1112 Manatee Ave. West
Bradenton, FL 34205
purchasing@mymanatee.org

Solicitation Addendum

Addendum No.:	3
Solicitation No.:	19-TA003062AJ
Project No.:	6092080 & 6092180
Solicitation Title:	SEWRF RAS / WAS Upgrade and Plant Drain Pump Stations Projects
Addendum Date:	September 27, 2019
Procurement Contact:	Abigail Jenkins

IFBC NO. 19-TA003062AJ IS AMENDED AS SET FORTH HEREIN. RESPONSES TO QUESTIONS POSED BY PROSPECTIVE BIDDERS ARE PROVIDED BELOW. THIS ADDENDUM IS HEREBY INCORPORATED IN AND MADE A PART OF IFBC NO. 19-TA003062AJ.

Change to:

DATE, TIME AND PLACE DUE:

The Due Date and Time for submission of Bids in response to this IFBC is October 8, 2019 at 3:00 P.M. ET. Bids must be delivered to the following location: Manatee County Administration Building, 1112 Manatee Ave. W., Suite 803, Bradenton, FL 34205 prior to the Due Date and Time.

Change to:

SECTION A, INFORMATION FOR BIDDERS, A.O1, BID DUE DATE

The Due Date and Time for submission of Bids in response to this Invitation for Bid (IFBC) is October 8, 2019 at 3:00 P.M. ET. Bids must be delivered to the following location: Manatee

County Administration Building, 1112 Manatee Ave. W., Suite 803, Bradenton, FL 34205 and time stamped by a Procurement representative prior to the Due Date and Time.

Scheduled Item	Scheduled Date
Final Addendum Posted	**September 27, 2019**
Bid Response Due Date and Time	**October 8, 2019 @ 3:00 PM**
Due Diligence Review Completed	**October, 2019**
Projected Award	**October, 2019**

ADD:

BID ATTACHMENT 6, GEOTECHNICAL REPORT.

The attached Bid Attachment 6, Geotechnical Report, is hereby incorporated into the IFBC.

ADD:

BID ATTACHMENT 7, Fig 02202-F1 EMBEDMENT'S FOR CONDUIT

The attached Bid Attachment 7, Fig 02202-F1 Embedment's for Conduit, is hereby incorporated into the IFBC

ADD:

BID ATTACHMENT 8, CONDUIT RISER DETAILS.

The attached Bid Attachment 8, Conduit Riser Details, is hereby incorporated into the IFBC

ADD;

ATTACHMENT 3, TECHNICAL SPECIFICATION, DIVISION 16-ELECTRICAL, SECTION 16050

The attached Technical specification, Division 16-Electrical, Section 16050, is hereby incorporated into Attachment 3 of the IFBC.

ADD:

ATTACHMENT 3, TECHNICAL SPECIFICATION, DIVISION 16-ELECTRICAL, SECTION 16100

The attached Technical specification, Division 16-Electrical, Section 16100, is hereby incorporated into Attachment 3 of the IFBC.

CHANGE TO:

ATTACHMENT 3, SECTION 15064, ITEM 2-1.04 Material Classification SS-4

Section 15064 Item 2-1-4 Material Classification SS-1

SS-1 – Schedule 10S With Beveled Ends PDPS Piping	Pipe	ASTM A312, Grade TP316L Buttwelded,
	Fittings	ASTM A403, WP316L. Fittings shall conform to ASMI/ASME B16.9, Schedule 10S with Beveled ends.

½ inch and larger.

QUESTIONS AND RESPONSES:

Q1. What is the engineer estimated cost for this bid?
R1. The engineer's estimate of cost is $4,225,00.00.

Q2. What is the engineer estimated completion time?
R2. Refer to Article A.45 of the IFBC Documents

Q3. Since there is a site visit following the non-mandatory pre-bid & the site visit is required for us to attend if we plan on bidding, will we need to be at the pre-bid as well?
R3. No, it was a non-mandatory information conference, the site tours are mandatory.

Q4. We are requesting for a second Mandatory Site Visit for above mentioned project. Please let us know via email or addendum if there is a possibility for a Second Site Visit.
R4. Mandatory site tours were provided on August 27, 2019 and September 13, 2019. Both dates were published on the County Web site and DemandStar. No additional site visits will be scheduled**.**

Q5. The following sections do not list approved manufacturer. We request clarification on the approved manufacturers for the following Equipment sections:
RAS/WAS System Upgrades Section 11115, Section 11130, Section 11160
SEWRF Plant Drain PS, Section 11150 (South), Section 11150 (West), Section 11151
R5. Section 11160 requires Seepex type BN 52-6LS without exception. Section 11151 requires Barney's Pumps or approved equal. For all other specifications listed, the pumps are required to meet the specification.

Q6. Our company is looking at bidding this project for Manatee County, and I would like to get a chance to visit the site in order to prepare an accurate estimate. I will just need to take some measurements and look over the site briefly. Please let me know when I could accomplish this to fulfill the wording of the specifications.

R6. See response to question 4.

Q7. Section 11130 2-6.06 regarding the adjustable frequency drives requires the pump manufacturer to be responsible for furnishing these drives (the same language is present in sections 11115 & 11160). A similarly worded spec in another Manatee County Bid was changed to remove that requirement from the pump manufacturer and enable us as the Prime Contractor to furnish these drives either directly or through our Electrical/Instrumentation & Control subcontractor. Would it be possible to incorporate that change into this project? Our pump manufacturers do not generally desire to provide the drives.

R7. The pump manufacturer shall be responsible for furnishing the drives, as well as coordinating the design to limit harmonics, in accordance with the specifications.

Q8. The south plant drain pump station is specified to get a wet well liner and the west drain pump station is specified to get a fiberglass liner. May GML Coatings be an option for the lining materials for both structures? GML Coatings is currently under contract with Manatee County for wastewater coatings

R8. The County and the Engineer of Record will not provide review and approval of "or equal" products prior to bid award. Prospective bidders are directed to bid on the products specified within the respective sections of the Technical Specifications. After award of the project, the County and the Engineer of Record will review requests for substitutions from the awarded Contractor, if requested, during shop drawing submittals to determine "or equal" status to the product(s) specified in the Technical Specifications.

Q9. Is there a Geotechnical Report available for this project? The West PDPS excavation is quite deep (~18') and will require shoring. We would like some indication of the subsurface materials in order to determine which method is appropriate.

R9. See Attachment No. 6 Geotechnical Report, issued with this Addendum 3

Q10. I do not see manufacturers listed for Specifications 11115, 11130, 11150, and 11151. Please advise.

R10. See response to question 5.

Q11. Regarding the electrical conduit installations-where they are shown crossing existing roadways / sidewalks, are those to be open cut and patched or directional drilled under? It's difficult to tell from the plans which sections are asphalt, which are concrete, if there is curb to be replaced, please clarify. There is an asphalt restoration detail shown on SW-07, but that is for a specific area shown on SW-02, we need a detail for the conduit patching.

R11. Contractor will be able to dictate means for conduit installation. Drawing G-03 does show asphalt pavement, vs concrete pavement, vs sidewalk. Intent of mandatory site visit was to collect additional information deemed important by the Contractor. Most of the concrete pavement is by the septage receiving facility. Section 02575 specifies the requirements and procedures for pavement repair and restoration. Although limited (generally at roadway curves if at all) conduit/duct bank does cross some curbing as indicated on Drawing E-03.

Q12. The scale on sheet E-03 of the RAS/WAS plan set does not seem to be correct.

R12. The specified scale of 1/64"=1' is correct. However, the incremental scale bar is incorrect.

Q13. I cannot locate the length of time for the shutdown of the RAS/WAS in the Summary or the Special Project Procedures, will this be provided?

R13. Allowable shut down durations are defined in the construction Schedule & Project restraints Specification 01310.

Q14. In the summary of work for the RAS/WAS it states that all cost for providing and operating by-pass system will be borne by the GC, can this be explained?

R14. It is understood that each Contractor may apply varying means and methods to accomplish the scope of work. If the Contractor identifies bypass pumping/piping is necessary to complete the work, the Contractor shall ensure all costs associated with bypassing is included in the Contractor's bid.

As long as Contractor plans accordingly, and meets requirements of 01310, bypass pumping could be avoided for RAS/WAS improvements. When replacing the short section of the common RAS discharge pipe (with Flowmeter), the Contractor could make use of the 8-hour shutdown of the sludge wet well allowed in accordance with Specification 01310. Similarly, when replacing short section of the common WAS discharge pipe (with Flowmeter), the Contactor could make use of the shutdown allowed per Specification 01310. In order to ensure work is done in the allotted time, Contractor may need to pre-fit piping/appurtenances in advance of shutdown (note 11 on M-01).

Q15. Sheet E-06 of the Plant Drain Pump Station – riser diagrams for the plant drain pump stations seem to indicate two wet well junction boxes, one for the pump motor status cables only and one for all the wet well cables. Note #2 indicated the pump control junction boxes to be located under the control panel. Where is the other junction box that has power and control cable routed through is to be located?

R15. E-06 Note 4 applies to umbilical cable from submersible pump to JB located underneath Pump Control Panel. E-06 Note 2 applies to pump motor internal JB where pump motor combined power and signal cables combine.

Q16. Please review and confirm that the following specification section is correct: Specification Section 16050 3-7.01 c. Conduit installed in all exposed outdoor locations shall be rigid aluminum, rigidly supported by stainless steel framing materials. Mounting hardware, which includes nuts, bolts, and anchors, shall be stainless steel. All damaged coatings shall be repaired according to the manufacturer's instructions. I believe this should read "shall be PVC coated rigid aluminum".

R16. The PVC-coated aluminum is only used for underground transition to exposed locations per 16050-3-7.01.z. Conduit riser details to be added to the RAS/WAS Project (drawing E-16) and the PDPS Project (drawing E-13). The PVC-coated aluminum is also for non-concrete-encased underground per 16050-3-7.01.e. Exposed conduit in outdoor locations shall be rigid aluminum per 16050-3-.7.01.c.

Q17. Sheets E12 of the Plant Drain Pump Station and E16 of the RAS/WAS section indicate "ELECTRICAL MANHOLES" both single and double chambers however drawings do not indicate and "MANHOLE" installations, only hand hole installations. Are there any "MANHOLE" installations on this project?

R17. No electrical manholes (MH-XX) are anticipated. Note that only Electrical Handholes (EH-XX) are called out on the electrical site plan drawings.

Q18. Sheet E03, E7 & E8 Plant Drain Pump Station - What is the required pole height at the East and west plant drain pump stations?

R18. Pole heights at the East and West Plant Drain Pump Stations shall be 12-ft as identified in the Lighting Fixture Schedule at the bottom of Sheet E-03.

Q19. Sheet E11 RAS/WAS – Are the poles to be replaced along with the pole mounted fixtures, Note-2?

R19. Existing poles are to remain as identified in the Lighting Fixture Schedule on Sheet e-04. Existing lighting circuits shall be used as noted on e-11 (note 2).

Q20. Sheet E06 Plant Drain Pump Station - What is the fiber count requirement between PLC-SP-1 and the West Plant Drain Pump Station Control panel?

R20. 6 Strand (3 pair) FOC per Sheet e-06.

Q21. Sheet E06 Plant Drain Pump Station - What is the fiber count requirement between PLC-SP-2 and the East Plant Drain Pump Station Control panel?

R21. See response to question 20.

Q22. Sheet E06 Plant Drain Pump Station - What are the branch conductor requirements between Lighting Panel "L1" and the West Plant Drain Pump Station pole lighting?

R22. 2 - #10 wire for 120V power, 1- #10 wire for the 'Ground'

Q23. Sheet E06 Plant Drain Pump Station - What are the branch conductor requirements between Lighting Panel "PT/TC 2A" and the East Plant Drain Pump Station pole lighting?

R23. See response to question 22.

Q24. Regarding sheet D-01, Remove Modular wall Seals (Link Seals), the drawings show these as DIP spool pieces with water stop. Are they in fact Link Seals or DIP spool pieces?

R24. The two 24" DI RAS influent (from Clarifiers to Sludge Wet well) and three 18" DI RAS Pump suction pipes are above grade wall sleeves with modular seals (although the record drawings indicate a DIP spool piece that is casted in place). The two 8" DI WAS Pump suction pipes are below grade and are presumed to have modular seals as well. Contractor will need to confirm this once sludge wet well is drained.

Q25. There are no pump manufacturers list in the specifications for any of the pumps, will they be provided?

R25. See response to question 5

Q26. Specification 03930 states to include 150 ft of concrete crack repair for new concrete, does this need to be included?

R26. Per Section 03930.1-1.02, Contractor shall include 150-LF of crack repair in the bid price. Crack repair is to be Engineer-directed and may include repairs to existing concrete in the area of work including, but not limited to, the RAS/WAS pump station slab, sidewalks, RAS/WAS pump bases or other concrete as deemed necessary for repair by the Engineer.

Q27. I cannot locate the length of time for the shutdown of the RAS/WAS in the Summary or the special Project Procedures, will this be provided?

R27. Allowable shut down durations are defined in the Construction Schedule & Project Restraints specification (01310).

Q28. What manufactures are approved for the "Horizontal End Suction Pumps" and the "Vertical End Suction Centrifugal Pumps"?

R28. See response to question 5.

Q29. I have reviewed specifications 11115 and 11130, respectively, and cannot find any Approved Manufacturers listed.

R29. See response to question 5

Q30. We were wondering if there would be any chance of having another mandatory facility site visit as we missed this one.

R30. See response to question no. 4

Q31. Reference specification section 02202 Trenching and Backfilling 3-4. Pipe Embedment. Unable to locate Figure 1-02202 referenced in this section?

R31. See Attachment 7, Fig 02202-F1 Embedment's for Conduit, issued with this Addendum 3**.**

Q32. Reference specification section 02202 Trenching and Backfilling 3-4. Pipe Embedment. Please confirm that CLSM is to be used for embedment of the 16" pipe from NDPS to SDPS. If required can detail be provided.

R32. In accordance with Specification 02202, Section 3-4, CLSM shall be used for embedment for the 16" pipe. Refer to Figure 1-02202 for detail.

Q33. Reference specification section 02202 Trenching and Backfilling 3-2.07. Temporary Earth Retention Systems. Is pre-drilling and then use of vibratory hammer acceptable in lieu of press-in type method of installing sheet piles.

