEGY 3

GENERAL READY, RUNNING AND FAILURE SYSTEM

Each motor-driven piece of equipment shall have "READY" and "RUNNING" status inputs to the SCADA system. A "READY" status indicates that there are no interlocks preventing the remote starting of this equipment. If the equipment is equipped with one or more HAND-OFF-AUTO switches, the "READY" status will not indicate "READY" status unless all the switches are in the AUTO position. If a "RUNNING" input status occurs and the "READY" status does not occur, the SCADA system shall identify that the motor is operating in the HAND mode.

The run time shall be calculated and stored for all equipment being monitored. This function shall be equivalent to a conventional elapsed time meter to include the tenth of an hour digit and shall include: Today's Total and Yesterday's Total and Cumulative Total. An adjustable timer shall be available to set a flag for maintenance of equipment. A summary of equipment requiring maintenance shall be printed out upon plant operator request.

The failure of driven equipment shall be monitored by the SCADA system. Equipment shall be considered failed under the following conditions:

1. The equipment is in AUTO and the SCADA system attempts to operate the equipment and it does not respond within a defined time period.

2. The equipment is in AUTO and running and for whatever reason other than the SCADA system requesting the equipment to "STOP," the equipment stops.

In addition, specific equipment is required to provide a "Trouble" or "Fault" input into the SCADA system. This input shall be added to the internal logic described in items 1 and 2 above so that any one of these events shall trigger a "FAIL" alarm.

The SCADA system shall be used to the extent that it shall facilitate sequencing of the equipment. The plant operator shall be able to bypass the sequencing and START/STOP the equipment and OPEN/CLOSE valves and gates on a "MANUAL" procedure from the hand switches when desired. Interface to the SCADA system shall be through I/Os or workstations or laptops.

END OF CONTROL STRATEGY 3

CONTROL STRATEGY 4

SCADA INPUTS AND OUTPUTS DISTRIBUTION AND CONTROL REQUIREMENTS

Reference Drawings

Various P&IDs

Description

SCADA system I/O assignment shall be as shown on the P&IDs.

Upon failure of a process equipment, SCADA system shall start the next available unit, as described in the applicable control strategy.

Upon failure of a PLC input/output module, SCADA system shall skip equipment controlled by PLC input/output module and go to next process unit in the lead-lag sequence.

For example, two pumps' input/outputs shall be equally distributed to two different I/O modules. If three pumps are required and only two input modules and two output modules are available, then as a minimum, two pumps shall be assigned to one set of input/output modules while the third pump shall be assigned to the second set of input/output modules.

Note that "pumps" are used to describe the I/O distribution requirements. The concept shall be extended to all process equipment including, valves, gates, instruments for level, flow, pressure, etc.

END OF CONTROL STRATEGY 4

CONTROL STRATEGY 5

GENERAL RECORDING SYSTEM

Reference Drawings

All P&IDs

Description

HMI workstations shall generate reports based upon process variables (pressure, flow, temperature, level and analytical) and equipment status (speed, and motor current) in real-time and from recent historical data.

All motors greater or equal to 40 HP shall be included under this recording requirement. All instruments shown on the P&IDs with PIRxxxx. FIRxxxx, TIRxxxx, LIRxxxx, and AIRxxxx shall also be included under this recording requirement (where xxxx indicates instrument tag number).

END OF CONTROL STRATEGY 5

CONTROL STRATEGY 6

GENERAL CONTACT/LOGIC SYSTEM

Reference Drawings

All P&IDs

Description

All digital/logic control functions shall be provided as required and shall include but not be limited to the following:

- Digital/Logic Functions--The ability to perform logic and sequencing functions shall be supported to provide control interlocks, event sequencing and other logic operations.

- Boolean Algebra requirements--AND gate, OR gate, NAND gate, NOR gate, XOR gate, and NXOR gate.

- Logic requirements--Logic switch, logic compare, bi-directional time delay, and on-off with feedback.

- Ladder Logic requirements--NO contact, NC contact, energize coil, latch/unlatch coil, retentive timer on/off delay, up/down counter, counter/timer reset, ladder execution control, immediate input, and immediate output.

END OF CONTROL STRATEGY 6

CONTROL STRATEGY 7

GENERAL PROCESS CONTROL FUNCTION (ANALOG) SYSTEM

Reference Drawings

All P&IDs

Description

All analog control functions shall be provided as required and shall include but not be limited to the following:

- Proportional-Integral-Derivative (PID) Control--Standard controller functions with balanceless, bumpless transfer from manual to automatic, manual overrides, external reset and output summing capabilities. Provision for cascade, ratioing gain, bias, lead-lag, dead-time, feedforward and feedback control shall be available.

- HMI display system shall have a common PID controller operator interface for all equipment utilizing PID control. Controller operator interface shall include alphanumeric and graphic indication of the following features as a minimum:
    - ID of controlled equipment
    - ID of process variable input
    - Controller setpoint value
    - Process variable value
    - Controller output value
    - Setpoint adjustment interface
    - Indication if setpoint is under local or remote control
    - Local/Manual control output adjustment interface
    - Indication if control output is under local/manual control or under control of process controller.

- Computational Functions--On-line mathematical functions shall be available to provide real-time computational capability of control variables for use in feed-forward and other advanced control functions.
- All setpoints for alarm and control shall be adjustable from password-protected HMI Computer screens.

Appropriate control action(s) shall be provided as needed.

END OF CONTROL STRATEGY 7

CONTROL STRATEGY 8

TREND PLOTS

Reference Drawings

All P&IDs

Description

HMI workstations shall graphically plot trends of process variables (pressure, flow, temperature, level and analytical), controller setpoints and outputs, and equipment status (speed and motor current) in real-time and from historical data. The plant operator shall be able to select the plotting interval, within the limits of the actual data collection. Four trends per display view shall be possible.