R33. Pre-drilling followed by the use of a vibratory hammer is not acceptable.

Q34. Reference Project 6092180. Drawing SW-01 Note # 2 stated contractor to provide additional pipe fittings and appurtenances. Unable to locate this additional material list.

R34. The Contractor is responsible for maintaining on site a reasonable level of spare fittings (e.g., 90-degree bends, 45-degree bends) as deemed appropriate to minimize the potential for scheduling impacts due to unforeseen conditions, such as crossing an existing pipe not identified by the Contractor as part of the required field investigations (Note 1).

NOTE: Items that are ~~struck through~~ are deleted. Items that are <u>underlined</u> have been added or changed. All other terms and conditions remain as stated in the IFBC.

End of Addendum

INSTRUCTIONS:

Receipt of this addendum must be acknowledged as instructed in the solicitation document. Failure to acknowledge receipt of this Addendum may result in the response being deemed non-responsive.

AUTHORIZED FOR RELEASE: Chris Daley, CPPO, CPPB

Digitally signed by Chris Daley, CPPO, CPPB
DN: cn=Chris Daley, CPPO, CPPB, o=manatee County Government, ou=Procurement Manager, email=chris.daley@mymanatee.org, c=US
Date: 2019.09.27 16:01:01 -04'00'

REPORT OF THE GEOTECHNICAL INVESTIGATION

SEWRF PLANT DRAIN PUMP STATION IMPROVEMENT
MANATEE COUNTY, FLORIDA

DRIGGERS ENGINEERING SERVICES INCORPORATED
Geotechnical Engineering & Construction Materials Testing

October 12, 2018

Black & Veatch Corporation
3405 W. Dr. Martin Luther King Jr. Blvd.
Suite 125
Tampa, Florida 33607

Attn: Mr. Mike Tache, P.E.
Engineering Manager

RE: Report of the Geotechnical Investigation
SEWRF Plant Drain Pump Station Improvements
Manatee County, Florida
Our File DES 188213

Dear Mike:

In accordance with your authorization, **DRIGGERS ENGINEERING SERVICES, INC.** has completed the authorized geotechnical investigation associated with the subject plant improvements. Presented herein are the results of our field and laboratory testing together with geotechnical recommendations for your consideration.

SCOPE OF SERVICES

Plate I of the report illustrations identifies the respective positioning of five (5) Standard Penetration Test (SPT) borings that were performed at locations which were requested. The test borings were performed utilizing the Standard Penetration Test method of sampling per ASTM D-1586. Logs of the Standard Penetration Test borings are presented in the report attachments reflecting visual together with estimated Unified Soil Classification. The test boring logs also present tabulated and graphically plotted Standard Penetration resistance values corresponding to each sample interval. You will note that at each test boring location the upper six (6) feet was advanced by hand augering as a double-check for any shallow utilities that may not have been

accurately identified. In order to obtain information as to the relative consistency of the surficial soils, hand cone penetration tests were performed. The results of the hand cone penetration tests are also included in the report attachments along with a detailed classification log of the upper 6 feet. Ground surface elevations at each test boring were provided by Black & Veatch Corporation.

A brief description of the Standard Penetration Test method of sampling together with a Hand Cone Penetration test is included in the report attachments.

GENERALIZED SUBSURFACE CONDITIONS

Our test borings have identified the presence of predominantly fine sands within the upper 15 to 18 feet. These fine sands contained silt fines commonly below 8 feet and variable traces of phosphate and cemented sand fragments near the 15 foot sample interval.

Standard Penetration resistance values and hand cone penetration resistance values indicate that the upper fine sands vary from very loose to medium dense in consistency. In fact, at test borings B-1 and B-3, extremely loose conditions were evidenced in the 3 to 6 foot depth interval suggesting the possibility that these areas may have been previously excavated at some point in time and perhaps not backfilled with compaction.

Test boring B-1 at the proposed westerly pump station, which was advanced to a nominal depth of 40 feet, revealed the presence of very soft silty clays in the 18 to 23 foot depth interval followed by medium dense silty sands to some 33 feet. Below 33 feet and continuing to the termination depth, the test boring encountered firm to stiff clays.

Although it is our understanding that there are no seismic design requirements, we would nevertheless assign a Seismic Site Classification "D".

Groundwater was encountered at depths varying from about 4.3 to 7.5 feet below existing grade. This variation in the depth of groundwater is in part due to variations in surface topography. Variations can also occur as a result of subtle differences in the subsurface drainage characteristics of the subsurface soils in response to seasonal rainfall. It should be noted that these observations were obtained during a period following some two (2) months of significant rainfall. Thus we

would anticipate that these water levels are probably reasonably representative of the normal wet season groundwater table.

EVALUATION AND GEOTECHNICAL RECOMMENDATIONS

PLANNED IMPROVEMENTS – Planned improvements include a westerly pump station with the bottom of the pump station mat at approximate EL +17.3 ft. (NAVD88). Associated with this deeper wet well, there will be a valve vault with the bottom of the mat at about EL +28.4 ft. Based upon information provided by your structural staff, the total dead and live loads of the wet well will be approximately 282.2 kips thus resulting in a gross mat pressure of about 2,000 pounds per square foot (psf). The mat pressure below the valve vault was indicated to be about 900 pounds per square foot.

The easterly pump station located at our test boring B-5 will be a package plant made of fiberglass embedded about 8 feet below existing grade and therefore the total vertical stress will be minimal. Indeed, it may be likely that the design of this station may require provisions for uplift resistance.

The improvements will also include installation of a nominal 8 inch diameter pipe that will be embedded with a minimum cover of not less than 3 feet below finished grade.

GEOTECHNICAL RECOMMENDATIONS

Westerly Pump Station - The wet well for the westerly pump station will be founded no more than a couple of feet above very soft clays that were encountered in our test boring. Based upon information provided, we would estimate that the net pressure (gross mat pressure of 2,000 psf minus overburden pressure) will approach 1,000 psf. The application of this pressure immediately above the very soft clays would likely result in excessive total and differential settlement. Accordingly, it is recommended that the clays be removed and replaced with compacted structural backfill. The over-excavation should encompass the limits of the wet well mat plus a margin of not less than 3 feet beyond the mat foundation perimeter. Backfill material should consist of select structural fill comprising the SP to SP –SM Unified Soil Classification or superior compacted to not less than 95% of the Modified Proctor maximum dry density per ASTM D-1557.

The over-excavation and compaction operations will necessitate proper control and management of groundwater. It is recommended that groundwater be lowered to no less than 1 foot below the maximum excavation depth. We would certainly recommend that the contractor employ the services of a qualified dewatering consultant in order to design and install an effective dewatering system in order to effect proper removal and replacement of the underlying soil clays.

The net mat pressure below the valve vault mat is on the order of 350 psf with the base of the mat supported 13 feet above the elevation of the very soft clays. Accordingly, it would not be necessary to remove and replace the clays beneath the valve vault. Subgrade preparation below the valve vault mat should include a program of vibratory compaction utilizing a hand guided vibratory compactor having a minimum drum width of not less than 30 inches. Compaction should consist of no less than ten (10) complete coverages throughout the mat foundation area and continues so as to achieve a uniform density of not less than 95% of the Modified Proctor maximum dry density measured at the bottom of mat elevation and 1 foot below. Again, control and management of groundwater will be important so as to maintain groundwater levels of no less than 1 foot below the bottom of mat elevation.

Easterly Pump Station – Although we have not been provided with any details relative to the subgrade support for the packaged pump station, we would anticipate that it would be supported on a mat foundation potentially sized to provide uplift resistance. In view of the expectation of a negligible net vertical pressure below the pump station mat, routine subgrade preparation should be sufficient. Herein we are referring to utilization of hand guided vibratory compaction equipment at the bottom of the mat elevation to effect a uniform density of not less than of 95% of the Modified Proctor maximum dry density. Naturally, considering the embedment depth of the pump station, appropriate dewatering would be required in order to maintain groundwater levels no less than 1 foot below the maximum excavation depth so as to enable development of appropriate subgrade compaction.

Lateral Earth Pressure Soil Parameters – It is recommended that the following soil parameters be utilized with the calculation of lateral earth pressures upon the embedded structures:

Moist Soil Unit Weight:	110 pcf
Buoyant Soil Unit Weight:	60 pcf
At Rest Lateral Earth Pressure Coefficients:	K_0=0.5

Pipe line – The test borings have identified the presence of predominantly fine sands within the anticipated embedment depth of the proposed piping. Subgrade preparation for the piping should include appropriate compaction of the bottom of the excavation together with compaction of all backfill soils consistent with project specification requirements. It should be noted that the soils encountered in our investigation would certainly be suitable for use as backfill following pipe placement.

Suitability Of Excavated Soils For Use As Backfill – Soils encountered in our geotechnical investigation comprising the SP to SP-SM or SM Unified Soil Classification or the AASHTO A-3 and A-2-4 Soil Classification would be considered suitable for use as backfill for structures or piping. Naturally soils excavated below the original groundwater table will warrant aeration in order to reduce moisture contents to levels suitable for replacement and compaction. Generally it is desirable to control moisture contents to within +/- 2% of the optimum moisture content based upon the Modified Proctor moisture density relationship of ASTM D-1557. You will note that soils comprising the SM Unified Soil Classification or the AASHTO A-2-4 Soil Classification may require more effort to reduce moisture content due to increased silt or clay fines content.

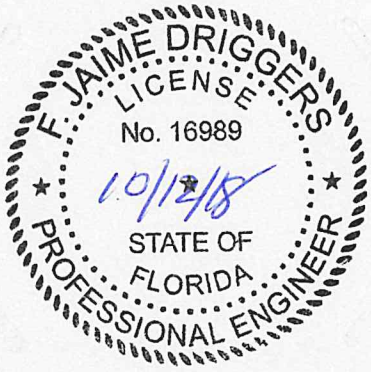
Geotechnical Inspection and Testing – Your requested geotechnical investigation program consisted of test borings at intervals ranging from about 225 to 500 feet apart. The requested scope was obviously intended to depict typical subsurface conditions that are likely to be encountered. However, variations can occur between the boring locations that may reflect conditions that would require special geotechnical considerations. Accordingly, it is recommended that careful geotechnical inspection be performed during construction activities in order to examine subsurface conditions along the pipeline

alignment as well as the pumping station subgrades. In this way, any necessary adjustments in subgrade preparations can be effected.

DRIGGERS ENGINEERING SERVICES, INC. appreciates this opportunity to serve you, and we trust that if you have any questions concerning our report, you will not hesitate to contact the undersigned at your convenience.

Respectfully submitted,
DRIGGERS ENGINEERING SERVICES, INC.

F. Jaime Driggers, P.E.
President
FL Registration No. 16989



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Copies: (1) Email

APPENDIX

PLATE I – BORING LOCATION PLAN

STANDARD PENETRATION TEST BORINGS

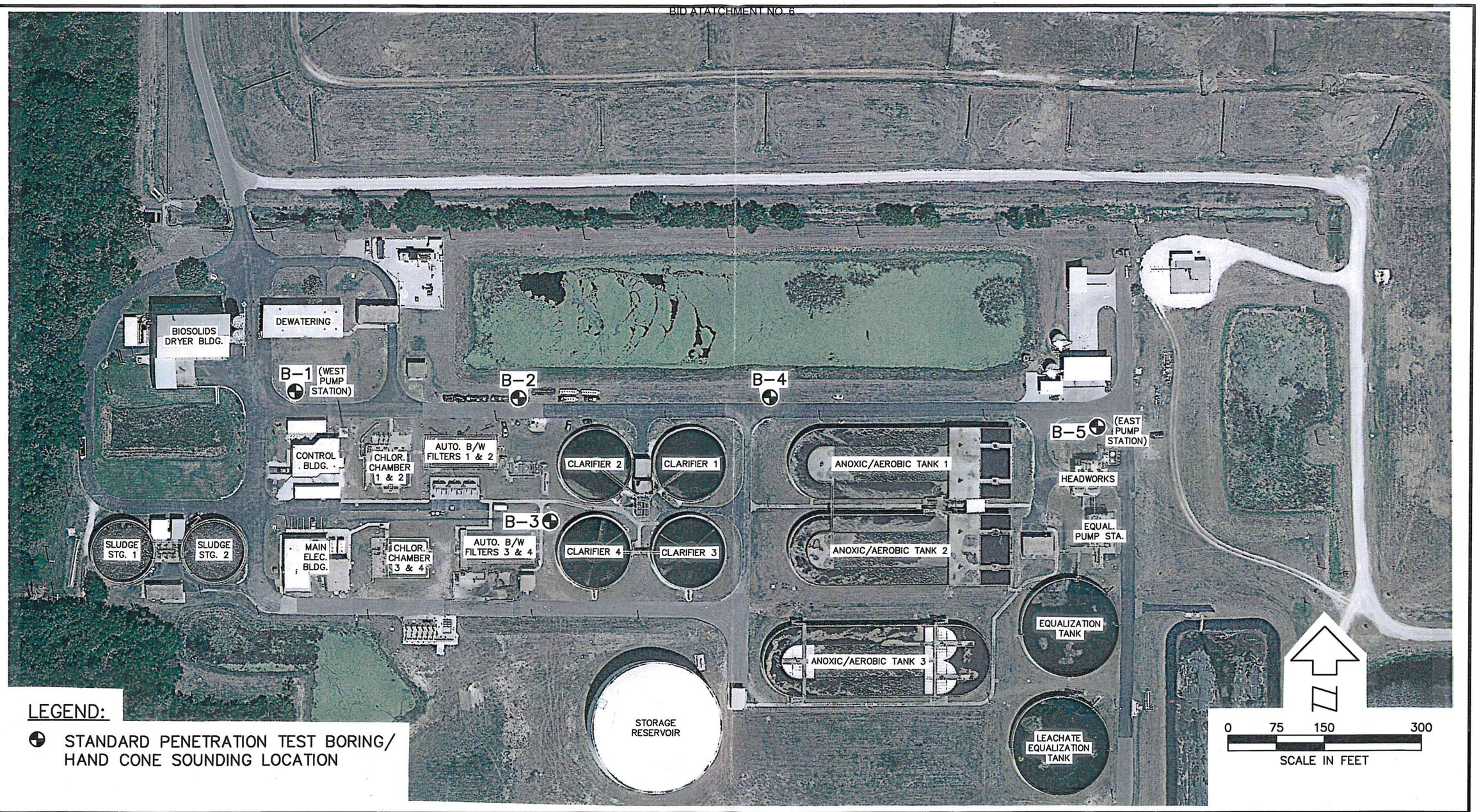
HAND AUGER BORING / HAND CONE SOUNDING LOGS

SUMMARY OF LABORATORY TEST RESULTS

GRAINSIZE ANALYSES

METHOD OF TESTING

PLATE I – BORING LOCATION PLAN



LEGEND:

⊕ STANDARD PENETRATION TEST BORING/ HAND CONE SOUNDING LOCATION

CAD / ENGINEER	SHEET TITLE	PROJECT NO.	DATE
R.D.B. / F.J.D.	BORING LOCATION PLAN	DES 188213	9/13/18
PREPARED BY	PROJECT NAME	SCALE	SHEET NO.
DRIGGERS ENGINEERING SERVICES, INCORPORATED	SEWRF DRAIN PUMP STATION IMPROVEMENTS MANATEE COUNTY, FLORIDA	AS SHOWN	PLATE 1

STANDARD PENETRATION TEST BORINGS

BID ATATCHMENT NO. 6

DRIGGERS ENGINEERING SERVICES INCORPORATED

Project No. DES 188213 **BORING NO.** B-1

Project SEWRF Drain Pump Station Improvements, Manatee County, Florida

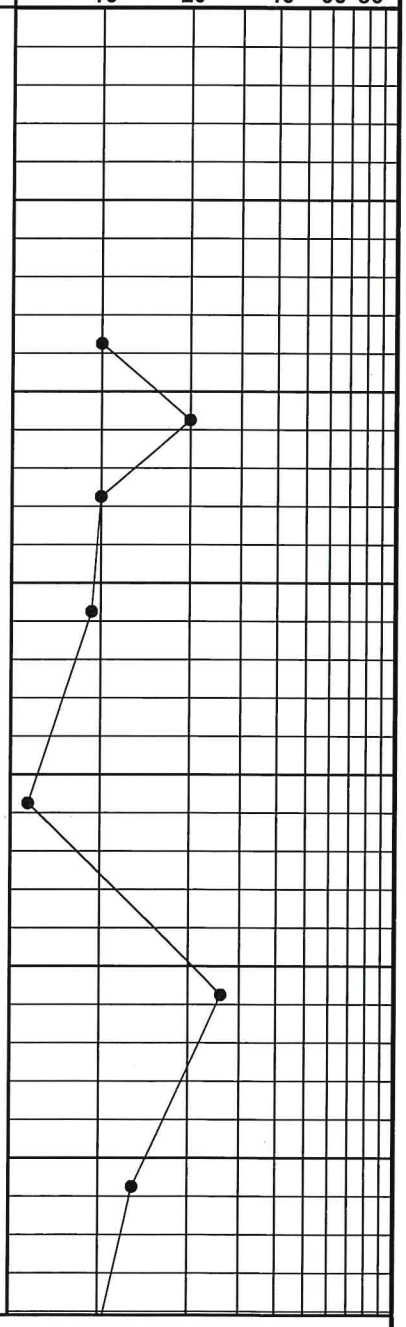
Location See Plate I **Foreman** C.O.

Completion Depth 41.5' **Date** 9/11/18 **Depth To Water** 4.3' **Time** _____ **Date** 9/11/18

DEPTH, FT	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS ON SAMPLER PER 6" OR PEN. STR.
			SURF. EL: +33.0+/-' (NAVD 88)	
0			Dark brown Fine SAND with roots and trace of gravel (SP) (A-3)	
			Brown Fine SAND (SP) (A-3)	
			Grayish-brown Fine SAND (SP) (A-3)	
5			Dark brown Fine SAND (SP) (A-3)	
			Loose to medium dense grayish-brown to gray slightly silty Fine SAND (SP-SM) (A-3)	4/4/6
10				6/9/11
				5/6/4
15			Loose brown slightly silty Fine SAND with trace of cemented sand (SP-SM) (A-3)	9/5/4
			Very soft grayish-brown silty CLAY (CH) (A-7-6)	
20				2/1/1
			Medium dense green silty Fine SAND (SM) (A-2-4)	
25				2/16/10
30				5/7/6
			Stiff to firm green CLAY (CH) (A-7-6)	

STANDARD PENETRATION TEST BLOWS/FT. ON 2" O.D. SAMPLER-140 LB. HAMMER, 30" DROP (AUTOMATIC HAMMER)

10 20 40 60 80



Remarks Borehole Grouted

Casing Length 25.0'

DRIGGERS ENGINEERING SERVICES INCORPORATED

Project No. DES 188213 **BORING NO.** B-1

Project SEWRF Drain Pump Station Improvements, Manatee County, Florida

Location See Plate I **Foreman** C.O.

Completion Depth 41.5' **Date** 9/11/18 **Depth To Water** 4.3' **Time** _____ **Date** 9/11/18

DEPTH, FT	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS ON SAMPLER PER 6" OR PEN. STR.	STANDARD PENETRATION TEST BLOWS/FT. ON 2" O.D. SAMPLER-140 LB. HAMMER, 30" DROP (AUTOMATIC HAMMER) 10 20 40 60 80
			SURF. EL: +33.0+/-' (NAVD 88)		
35			Stiff to firm green CLAY (CH) (A-7-6)	3/4/5	
40				4/4/4	
45					
50					
55					
60					
65					

Remarks Borehole Grouted

Casing Length 25.0'

DRIGGERS ENGINEERING SERVICES INCORPORATED

Project No. DES 188213 **BORING NO.** B-2

Project SEWRF Drain Pump Station Improvements, Manatee County, Florida

Location See Plate I **Foreman** C.O.

Completion Depth 16.5' **Date** 9/11/18 **Depth To Water** 6.2' **Time** _____ **Date** 9/11/18

DEPTH, FT	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS ON SAMPLER PER 6" OR PEN. STR.	STANDARD PENETRATION TEST BLOWS/FT. ON 2" O.D. SAMPLER-140 LB. HAMMER, 30" DROP (AUTOMATIC HAMMER) 10 20 40 60 80
			SURF. EL: +35.7+/-' (NAVD 88)		
0			Brown Fine SAND with roots (SP) (A-3)		
			Grayish-brown Fine SAND (SP) (A-3)		
			Brown Fine SAND (SP) (A-3)		
5			Dark brown Fine SAND (SP) (A-3)		
			Very loose brown Fine SAND (SP) (A-3)	1/1/1	
			Very loose brown to light grayish-brown slightly silty Fine SAND (SP-SM) (A-3)	WH/1/2	
10				WH/1/3	
			Loose gray Fine SAND (SP) (A-3)	4/6/4	
			Very loose gray Fine to Medium SAND with phosphate (SP) (A-3)	1/1/2	
15					
20					
25					
30					

Remarks Borehole Grouted

WH = Weight of Hammer **Casing Length** _____

DRIGGERS ENGINEERING SERVICES INCORPORATED

Project No. DES 188213 **BORING NO.** B-3

Project SEWRF Drain Pump Station Improvements, Manatee County, Florida

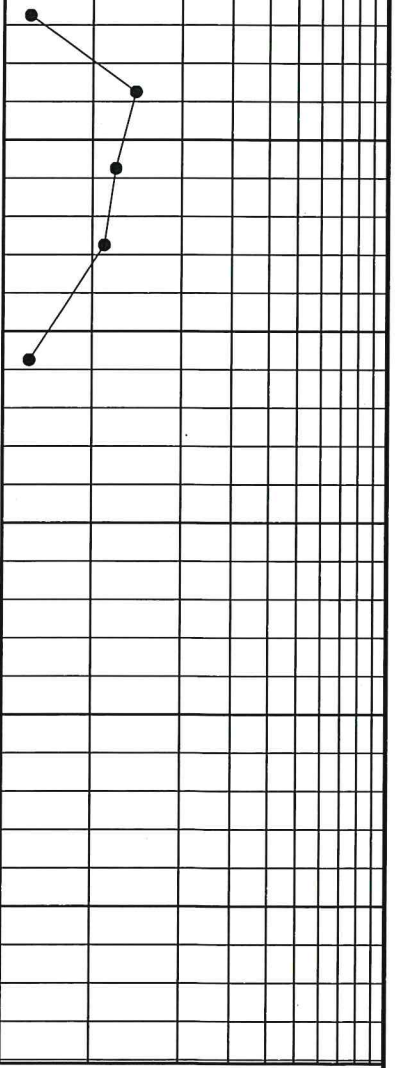
Location See Plate I **Foreman** C.O.

Completion Depth 16.5' **Date** 9/11/18 **Depth To Water** 4.7' **Time** _____ **Date** 9/11/18

DEPTH, FT	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS ON SAMPLER PER 6" OR PEN. STR.
			SURF. EL: +35.1+/-' (NAVD 88)	
0			Dark brown Fine SAND with roots (SP) (A-3)	
			Dark brown Fine SAND (SP) (A-3)	
5			Very loose brown Fine SAND (SP) (A-3)	1/1/2
			Medium dense light grayish-brown Fine SAND (SP) (A-3)	3/6/8
10				4/5/7
				5/5/6
15			Very loose grayish-brown silty Fine SAND with phosphate (SM) (A-2-4)	1/1/2
20				
25				
30				

STANDARD PENETRATION TEST BLOWS/FT. ON 2" O.D. SAMPLER-140 LB. HAMMER, 30" DROP (AUTOMATIC HAMMER)

10 20 40 60 80



Remarks Borehole Grouted

Casing Length _____

DRIGGERS ENGINEERING SERVICES INCORPORATED

Project No. DES 188213 **BORING NO.** B-4

Project SEWRF Drain Pump Station Improvements, Manatee County, Florida

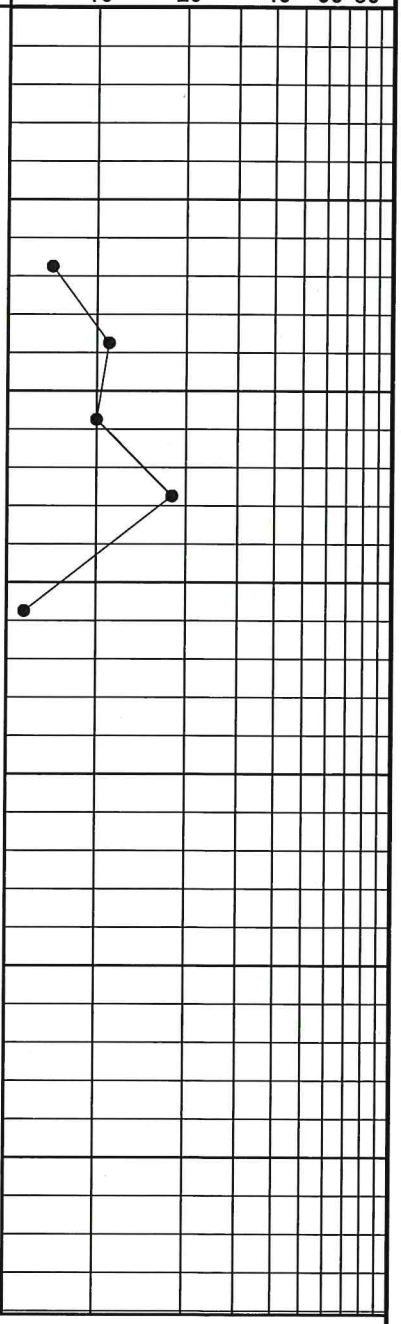
Location See Plate I **Foreman** C.O.

Completion Depth 16.5' **Date** 9/12/18 **Depth To Water** 7.5' **Time** _____ **Date** 9/12/18

DEPTH, FT	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS ON SAMPLER PER 6" OR PEN. STR.
			SURF. EL: +36.4+/-' (NAVD 88)	
0			Dark brown organic Fine SAND with roots (SP-SM/Pt) (A-8)	
			Dark brown Fine SAND (SP) (A-3)	
			Dark grayish-brown Fine SAND (SP) (A-3)	
			Brown Fine SAND (SP) (A-3)	
5			Dark brown Fine SAND (SP) (A-3)	
			Loose dark brown slightly organic Fine SAND (SP) (A-3)	2/2/3
			Loose to medium dense light grayish-brown Fine SAND (SP) (A-3)	6/5/6
10				3/4/6
				5/7/11
15			Very loose grayish-brown silty Fine SAND with trace of phosphate (SM) (A-2-4)	3/1/1
20				
25				
30				

STANDARD PENETRATION TEST BLOWS/FT. ON 2" O.D. SAMPLER-140 LB. HAMMER, 30" DROP (AUTOMATIC HAMMER)

10 20 40 60 80



Remarks Borehole Grouted

Casing Length _____

DRIGGERS ENGINEERING SERVICES INCORPORATED

Project No. DES 188213 **BORING NO.** B-5

Project SEWRF Drain Pump Station Improvements, Manatee County, Florida

Location See Plate I **Foreman** C.O.