In addition to the plotted data, a trend shall include:

- Time
- Date
- Tag number
- Plotting interval
- Time at start
- Time at latest value

END OF CONTROL STRATEGY 8

CONTROL STRATEGY 9

COLOR NOTATION FOR DYNAMIC OBJECTS ON CONTROL GRAPHIC DISPLAY SCREENS

Reference Drawings

All P&IDs
All control strategies

Description

All dynamic objects on control graphic display screens shall be provided with multiple-color display to identify status as tabulated below:

Equipment	Status	Required color
Motor	Running	Red
Motor	Ready	Green
Valve	Open position	Red
Valve	Closed position	Green
Gate (both slide and sluice)	Open position	Red
Gate (both slide and sluice)	Closed position	Green
All	Abnormal condition	Amber (Yellow)

END OF CONTROL STRATEGY 9

CONTROL STRATEGY 10

DIGITAL ALARM SYSTEM

Reference Drawings

All P&IDs, electrical control diagrams, and vendor drawings

System Components

In accordance with P&IDs.

Description

All digital input alarms shall be provided as shown on P&IDs or listed in the instrument index (Section 17200) whether or not specific control strategies are provided. Whenever a P&ID is not shown with any On/Off, Start/Stop, Open/Close or analog modulation control, no specific control strategy will be written even if a digital alarm system is shown on the drawing. For this condition, control strategy 10 shall be applicable. Digital inputs can be from field instruments (level switches, pressure switches, etc.), local control panels (relay outputs, alarm module outputs, switches), and packaged systems (designated terminals with packaged units). A manual reset is required at the equipment control panel; Reset from SCADA is not acceptable.

On a power failure, equipment shall return to the ready state when power is returned. Given the process condition, the lead piece of equipment shall start if called for. The lag and lag-lag, etc., starting sequence shall be staggered at 15-second intervals (adjustable) depending on the process. Operations shall designate this time during startup.

END OF CONTROL STRATEGY 10

CONTROL STRATEGY 11

DIGITAL STATUS SYSTEM

Reference Drawings

All P&IDs, electrical control diagrams, and vendor drawings

System Components

In accordance with P&IDs.

Description

All digital input status shall be displayed on HMI screens as required by the reference drawings and specifications regardless whether or not specific control strategies are provided. Each digital input shall be shown in its appropriate process screen and/or equipment status screen. Digital inputs can be originated from field instruments (motorized actuators, HVAC related air handling units, power management related contact inputs, level switches, pressure switches, etc.), local control panels (relay outputs, alarm module outputs, switches), and packaged systems (designated terminals with packaged units).

All equipment HOA selector switch Auto mode status contact is to be monitored by the PLC. When the HOA switch is not in the Auto mode the SCADA system shall display “Not in Auto” for that respective piece of equipment.

END OF CONTROL STRATEGY 11

CONTROL STRATEGY 12

ADJUSTABLE FREQUENCY DRIVE ALARMS

Description

Each adjustable frequency drive shall be provided with direct one on one hard-wired interfaces to the SCADA system. This interface shall provide control and monitoring of the adjustable frequency drive and the driven equipment including the motor.

SCADA Annunciation

The SCADA system shall display or annunciate (as indicated) the following conditions for each adjustable frequency drive and its driven equipment:

Off -	Display
Running -	Display
Speed Feedback -	Display
Failure -	Annunciate
High Pressure -	Annunciate

END OF CONTROL STRATEGY 12

CONTROL STRATEGY 13

BELT FILTER PRESS/ WASHWATER VALVE/ BOOSTER PUMP/ HYDRAULIC PUMP

Reference Drawings:

All P&IDs, electrical control diagrams, and vendor drawings.

System Components:

In accordance with contract drawings, P&IDs and as called out in the specifications.

Description:

A project-specific controls description shall be provided by the BFP Vendor describing the proposed programming control strategy for review and coordination with the Owner's SCADA system.

END OF CONTROL STRATEGY 13

CONTROL STRATEGY 14

POLYMER PUMPS

Reference Drawings:

All P&IDs, electrical control diagrams, and vendor drawings.

System Components:

In accordance with contract drawings, P&IDs and as called out in the specifications.

Description:

A project-specific controls description shall be provided by the BFP Vendor describing the proposed programming control strategy for review and coordination with the Owner's SCADA system.

END OF CONTROL STRATEGY 14

CONTROL STRATEGY 15

SLUDGE FEED PUMPS

Reference Drawings:

All P&IDs, electrical control diagrams, and vendor drawings.

System Components:

In accordance with contract drawings, P&IDs and as called out in the specifications.

Description:

A project-specific controls description shall be provided by the BFP Vendor describing the proposed programming control strategy for review and coordination with the Owner's SCADA system.

END OF CONTROL STRATEGY 15

CONTROL STRATEGY 16

CONVEYORS AND TRUCK LOAD OUT VALVES

Reference Drawings:

All P&IDs, electrical control diagrams, and vendor drawings.

System Components:

In accordance with contract drawings, P&IDs and as called out in the specifications.

Description:

A project-specific controls description shall be provided by the BFP Vendor describing the proposed programming control strategy for review and coordination with the Owner's SCADA system.

END OF CONTROL STRATEGY 16

CONTROL STRATEGY 17

CAKE PUMPS

Reference Drawings:

All P&IDs, electrical control diagrams, and vendor drawings.

System Components:

In accordance with contract drawings, P&IDs and as called out in the specifications.

Description:

A project-specific controls description shall be provided by the Cake Pump Vendor describing the proposed programming control strategy for review and coordination with the Owner's SCADA system.

END OF CONTROL STRATEGY 17