Completion Depth 16.5' **Date** 9/12/18 **Depth To Water** 7.1' **Time** _____ **Date** 9/12/18

DEPTH, FT	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS ON SAMPLER PER 6" OR PEN. STR.	STANDARD PENETRATION TEST BLOWS/FT. ON 2" O.D. SAMPLER-140 LB. HAMMER, 30" DROP (AUTOMATIC HAMMER) 10 20 40 60 80
			SURF. EL: +35.7+/-' (NAVD 88)		
0			Grayish-brown Fine SAND with roots (SP) (A-3)		
			Dark grayish-brown Fine SAND (SP) (A-3)		
5			Very loose dark brown Fine SAND (SP) (A-3)	2/1/2	
			Very loose to loose grayish-brown to dark grayish-brown Fine SAND (SP) (A-3)	2/1/3	
10				2/2/4	
				4/4/3	
15			Loose grayish-brown Fine SAND with shell (SP) (A-3)	3/2/3	
20					
25					
30					

Remarks Borehole Grouted

Casing Length _____

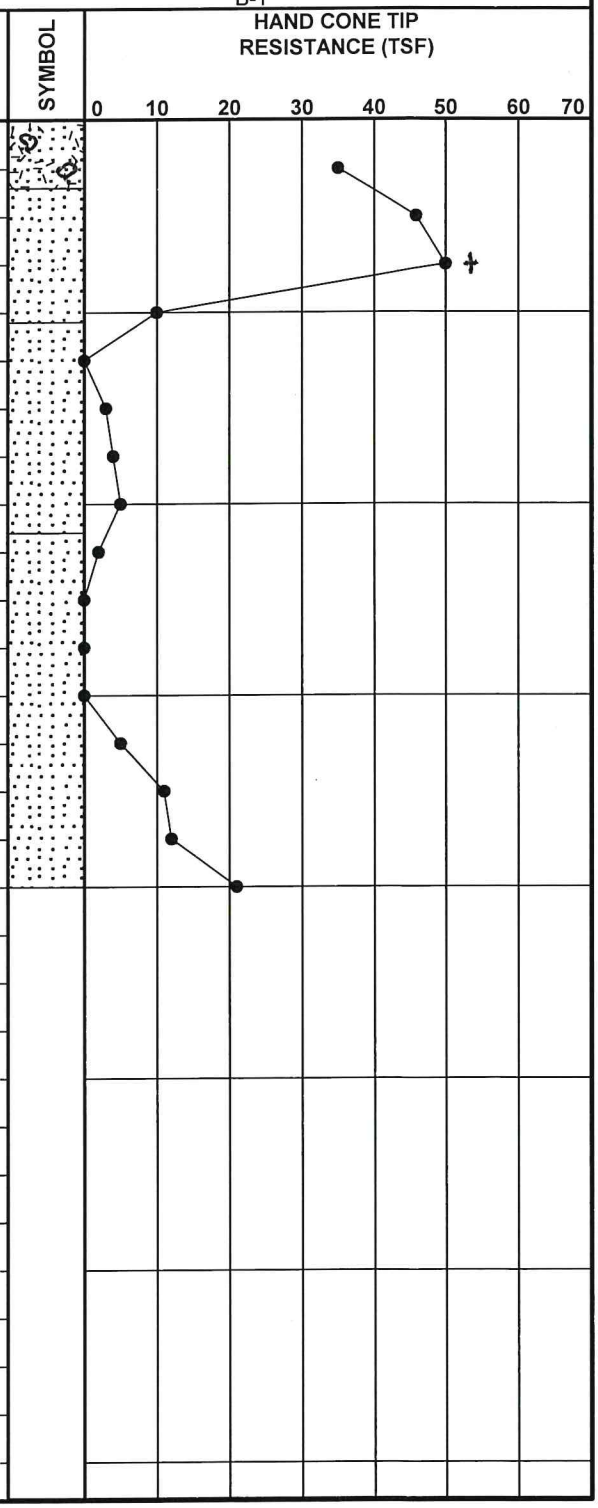
HAND AUGER BORING / HAND CONE SOUNDING LOGS

DRIGGERS ENGINEERING SERVICES INCORPORATED

HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT: SEWRF Drain Pump Station Improvements Manatee County, Florida Project No.: DES 188213	**CLIENT:** Blkack & Veatch Corporation
WATER TABLE: 4.3'	**DATE:** 9/11/18
TECHNICIAN: C.O.	**DATE:** 9/11/18
COMPLETION DEPTH: 8.0'	
LOCATION: See Plate I	**TEST NUMBER:** B-1

ELEV. (FT)	DESCRIPTION	DEPTH (FT)
	Dark brown Fine SAND with roots and trace of gravel (SP) (A-3)	0
32	Brown Fine SAND (SP) (A-3)	2
30	Grayish-brown Fine SAND (SP) (A-3)	4
28	Dark brown Fine SAND (SP) (A-3)	6
26		8
24	Surface Elevation: +33.0+/-' (NAVD 88)	10
22		12
20	LEGEND: ● + Denotes Penetration Resistance in excess of 50 TSF	14



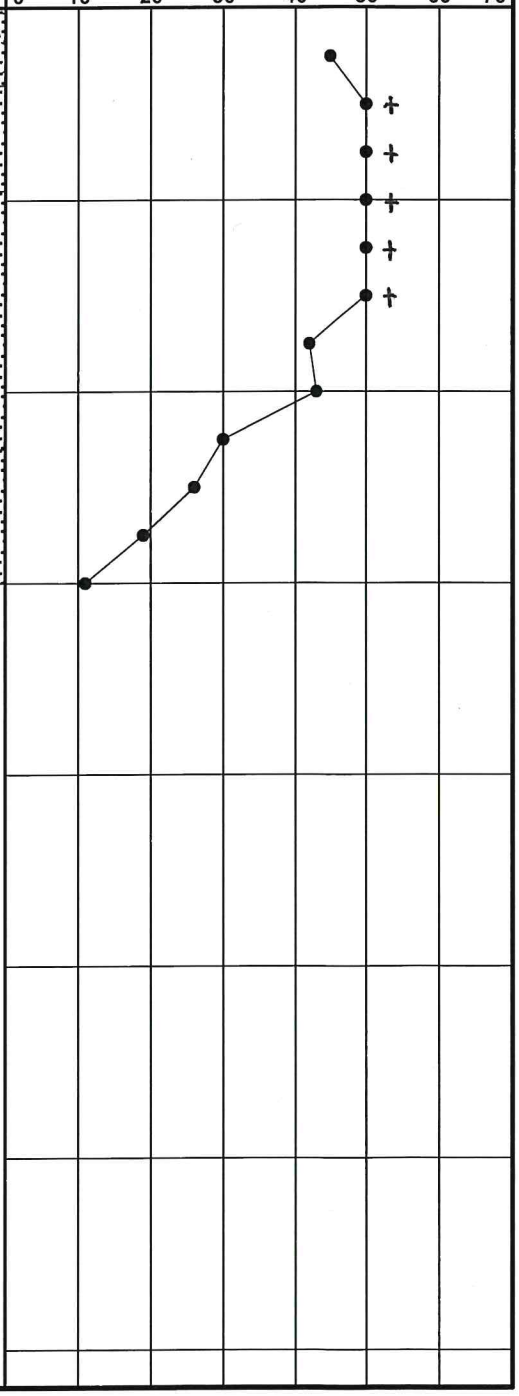
DRIGGERS ENGINEERING SERVICES INCORPORATED

HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT: SEWRF Drain Pump Station Improvements Manatee County, Florida Project No.: DES 188213	**CLIENT:** Blkack & Veatch Corporation
TECHNICIAN: C.O.	**WATER TABLE:** See "Note" — **DATE:** 9/11/18
LOCATION: See Plate I	**DATE:** 9/11/18 — **COMPLETION DEPTH:** 6.0'
	TEST NUMBER: B-2

ELEV. (FT)	DESCRIPTION	DEPTH (FT)
	Brown Fine SAND with roots (SP) (A-3)	0
34	Grayish-brown Fine SAND (SP) (A-3)	2
32	Brown Fine SAND (SP) (A-3)	4
30	Dark brown Fine SAND (SP) (A-3)	6
28	Surface Elevation: +35.7+/-' (NAVD 88) Note: Water Table not encountered within depth of 6.0'.	8
26		10
24		12
22	LEGEND: ● + Denotes Penetration Resistance in excess of 50 TSF	14

SYMBOL



DRIGGERS ENGINEERING SERVICES INCORPORATED

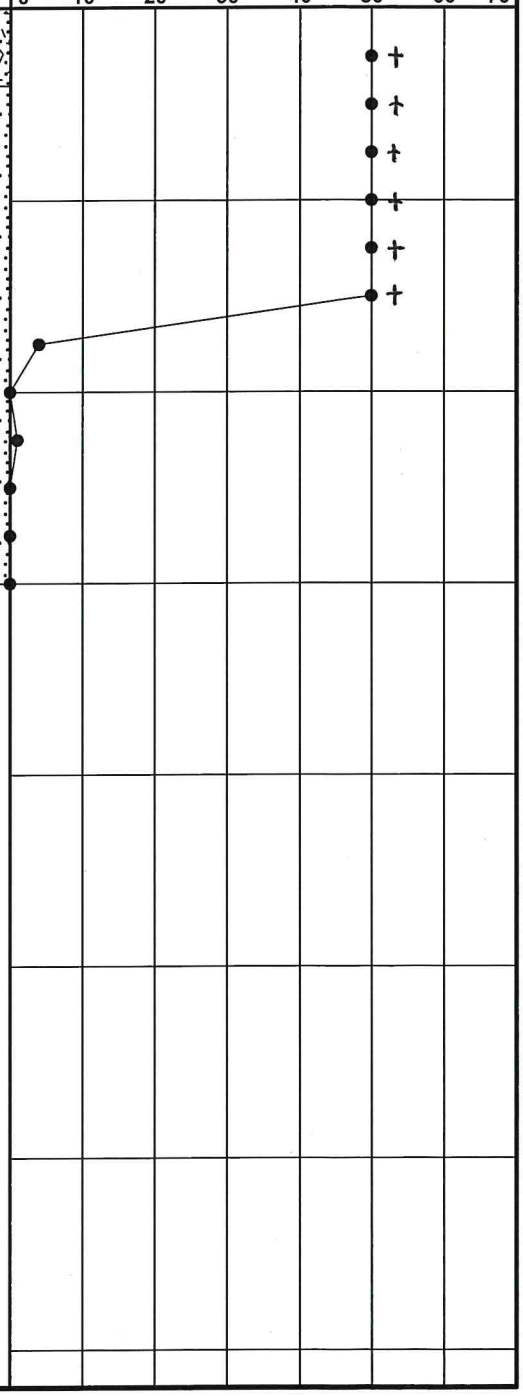
HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT: SEWRF Drain Pump Station Improvements Manatee County, Florida Project No.: DES 188213	**CLIENT:** Blkack & Veatch Corporation
TECHNICIAN: C.O.	**WATER TABLE:** 4.7' — **DATE:** 9/11/18
LOCATION: See Plate I	**DATE:** 9/11/18 — **COMPLETION DEPTH:** 6.0'
	TEST NUMBER: B-3

ELEV. (FT)	DESCRIPTION	DEPTH (FT)
	Dark brown Fine SAND with roots (SP) (A-3)	0
34	Dark brown Fine SAND (SP) (A-3)	2
32		4
30		6
28	Surface Elevation: +35.1+/-' (NAVD 88)	8
26		10
24		12
22	LEGEND: ● + Denotes Penetration Resistance in excess of 50 TSF	14

SYMBOL

HAND CONE TIP RESISTANCE (TSF)



DRIGGERS ENGINEERING SERVICES INCORPORATED

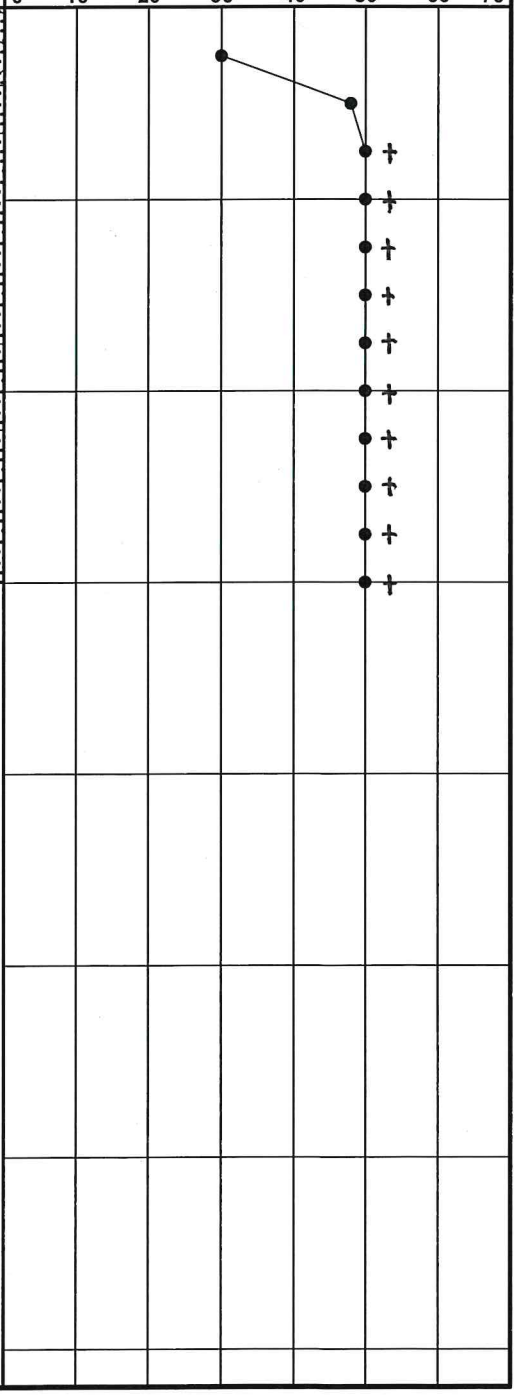
HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT: SEWRF Drain Pump Station Improvements Manatee County, Florida Project No.: DES 188213	**CLIENT:** Blkack & Veatch Corporation
TECHNICIAN: C.O.	**WATER TABLE:** See "Note" — **DATE:** 9/12/18
LOCATION: See Plate I	**DATE:** 9/12/18 — **COMPLETION DEPTH:** 6.0'
	TEST NUMBER: B-4

ELEV. (FT)	DESCRIPTION	DEPTH (FT)
36	Dark brown organic Fine SAND with roots (SP-SM/Pt) (A-8)	0
	Dark brown Fine SAND (SP) (A-3)	
	Dark grayish-brown Fine SAND (SP) (A-3)	2
34		
	Brown Fine SAND (SP) (A-3)	4
32	Dark brown Fine SAND (SP) (A-3)	
		6
30	Surface Elevation: +36.4+/-' (NAVD 88)	
	Note: Water Table not encountered within depth of 6.0'.	8
28		
		10
26		
		12
24	LEGEND:	
	●+ Denotes Penetration Resistance in excess of 50 TSF	14

SYMBOL

HAND CONE TIP RESISTANCE (TSF)



DRIGGERS ENGINEERING SERVICES INCORPORATED

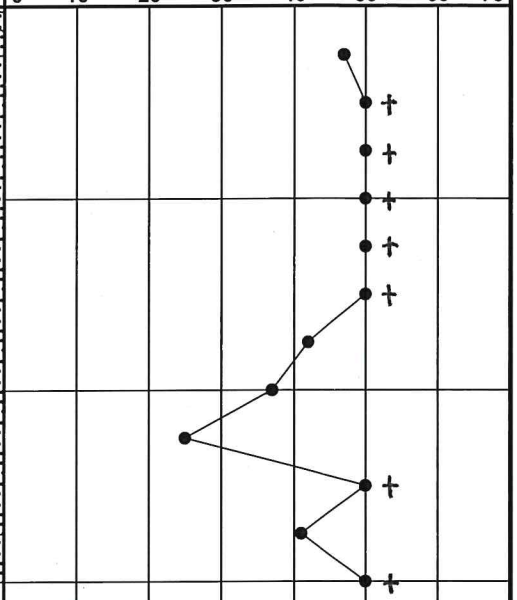
HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT: SEWRF Drain Pump Station Improvements Manatee County, Florida Project No.: DES 188213	**CLIENT:** Blkack & Veatch Corporation
TECHNICIAN: C.O.	**WATER TABLE:** See "Note" — **DATE:** 9/12/18
LOCATION: See Plate I	**DATE:** 9/12/18 — **COMPLETION DEPTH:** 6.0'
	TEST NUMBER: B-5

ELEV. (FT)	DESCRIPTION	DEPTH (FT)
	Grayish-brown Fine SAND with roots (SP) (A-3)	0
34	Dark grayish-brown Fine SAND (SP) (A-3)	2
32		4
30	Dark brown Fine SAND (SP) (A-3)	6
28	Surface Elevation: +35.7+/-' (NAVD 88) Note: Water Table not encountered within depth of 6.0'.	8
26		10
24		12
22	LEGEND: ● + Denotes Penetration Resistance in excess of 50 TSF	14

SYMBOL

HAND CONE TIP RESISTANCE (TSF)



SUMMARY OF LABORATORY TEST RESULTS

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH (ft)	DESCRIPTION	W %	Y_d (pcf)	G_s	ATTERBERG LIMITS			P.P. (tsf)	U.C.	CON.	G.S.	ORG. (%)	pH	Cl. (ppm)	SO_4 (ppm)	RES. (ohm-cm)
						LL	PL	PI									
B-1	8.0-9.5	Grayish-brown slightly silty Fine SAND										*					
B-1	20.0-21.5	Grayish-brown silty CLAY	47.5			79	29	50									
B-1	25.0-26.5	Green silty Fine SAND				NP	NP					** 37.0					
B-2	4.6-6.0	Dark brown Fine SAND											0.9				
B-3	10.0-11.5	Grayish-brown Fine SAND										*					
B-4	6.0-7.5	Dark brown slightly organic Fine SAND										** 4.3	2.7				
B-5	6.0-7.5	Dark brown Fine SAND										** 5.1	1.8				
B-5	12.0-13.5	Dark grayish-brown Fine SAND										** 4.2					

BID ATTACHMENT NO. 6

W % = Water Content
Y_d (pcf) = Dry Density
G_S = Specific Gravity
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
P.P. (tsf) = Pocket Penetrometer
U.C. = Unconfined Compression

Con. = Consolidation Test
G.S. (+1) = Grainsize Analysis (Hydrometer)
ORG. (%) = Organic Content
Cl. (ppm) = Total Chloride
SO_4 (ppm) = Total Sulfate
RES. (ohm-cm) = Lab Resistivity
* = See Test Curves
** = Percent Passing No. 200 Sieve

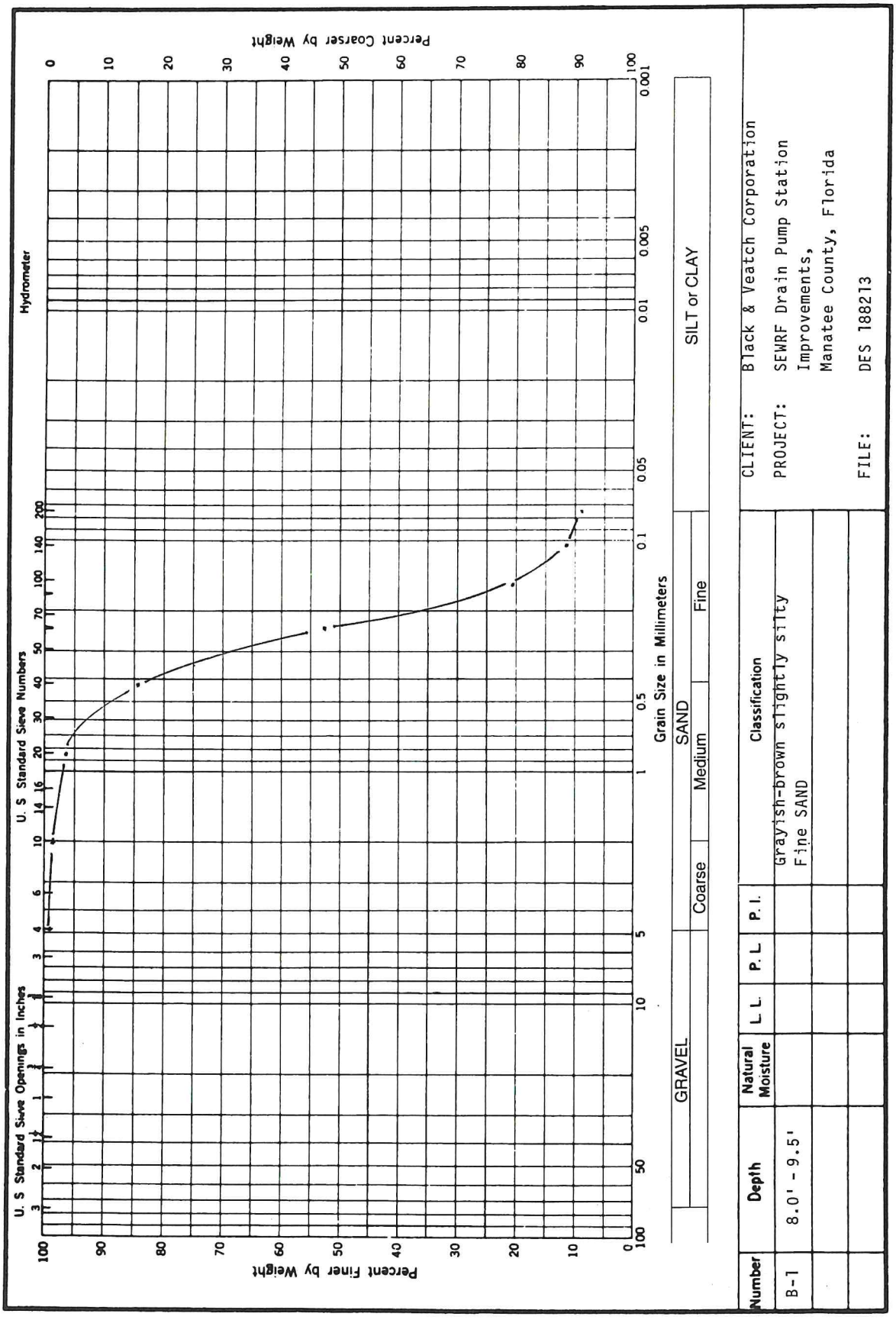
CLIENT: Black & Veatch Corporation

PROJECT: SEWRF Drain Pump Station Improvements, Manatee County, Florida

FILE: DES 188213

GRAINSIZE ANALYSES

DRIGGERS ENGINEERING SERVICES, INC.



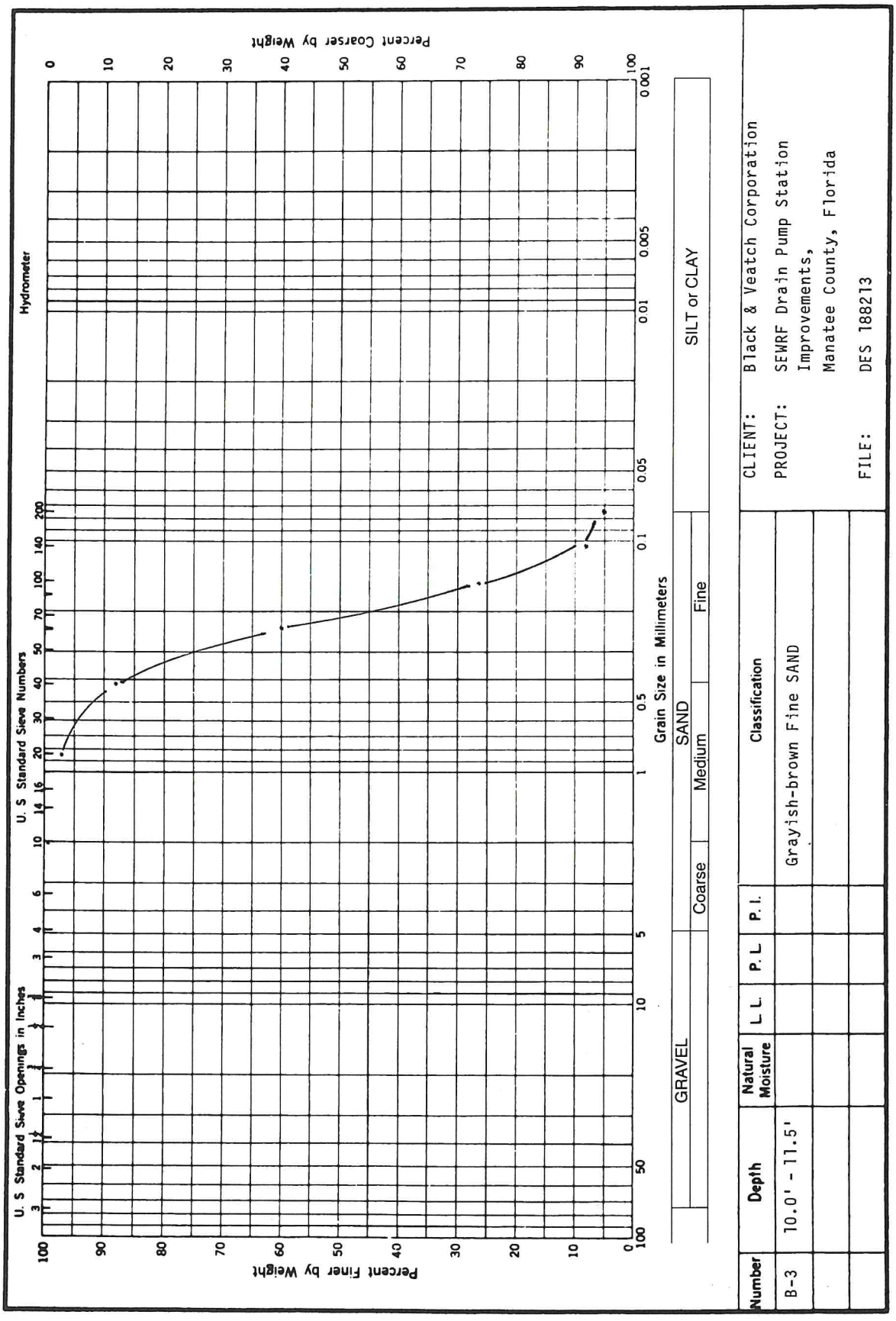
Number	Depth	Natural Moisture	L L.	P. L	P. I.	Classification
B-1	8.0' - 9.5'					grayish-brown slightly silty Fine SAND

CLIENT: Black & Veatch Corporation

PROJECT: SEWRF Drain Pump Station Improvements, Manatee County, Florida

FILE: DES 188213

DRIGGERS ENGINEERING SERVICES, INC.



Number	Depth	Natural Moisture	L L.	P. L	P. I.	Classification
B-3	10.0' - 11.5'					Grayish-brown Fine SAND

CLIENT: Black & Veatch Corporation

PROJECT: SEWRF Drain Pump Station Improvements, Manatee County, Florida

FILE: DES 188213

METHOD OF TESTING

STANDARD PENETRATION TEST WITH AUTOMATIC HAMMER AND SOIL CLASSIFICATION

STANDARD PENETRATION TEST (ASTM D-1586)

In the Standard Penetration Test borings, a rotary drilling rig is used to advance the borehole to the desired test depth. A viscous drilling fluid is circulated through the drill rods and bit to stabilize the borehole and to assist in removal of soil and rock cuttings up and out of the borehole.

Upon reaching the desired test depth, the 2 inch O.D. split-barrel sampler or "split-spoon", as it is sometimes called, is attached to an N-size drill rod and lowered to the bottom of the borehole. A 140 pound automatic hammer, attached to the drill string at the ground surface, is then used to drive the sampler into the formation. The hammer is successively raised and dropped for a distance of 30 inches using an automated lifting mechanism. The number of blows is recorded for each 6 inch interval of penetration or until virtual refusal is achieved. In the above manner, the samples are ideally advanced a total of 18 inches. The sum of the blows required to effect the final 12 inches of penetration is called the blowcount, penetration resistance or "N" value of the particular material at the sample depth.

After penetration, the rods and sampler are retracted to the ground surface where the core sample is removed, sealed in a glass jar and transported to the laboratory for verification of field classification and storage.

SOIL SYMBOLS AND CLASSIFICATION

Soil and rock samples secured in the field sampling operation were visually classified as to texture, color and consistency. The Unified Soil Classification was assigned to each soil stratum per ASTM D-2487. Soil classifications are presented descriptively and symbolically for ease of interpretation. The stratum identification lines represent the approximate boundary between soil types. In many cases, this transition may be gradual.

Consistency of the soil as to relative density or undrained shear strength, unless otherwise noted, is based upon Standard Penetration resistance values of "N" values and industry-accepted standards. "N" values, or blowcounts, are presented in both tabular and graphical form on each respective boring log at each sample interval. The graphical plot of blowcount versus depth is for illustration purposes only and does not warrant continuity in soil consistency or linear variation between sample intervals.

The borings represent subsurface conditions at respective boring locations and sample intervals only. Variations in subsurface conditions may occur between boring locations. Groundwater depths shown represent water depths at the dates and time shown only. The absence of water table information does not necessarily imply that groundwater was not encountered.

HAND CONE PENETRATION TEST

The cone penetration test was performed using a DGSI Model S-215 double rod Static Cone Penetrometer.

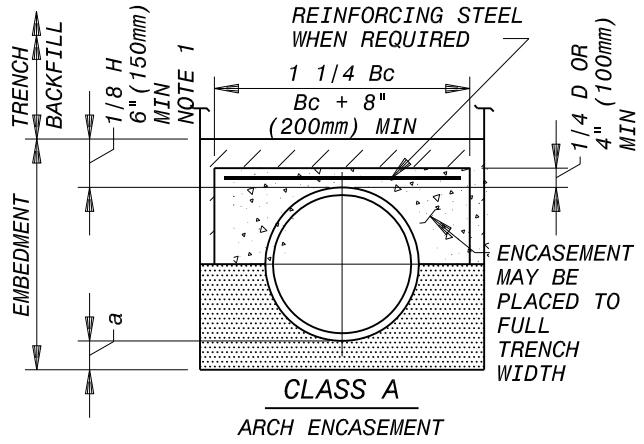
Dual rods enable the cone stress to be measured directly. Soil friction on the outer rod does not influence the reading. Depending upon the application, either the maximum bearing for an increment of push or the least bearing for an increment can be reported. If you were investigating for soft spots, you would take the least reading. In typical use, you would force the cone into the soil 6 inches, retract the cone slightly until the gauge reads zero, then advance an additional 6 inch increment. If you meet with refusal, the cone can be removed and the hole opened with a hand auger to permit a continuation of measurements against depth.

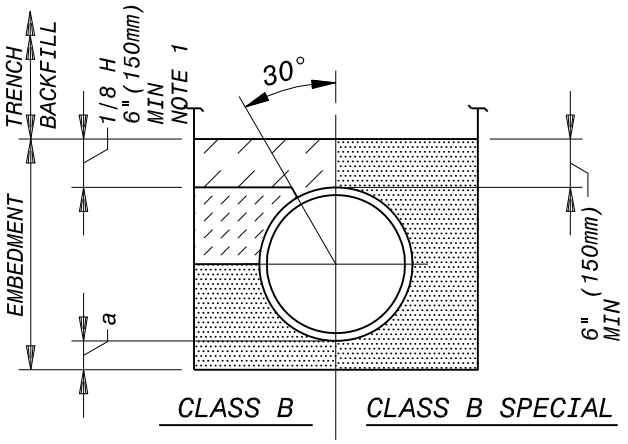
The tool has been designed to allow a maximum force of 250 lbs. to be applied, somewhat more than the average weight of an operator. The unit can be operated in a vertical or horizontal position. The cone tip has an included angle of 60°. The cone has a section area of 1.5 cm^2. The maximum total bearing (Q_c) is 70 kg/cm^2.

The reading (Q_c) is in kg/cm^2 which is essentially equal to ton/ft^2.

The cone index (Q_c) is read directly. The correlation between the cone index and soil constants is not absolute. Generally, the following results have been determined through extensive field use of the unit. Further verification of correlation in your local soil types is essential.

Standard Penetration (Sands)	**Strength and Cohesion**
Test "N" Value $Q_c = 4$ "N"	Q_u - Unconfined compression (kg/cm^2) c - Cohesion (kg/cm2)
	Uniform clay and silty clays: $Q_c = 5\ Q_u$ $Q_c = 10\ c$
	Clayey Silts: $Q_c = (10 \text{ to } 20)\ Q_u$ $Q_c = (20 \text{ to } 40)\ c$





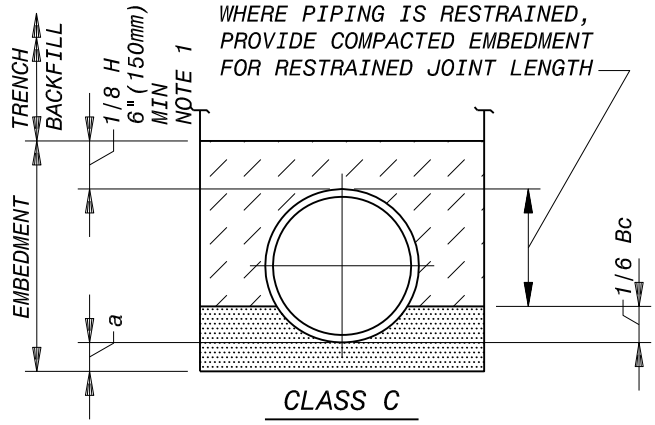


TABLE OF EMBEDMENT DEPTHS BELOW PIPE

D	a MIN SOIL		a MIN ROCK	
	in	mm	in	mm
27"(675 mm) & SMALLER	3	75	6	150
30"(750 mm) TO 60"(1500 mm)	4	100	9	225
66"(1650 mm) & LARGER	6	150	12	300

NOTES:

1. EMBEDMENT ABOVE THE TOP OF THE PIPE SHALL BE AN UNCOMPACTED LAYER FOR ALL INSTALLATIONS.
2. REFER TO SPECIFICATIONS FOR GEOTECHNICAL FABRIC OR SPECIAL EMBEDMENT REQUIREMENTS FOR TRENCHES IN FINE SOILS EXTENDING BELOW GROUNDWATER LEVEL.
3. TRENCH OUTLINES DO NOT INDICATE ACTUAL TRENCH EXCAVATION SHAPE, SOIL CONDITIONS, OR PRESENCE OF SHEETING LEFT IN PLACE. EMBEDMENT MATERIAL SHALL EXTEND THE FULL WIDTH OF THE ACTUAL TRENCH EXCAVATION.
4. FOR RESTRAINED JOINT PIPE LENGTH WITH CLASS C EMBEDMENT THE BACKFILL ABOVE THE GRANULAR EMBEDMENT AND BELOW THE TOP OF THE PIPE SHALL BE COMPACTED EMBEDMENT.

LEGEND

Bc	OUTSIDE DIAMETER OF PIPE
H	COVER ABOVE TOP OF PIPE
D	NOMINAL PIPE SIZE
a	EMBEDMENT BELOW PIPE (SEE TABLE)

HAND PLACED EMBEDMENT *

COMPACTED EMBEDMENT *

GRANULAR EMBEDMENT

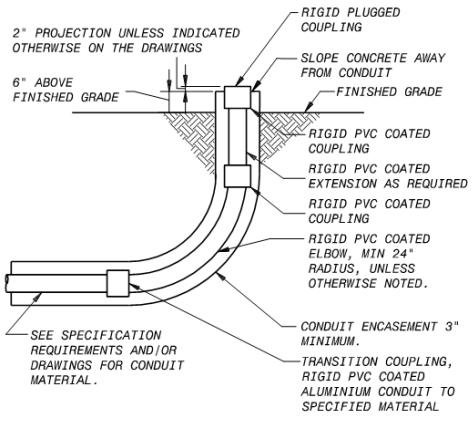
CONCRETE

* OR GRANULAR EMBEDMENT

EMBEDMENTS FOR CONDUITS

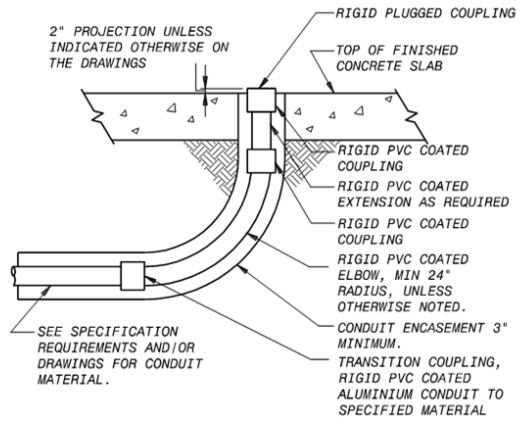
BLACK & VEATCH	TRENCHING AND BACKFILLING	FIG 1-02202

ADD BOTH DETAILS BELOW TO E-16 (RAS/WAS PROJECT) AND E-13 (PDPS PROJECT)



TYPICAL CONDUIT RISER TERMINATING IN SOIL

NO SCALE



TYPICAL CONDUIT RISER TERMINATING IN CONCRETE SLAB

NO SCALE

Section 16050

ELECTRICAL

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of all equipment and materials needed for the electrical requirements of this Contract. It also covers conduit, wiring, and terminations for electrical equipment installed under Electrical Equipment Installation section.

This section covers the installation and interconnection of electrical equipment furnished under other sections, except electrical items designated to be installed under those sections.

West Plant Drain Pump Station

Electrical work elements include providing conduit, wiring, and ancillaries for a new triplex pump station specified under section '11150' powered from existing Electrical Building No.1 MCC and monitored by the PCS via fiber-optic cabling over Ethernet connecting to the PCS Ethernet switch located in SP-1 PLC panel per specifications and plans. Electrical work elements include new grounding grid and new pump station lighting as shown on plans and wiring and conduits associated with West Plant Drain Pump Station discharge flow meter.

New East Plant Drain Pump Station

Electrical work elements include providing conduit, wiring, and ancillaries for a new duplex pump station specified under section '11151' powered from existing Electrical Building No.2 MCC and monitored by the PCS via fiber-optic cabling over Ethernet connecting to the PCS Ethernet switch located in SP-2 PLC panel per specifications and plans. Electrical work elements include new grounding grid and new pump station lighting as shown on plans and wiring and conduits associated with East Plant Drain Pump Station discharge flow meter.

North Plant Drain Pump Station – Modifications to Existing Equipment

Electrical work elements include replacement of and improvements to existing control panel support structures, and 90-degree rotation of existing pump station control panel as shown on plans.

South Plant Drain Pump Station – Modifications to Existing Equipment

Providing electrical connections required for replacement of existing submersible pumps specified under section '11150-South'.

1-2. GENERAL. Electrical apparatus on all equipment shall be installed complete and placed in readiness for proper operation.

Electrical materials furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations section shall apply to all equipment provided under this section. If requirements in this section differ from those in the General Equipment Stipulations section, the requirements specified herein shall take precedence

1-2.02. Seismic Design Requirements. Seismic design requirements for products specified herein shall be as indicated in the Meteorological and Seismic Design Criteria section.

1-2.03. Coordination. Electrical work shall conform to the construction schedule and the progress of other trades.

1-2.04. Anchor Bolts and Expansion Anchors. All anchor bolts, nuts, washers, and expansion anchors shall comply with Anchorage in Concrete and Masonry section, except smaller than 3/4 inch [19 mm] will be permitted to match NEMA standard size bolt holes on motors and electrical equipment.

1-2.05. Drawings. Supplementing this section, the Drawings indicate locations of equipment and enclosures and provide one-line and schematic diagrams regarding the connection and interaction with other equipment.

1-3. CODES AND PERMITS. All work shall be performed and materials shall be furnished in accordance with the NEC - National Electrical Code, the NESC - National Electrical Safety Code, and the following standards where applicable:

AEIC	The Association of Edison Illuminating Companies
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
Fed Spec	Federal Specification
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers

IESNA	Illuminating Engineering Society of North America
NEIS	National Electrical Installation Standards
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
UL	Underwriters' Laboratories

Equipment covered by this section shall be listed by UL, or by a nationally recognized third party testing laboratory. All costs associated with obtaining the listing shall be the responsibility of Contractor. If no third-party testing laboratory provides the required listing, an independent test shall be performed at Contractor's expense. Before the test is conducted, Contractor shall submit a copy of the testing procedure to be used.

1-4. SEISMIC DESIGN REQUIREMENT.

1-4.01. Seismic Design Requirements. Submit confirmation of compliance with the requirements of the Meteorological and Seismic Design Criteria section.

1-5. IDENTIFICATION.

1-5.01. Conduit. Conduits in manholes, handholes, building entrance pull boxes, junction boxes, and equipment shall be provided with identification tags. Identification tags shall be 19 gage [1 mm thick] stainless steel, with 1/2 inch [13 mm] stamped letters and numbers as indicated on the Drawings. Identification tags shall be attached to conduits with nylon tie wraps and shall be positioned to be readily visible.

1-5.02. Conductors. All conductors in power, control, and instrumentation circuits shall be identified and color coded as described herein.

1-5.02.01. Conductor Identification Number. Except for lighting and receptacle circuits, each individual conductor in power, control, and instrumentation circuits shall be provided with wire identification markers at the point of termination.

The wire markers shall be of the heat-shrinkable tube type, with custom typed identification numbers.

The wire numbers shall be as indicated on the equipment manufacturer's drawings.

The wire markers shall be positioned to be readily visible for inspection.

1-5.02.02. Conductor Color Coding. Power conductors shall be color coded as indicated below. For conductors 6 AWG and smaller, the color coding shall be

the insulation finish color. For sizes larger than 6 AWG, the color coding may be by marking tape. The equipment grounding conductor shall be green or green with one or more yellow stripes if the conductor is insulated.

The following color coding system shall be used:

120/240V single-phase — black, red, and white
120/208V, three-phase — black, red, blue, and white
120/240V, three-phase — black, orange, blue, and white
277/480V, three-phase — brown, orange, yellow, and gray
2400/4160V, three-phase — black, red, blue, and white
7200/12470V, three-phase — black, red, blue, and white

Where 120/240 and 120/208 volt systems share the same conduit or enclosure, the neutral for either the 120/240 volt system or the 208 volt system shall be white with a permanent identifiable violet stripe.

Control and instrumentation circuit conductors shall be color coded as indicated in the Cable Data Figures at the end of this section.

1-5.03. Motor Starters. Plant Drain Pump Station submersible pump Reduced Voltage Solid-State motor starters are specified and provided integral to the Local Control Panels furnished by respective pump equipment suppliers under 11150 and 11151.

1-5.04. Control Stations. Not used.

1-5.05. Circuit Breakers. Circuit breakers shall be provided with nameplates identifying related equipment. Nameplates shall be laminated white-over-black plastic, with 1/8 inch [3 mm] engraved letters, and shall be securely fastened to the circuit breakers.

1-5.06. Disconnect Switches. Not used.

1-5.07. Arc Flash Hazard Labels. Lighting panels, power panels, power centers, switchgear, switchboards, motor control centers, motor control line ups, transfer switches, industrial control panels, adjustable frequency drives, fused switches, meter socket enclosures, and other electrical equipment likely to be worked on energized shall be provided with permanent labels warning the risk of arc flash and shock hazard. Labels shall be designed in accordance with ANSI Z535.4 and shall include the following:

WARNING
Arc Flash and Shock Hazard

Appropriate personal protection equipment (PPE) required. SEE NFPA 70E.
Equipment must be accessed by qualified personnel only.
Turn off all power sources prior to working on or inside equipment.

Additional information shall be provided on the labels where specified in the Arc Flash Hazard Analysis section of this section.

1-6. SUBMITTALS. Complete assembly, foundation, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the work performed by the Contractor, shall be submitted in accordance with the Submittal Procedures section. The drawings and data shall include, but shall not be limited to, the following:

Drawings and data.
Operating manuals.
Samples.
Test reports
Studies

1-6.01. Submittal Identification. Information covering all materials and equipment shall be submitted for review in accordance with the Submittal Procedures section. Each sheet of descriptive literature submitted shall be clearly marked to identify the material or equipment as follows:

a. Lamp fixture descriptive sheets shall show the fixture schedule letter, number, or symbol for which the sheet applies.
b. Equipment and materials descriptive literature and drawings shall show the specification paragraph for which the equipment applies.
c. Sheets or drawings covering more than the item being considered shall have all inapplicable information crossed out.
d. A suitable notation shall identify equipment and materials descriptive literature not readily cross-referenced with the Drawings or Specifications.
e. Schematics and connection diagrams for all electrical equipment shall be submitted for review. A manufacturer's standard connection diagram or schematic showing more than one scheme of connection will not be accepted, unless it is clearly marked to show the intended connections.

Contractor shall submit the name and qualifications of the Engineering and Testing Services firm proposed to perform the protective device study and the on-site testing.

Within 90 days after the Notice to Proceed, Contractor shall furnish a submittal for all types of cable and conduit to be provided. The submittal shall include the cable manufacturer and type, and sufficient data to indicate that the cable and conduit meet the specified requirements.

In addition to the complete specifications and descriptive literature, a sample of the largest size of each type of cable shall be submitted for review before installation. Each sample shall include legible and complete surface printing of the cable identification.

1-6.02. Seismic Design Requirements. Submitted confirmation of compliance with the requirements of the Meteorological and Seismic Design Criteria section.

1-7. PROTECTION AND STORAGE. During construction, the insulation on all electrical equipment shall be protected against absorption of moisture, and metallic components shall be protected against corrosion by strip heaters, lamps, or other suitable means. This protection shall be provided immediately upon receipt of the equipment and shall be maintained continuously.

PART 2 - PRODUCTS

2-1. POWER SERVICE ENTRANCE. Not used.

2-2. TELEPHONE SERVICE ENTRANCE. Not used.

2-3. CABLE. All cables of each type (such as lighting cable or 600 volt power cable) shall be from the same manufacturer.

All types of cable shall conform to the Cable Data Figures at the end of this section and as described herein.

2-3.01. Lighting Cable. Lighting cable (Figure 1-16050 THHN-THWN) shall be provided only in lighting and receptacle circuits operating at 277 volts or less. Lighting and receptacle circuits, 8 AWG [10 mm2] or larger, shall be as specified for 600 volt (Figure 2-16050 XHHW) power cable.

2-3.02. 600 Volt Power Cable. Cable in power, control, indication, and alarm circuits operating at 600 volts or less, except where lighting, multiconductor control, and instrument cables are required, shall be 600 volt (Figure 2-16050 XHHW-2) power cable.

2-3.03. Instrument Cable. Not used.

2.3.04. Multiconductor Control Cable. Not used.

2-3.05. Medium Voltage Power Cable. Not used.

2-3.06. Tray Cable. Not used.

2-4. CONDUIT. Conduit and raceways shall be as described in the following paragraphs:

2-4.01. Rigid Steel Conduit. Not used.

2-4.02. Intermediate Metal Conduit (IMC). Not used.

2-4.03. Liquidtight Flexible Metal Conduit. Liquidtight flexible metal conduit shall be hot-dip galvanized steel, shall be covered with a moisture-proof polyvinyl chloride jacket, and shall be UL labeled.

2-4.04. Utility (PVC) Duct. Not used.

2-4.05. Rigid Nonmetallic (PVC) Conduit. PVC conduit shall be heavy wall, Schedule 40 UL labeled for aboveground and underground uses, and shall conform to NEMA TC-2 and UL 651.

2-4.06. PVC-Coated Rigid Aluminum. The conduit shall be rigid aluminum. The PVC coating shall be bonded to the primed outer surface of the conduit. The bond on conduit and fittings shall be stronger than the tensile strength of the PVC coating. The thickness of the PVC coating shall be at least 40 mils [1000 µm].

A chemically cured two-part urethane coating, at a nominal 2 mil [50 µm] thickness, shall be applied to the interior of all conduit and fittings. The coating shall be sufficiently flexible to permit field bending the conduit without cracking or flaking of the coating.

Every female conduit opening shall have a PVC sleeve extending one conduit diameter or 2 inches [50 mm], whichever is less, beyond the opening. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit before coating. The wall thickness of the sleeve shall be at least 40 mils
[1000 µm].

All fittings, condulets, mounting hardware, and accessories shall be PVC-coated. All hollow conduit fittings shall be coated with the interior urethane coating described above. Fittings shall be Form 8 Condulets, 1/2” through 4” diameters, shall have a v-seal tongue-in-groove gasket and supplied with plastic encapsulated stainless steel cover screws to effectively seal against the elements. The screw heads on condulets shall be encapsulated with a corrosion-resistant material. Form 8 fittings shall be UL Type 4X and IP69 listed.

PVC coated rigid aluminum conduit shall be UL/cUL 6A Listed and NEMA RN-1 compliant, without exceptions. The PVC coated rigid steel conduit shall be manufactured by Calbond, Plasti-Bond, or approved equal.

2-4.07. Electrical Metallic Tubing (EMT). Not used.

2-4.08. Rigid Aluminum Conduit (RAC). Rigid aluminum conduit and fittings shall be manufactured of 6063-T1 alloy, shall conform to ANSI C80.5, and shall be manufactured in accordance with UL 6A.

2-4.09. Cable Tray. Not used.

2-5. WIRING DEVICES, BOXES, AND FITTINGS. Concealed conduit systems shall have flush-mounted switches and convenience outlets. Exposed conduit systems shall have surface-mounted switches and convenience outlets.

2-5.01. Conduit Boxes and Fittings.

a. In applications utilizing aluminum conduit systems, aluminum boxes and fittings manufactured by Crouse-Hinds, Appleton, or O Z Gedney shall be installed.

b. Rigid PVC device boxes and fittings shall be manufactured by Carlon or Cantex.

c. Stainless steel device boxes shall be manufactured by Appleton, Raco, or Steel City.

d. PVC coated device boxes shall be manufactured by Calbond, Ocal, or Robroy Industries.

e. Hub arrangements on threaded fittings shall be the most appropriate for the conduit arrangement to avoid unnecessary bends and fittings.

2-5.02. Device Plates.

a. Stainless steel device plates shall be used on surface mounted outlet boxes where weatherproof plates are not required.

b. Device plates on flush mounted outlet boxes where weatherproof plates are not required shall be AISI Type 302 stainless steel, Eaton "93000 series", Hubbell "S series", or Leviton "840nn-40 series"; nylon or polycarbonate, Eaton "5000 series", Hubbell "Pn series", or Leviton "807nn-I series".

c. Device plate mounting hardware shall be countersunk and finished to match the plate.

d. Device plates for switches outdoors or indicated as weatherproof shall have provisions for padlocking switches "On" and "Off", and shall be Appleton "FSK-1VS", Crouse-Hinds "DS185" or O Z Gedney "FS-1-WSCA".

e. Device plates for receptacles indicated as weatherproof shall be Appleton "FSK-WRD", Crouse-Hinds "WLRD1", or O Z Gedney "FS-1-WDCA.

f. Flush-mounted, weatherproof plates shall be provided with adapter plates, Appleton "FSK-SBA" or Crouse-Hinds "FS031".

g. Device plates for ground fault interrupter receptacles indicated to be weatherproof shall be Appleton "FSK-WGFI", Eaton "S966", or O Z Gedney "FS-1-GFCA".

h. Receptacle covers outdoors or otherwise indicated to be weatherproof while in-use shall be die cast aluminum and shall include a padlock eye. Covers for standard convenience outlets shall be Hubbell “WP8M” or Thomas and Betts Red Dot “CKMUV”. Covers for ground fault interrupter receptacles shall be Hubbell “WP26M” or Thomas and Betts Red Dot “CKMUV”.

i. Engraved device plates, where required, shall be manufactured by Leviton, or equal.

j. Device plates on PVC conduit fittings shall be Carlon "E98 Series" or Cantex "513300 Series".

2-5.03. Wall Switches.

a. Switches on ac lighting panel load circuits through 277 volts shall be 20 amperes, 120/277 volts, Eaton "AH1221V" through "AH1224V", Hubbell "HBL 1221I" through "HBL 1224I", or Leviton "1221-2I" through "1224-2I".

b. Switches for pulse control of lighting contactors shall be 20 amperes, 120/277 volts, momentary, double-throw, center "Off", Eaton "1995V", Hubbell "1557I" or Leviton "1257-I".

c. Switches on ac lighting panel load circuits through 277 volts in Class I, Division 1 and Division 2, Group D hazardous areas indicated on the Drawings shall be 20 ampere, 120/277 volts. Hazardous area switches shall be factory sealed tumbler switches, Appleton “EDS” or Killark “FXS”.

2-5.04. Receptacles.

a. Standard convenience outlets shall be duplex, three-wire, grounding, 20 amperes, 125 volts, Eaton "AH5362V", Hubbell "5362I" or Leviton "5362-I" for 120 volt circuits, and 250 volts, Eaton "AH5462CV", Hubbell "5462I" or Leviton "5462-I" for 240 volt circuits.

b. Ground fault circuit interrupter receptacles shall be duplex, 20 amperes, 125 volts, Eaton "SGFH20", Hubbell "GF5362I" or Leviton "7899-I".

c. Ground fault circuit interrupter receptacles in damp or wet locations shall be duplex, 20 amperes, 125 volts, Hubbell "GFWRST20I" or Leviton "WT899-HGI".

d. Welding receptacles shall be 30 amperes, 600 volts, 3 phase, with grounding conductors connected through a fourth pole, Appleton "ADRE3034-100", Crouse-Hinds "AR348" plus "ARRC33" and "AR30" or Leviton " 430MI5W". One matching plug, Appleton "ACP3034BC", Crouse-Hinds "APJ3485" or Leviton "430P5W" with appropriate woven grip and plug cap, shall be furnished for the cable size directed by Owner.

e. Welding receptacles shall be 60 amperes, 240 volts, 3 phase, with grounding conductors connected through a fourth pole, Appleton "ADRE6034-150", Crouse-Hinds "AREA6425" or Leviton "460MI9W". One matching plug, Appleton "ACP6034BC", Crouse-Hinds "APJ6485" or Leviton "460P9W" with appropriate woven grip and plug cap, shall be furnished for the cable size directed by Owner.

f. Receptacles in Class I, Division 1 and Division 2, Group D hazardous areas indicated on the Drawings shall be three-wire, grounding, 20 amperes, 125 volts. Hazardous area receptacles shall be factory sealed, with an integral switch that is only activated when an approved matching plug is fully inserted and rotated into the engaged position. Hazardous area receptacles shall be Appleton “ENR”, Crouse-Hinds “ENR”, or Killark “UGR”.

2-5.05. Special Outlets. Not used.

2-6. JUNCTION BOXES, PULL BOXES, AND WIRING GUTTERS. Indoor boxes (larger than switch, receptacle, or fixture type) and gutters shall be constructed of aluminum or stainless steel, and shall be rigidly supported by stainless steel hardware and framing materials, including nuts and bolts.

Indoor boxes and gutters in corrosive areas indicated on the Drawings and outdoor boxes and gutters shall be NEMA Type 4X, ABS or stainless steel and shall be rigidly supported by PVC-coated or stainless steel framing materials. Mounting hardware, which includes nuts, bolts, and anchors, shall be stainless

steel. All damaged coatings shall be repaired according to the manufacturer's instructions.

Bolt-on junction box covers 3 feet [900 mm] square or larger, or heavier than 25 lbs [11 kg], shall have rigid handles. Covers larger than 3 by 4 feet [900 by 1200 mm] shall be split.

Where indicated on the Drawings, junction and pull boxes with a removable side opposite the underground conduits shall be provided over building ends of underground conduit banks. Boxes shall be sized in accordance with the National Electrical Code, including space for full size continuations of all underground conduits not originally continued. Conduit arrangement shall leave maximum space for future conduits.

2-7. LIGHTING FIXTURES. Lighting fixtures shall be furnished as described in the fixture schedule and as indicated on the Drawings. Lighting fixtures shall be furnished complete with lamps. Pendant fixtures shall have swivel type box covers and threaded conduit pendants unless otherwise specified. Lighting fixtures shall be provided with disconnects in accordance with NEC requirements.

2-7.01. Electronic Drivers. Electronic drivers furnished with LED type lighting fixtures shall be certified as meeting requirements of ANSI C82.77 with a THD level of not more than 20 percent.

2-8. LIGHTING PANELS. Not used.

2-9. POWER PANELS. Not used

2-10. SURGE PROTECTIVE DEVICES.

2 -10.01. Scope. Surge protective devices (SPD) shall be provided as specified herein and as indicated on the Drawings. Each unit shall be designed for parallel connection to the wiring system and shall utilize non-linear voltage-dependent metal oxide varistors (MOV) in parallel.

Each SPD shall be furnished and installed for the electrical equipment indicated on the Drawings or as specified herein. All new lighting and pump station power panels shall be furnished with an integral SPD.

Lighting panels shall be rated for the low exposure level capacity unless otherwise noted.
Power Pump Station Power control panels shall have SPD’s rated for a medium exposure level.

The table below lists the specific SPD ratings for new pump power control panels.

Power Panel Name	Location	Voltage/ Phase	Exposure Level
East Plant Drain Pump Station	As shown on plans	480VAC, 3 Phase	Medium
West Plant Drain Pump Station	As shown on plans	480VAC, 3 Phase	Medium

2-10.02. Standards. The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

ANSI/IEEE C62.41 and C62.45;

ANSI/IEEE C62.1 and C62.11;

IEEE C62.62;

National Electrical Manufacturers Association (NEMA LS1 Guidelines);

National Fire Protection Association (NFPA 20, 70 [NEC], 75, and 780);

Underwriters Laboratories UL 1449 and 1283

The unit shall be UL 1449 Listed as a Type 2 Surge Protective Device and UL 1283 Listed as an Electromagnetic Interference (EMI) Filter.

2-10.03. Environmental Requirements.

a. Operating Temperature: 0°F to +140°F [-18°C to +60°C].

b. Relative Humidity: Reliable operation with 5 percent to 95 percent non-condensing.

2-10.04. Electrical Requirements.

a. Unit Operating Voltage. The nominal unit operating voltage and configuration shall be as indicated on the Drawings.

b. Maximum Continuous Operating Voltage (MCOV). The SPD shall be designed to withstand a MCOV of not less than 115 percent of nominal RMS voltage.

c. Operating Frequency. Operating frequency range shall be 47 to 63 Hertz.

d. Protection Modes. Four-wire configured systems shall provide, Line-to-Neutral (L-N), Line-to-Ground (L-G), and Neutral-to-Ground (N-G), and Line-to-Line (L-L) protection. Three-wire configured systems shall provide, Line-to-Line (L-L) protection and Line-to-Ground (L-G) protection.

e. Rated Single Pulse Surge Current Capacity. The rated single pulse surge current capacity, in amps, for each mode of protection of the unit shall be as required and shall be no less than listed in the following table.

	L-N	L-G	N-G	L-L
High Exposure Level	120 kA	120 kA	120 kA	120 kA
Medium-High Exposure Level	100 kA	100 kA	100 kA	100 kA
Medium Exposure Level	80 kA	80 kA	80 kA	80 kA
Low Exposure Level	60 kA	60 kA	40 kA	60 kA

f. UL 1449 Voltage Protection Rating (VPR). The maximum VPR per mode for the device (inclusive of disconnect) shall be as required and shall not exceed the following:

Voltage	L-N	L-G	N-G	L-L
120/240 1-phase	800 V	800 V	800 V	1200 V
480 V 4W	1200 V	1200 V	1200 V	2000 V

g. Noise Attenuation. The unit shall be capable of a minimum -30 dB attenuation at 100kHz when tested per the 50 ohm insertion loss method as defined by MIL-STD-220C.

h. Nominal Discharge Current. Each SPD shall have a nominal discharge current rating of 20 kA.

i. Overcurrent Protection. At high and medium-high exposure levels, the SPD shall incorporate internal fusing capable of interrupting, at minimum, up to 200 kA symmetrical fault current with 600 volts ac applied.

   At medium and low exposure levels, the SPD shall incorporate internal fusing capable of interrupting, at minimum, up to 65kA symmetrical fault current with 600 volts ac applied.

   The device shall be capable of allowing passage of the rated maximum surge current for every mode without fuse operation.

j. Unit Status Indicators. The unit shall include long-life, externally visible phase indicators that monitor the on-line status of the unit. When furnished integral to the panelboard, the status indicators shall be viewable when the panelboard door is opened.

2-10.05. Warranty. The manufacturer shall provide a minimum Five Year Limited Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

2-10.06. Installation. Each SPD shall be installed according to the manufacturer's recommendations. If possible for the integral units, provide direct bus connections.

2-10.07. Miscellaneous.

a. Disconnect Switch. Each SPD shall be furnished with an integral disconnect switch. The unit shall be UL 1449 listed as such, and the UL 1449 Voltage Protection Ratings shall be provided. The disconnect switch shall be fused and capable of withstanding, without failure, the published maximum surge current magnitude without failure or damage to the switch.

2-10.08. Acceptable Manufacturers. Integral SPD's shall be manufactured by Eaton, General Electric, or Schneider-Electric. External SPD's shall be manufactured by Eaton, General Electric, Siemens Energy & Automation, Schneider-Electric, or Current Technology. The products of other manufacturers will not be acceptable.

2-11. SEPARATELY ENCLOSED MOTOR STARTERS.

2-11.01. Three Phase Starters. Three phase starters shall be circuit breaker combination type consisting of 3 phase, 60 Hz contactors with heaterless overloads, a 120 volt ac coil, a dry type control power transformer where required, and a circuit breaker disconnect. Control power transformers shall be sized to handle all simultaneous loads. Starters shall be at least NEMA Size 1, or shall be sized as indicated on the Drawings.

Circuit breakers shall be 600 volt magnetic motor circuit protectors for motors smaller than 100 horsepower [75 kW] and 600 volt thermal-magnetic type for 100 horsepower [75 kW] and larger motors. Each breaker shall be manually operated with a quick-make, quick-break, trip-free toggle mechanism.

Three phase starters shall be furnished with external manual breaker operating handles and provisions for up to three padlocks. The access door shall be interlocked with the motor circuit protector, so that the door cannot be opened, except by an interlock override, while the breaker is closed. The starter enclosure shall be NEMA 4X, stainless steel.

The complete 3 phase starter shall have an interrupting rating of at least 65,000 amperes at 480 volts.

2-11.02. Single Phase Starters. Not Used

2-12. SEPARATELY ENCLOSED MANUAL STARTERS. Not used.

2-13. CONTROL STATIONS. Not used.

2-14. MCC ENCLOSED CIRCUIT BREAKERS. Circuit breakers shall be 3 pole, 480 volt, molded-case circuit breakers of not less than 65,000 amperes interrupting rating at 480 volts ac, complete with thermal and instantaneous trip elements. Each breaker shall be manually operated with a quick-make, quick-break, trip-free toggle mechanism. Bimetallic thermal elements shall withstand sustained overloads and short-circuit currents without injury and without affecting calibration.

Circuit breakers shall have "On", "Off", and "Tripped" indication and padlockable exterior handles.

Electrical Building No. 1
MCC-9, MCC-10:
Manufacturer: Westinghouse
Type Five Star Motor Control Center
Order # TA-86183 IT.005 FVC, Jan. 87

Electrical Building No. 2
MCC-1A, MCC-2A:
Manufacturer: Square D
Type Model 6 Motor Control Center
Order # 34678593-002

2-15. DISCONNECT SWITCHES. Not used.

2-16. LIGHTING AND AUXILIARY POWER TRANSFORMERS. Not used.

2-17. POWER CENTERS. Not used.

2-18. POWER FACTOR CORRECTION CAPACITORS. Not used.

2-19. LIGHTING CONTACTORS. Not used.

2-20. PHOTOELECTRIC CONTROLS. Photoelectric controls shall be weatherproof, swivel adjustable, with built-in time delay to prevent accidental turnoff by momentary brightness. The photocell shall be rated 1800 VA, 120 volts

ac, and shall be field adjustable from 1 ft/c [11 lux] turn-on to 15 ft/c [161 lux] turn-off.

2-21. RELAY ENCLOSURES. Relay enclosures shall be furnished as indicated on the Drawings. The enclosure shall have a NEMA 4X stainless steel painted white construction. Pilot devices shall be heavy duty, oiltight construction in accordance with 13561. Relays and timers shall have 120 volt, 60 Hz coils rated for continuous duty in 40 C ambient and 10 ampere, 120 volt ac contacts.

2-22. ALARM HORN AND BEACON. Not used.

2-23. HEAT-TRACED PIPING. Not used.

PART 3 - EXECUTION

3-1. INSTALLATION, TESTING, AND COMMISSIONING. All material, equipment, and components specified herein shall be installed, tested, and commissioned for operation in compliance with NECA 1000 – NEIS Specification System. Where required in NECA 1000, testing and commissioning procedures shall be followed prior to energizing equipment.

3-2. ARC FLASH HAZARD ANALYSIS. Contractor shall utilize Owner's Arc Flash Hazard Analysis for proper labeling of each new piece of electrical equipment including industrial control panels, and other electrical equipment likely to be worked on energized, in accordance with OSHA 29 CFR Part 1910, NEC, NFPA 70E, and IEEE 1584.

3-2.03. Arc Flash Labeling. Contractor shall furnish and install arc flash labels on the applicable electrical equipment. The arc flash labels shall comply with ANSI Z535.4 and NFPA 70E requirements. Labels shall include, at a minimum, the nominal system voltage, the arc flash boundary distance, worst-case incident energy and the corresponding working distance, date of the analysis, and equipment name.

Equipment with arc reduction maintenance mode switches shall include a dual label with the worst-case calculated incident energy level with and without the switch enabled. The label shall clearly identify the associated maintenance mode switch that shall be enabled in order for the lower incident energy level to apply.

3-3. PROTECTIVE DEVICE STUDY. Not used.

3-4. POWER AND SERVICE ENTRANCE INSTALLATION. Not used.

3-5. TELECOMMUNICATIONS SERVICE ENTRANCE INSTALLATION. Not used.

3-6. CABLE INSTALLATION.

3-6.01. General. Except as otherwise specified or indicated on the Drawings, cable shall be installed according to the following procedures, taking care to protect the cable and to avoid kinking the conductors, cutting or puncturing the jacket, contamination by oil or grease, or any other damage. Circuits to supply electric power and control to equipment and devices, communication and signal circuits as indicated on the one-line diagrams shall be installed continuous and may not be spliced unless approved by the Engineer.

a. Stranded conductor cable shall be terminated by lugs or pressure type connectors. Wrapping stranded cables around screw type terminals is not acceptable.

b. Stranded conductor cable shall be spliced by crimp type connectors. Twist-on wire connectors may only be used for splicing solid cable and for terminations at lighting fixtures.

c. Splices may be made only at readily accessible locations.

d. Cable terminations and splices shall be made as recommended by the cable manufacturer for the particular cable and service conditions.

e. All 5,000 volt rated cable and above shielded cable stress cone terminations shall be IEEE Class 1 molded rubber type. Shielded cable splices shall be tape or molded rubber type as required. Shielded cable splices and stress cone terminations shall be made by qualified splicers. Materials shall be by 3M Company, Plymouth/Bishop, or Raychem Electric Power Products.

f. Cable shall not be pulled tight against bushings nor pressed heavily against enclosures.

g. Cable-pulling lubricant shall be compatible with all cable jackets; shall not contain wax, grease, or silicone; and shall be Polywater "Type J".

h. Cables operating at more than 2000 volts shall be fireproofed in all cable vaults, manholes, and handholes. Fireproofing shall be applied with a half-lapped layer of 3M "Scotch 77 Arc-Proofing Tape", anchored at each end with a double wrap of 3M "Scotch 69 Glass Cloth Tape" or with equivalent tape by Anixter or Plymouth/Bishop.

i. Where necessary to prevent heavy loading on cable connections, in vertical risers, the cable shall be supported by Kellems, or equal, woven grips.

j. Spare cable ends shall be taped, coiled, and identified.

k. Cables shall not be bent to a radius less than the minimum recommended by the manufacturer. For cables rated higher than 600 volts, the minimum radius shall be 8 diameters for nonshielded cable and 12 diameters for shielded cable.

l. All cables in one conduit, over 1 foot [305 mm] long, or with any bends, shall be pulled in or out simultaneously.

m. Circuits to supply electric power and control to equipment and devices are indicated on the one-line diagrams. Conductors in designated numbers and sizes shall be installed in conduit of designated size. Circuits shall not be combined to reduce conduit requirements unless acceptable to Engineer.

n. Instrument cable shields and drain wires shall be continuous over the entire length of the circuit and grounded at one end only. In general, the field end of the shield shall be ungrounded. At the ungrounded termination of the circuit, the shield and drain wire shall be insulated by taping to prevent grounding.

o. Cables operating at more than 2,000 volts which terminate at medium-voltage padmounted equipment bushings shall include a metal oxide varistor surge protective elbow terminator conforming to IEEE Standard 386. Elbows shall provide a weatherproof, dead-front, hot-stick operable separable connection. Surge protector rating shall be as recommended by the terminator supplier.

3-6.02. Underground Cable Pulling Procedure. Care shall be taken to prevent excessive physical stresses that would cause mechanical damage to cables during pulling. Before pulling cables into the underground duct system the Contractor shall submit a pulling procedure for the underground circuits.

The procedure shall include the following information:

a. Point of cable entrance into the duct system.

b. Point of cable exit from the duct system.

c. Type of cable grip to be used.

d. Type of pulling device to be used.

e. Method of continuously monitoring cable tension during pulling.

f. Identification of manholes through which cable will be pulled or where splices will be made.

g. Size and type of cable sheave assemblies to be used.

3-6.03. Medium-Voltage Cable Insulation Test. Not used.

3-7. CONDUIT INSTALLATION. Contractor shall be responsible for routing all conduits. This shall include all conduits indicated on the one-lines, riser diagrams, conduit schedules, and home-runs shown on the plan Drawings. Conduits shall be routed as defined in these Specifications. Where conduit routing is shown on plans, it shall be considered a general guideline and shall be field verified to avoid interferences.

Except as otherwise specified or indicated on the Drawings, conduit installation and identification shall be completed according to the following procedures.

3-7.01. Installation of Interior and Exposed Exterior Conduit. This section covers the installation of conduit inside structures, above and below grade, and in exposed outdoor locations. In general, conduit inside structures shall be concealed. Large conduit and conduit stubs may be exposed unless otherwise specified or indicated on the Drawings. No conduit shall be exposed in water chambers unless so indicated on the Drawings.

Unless otherwise indicated on the Drawings, Contractor shall be responsible for routing the conduit to meet the following installation requirements:

a. Conduit installed in all exposed indoor locations, except corrosive areas indicated on the Drawings, and in floor slabs, walls, and ceilings of hazardous (classified) locations, shall be rigid aluminum. Exposed conduit shall be rigidly supported by stainless steel hardware and framing materials, including nuts and bolts.

b. Conduit installed in floor slabs and walls in non-hazardous locations shall be rigid Schedule 40 PVC.

c. Conduit installed in all exposed outdoor locations shall be rigid aluminum, rigidly supported by stainless steel framing materials. Mounting hardware, which includes nuts, bolts, and anchors, shall be stainless steel. All damaged coatings shall be repaired according to the manufacturer's instructions.

d. Final connections to dry type transformers, to motors without flexible cords, and to other equipment with rotating or moving parts shall be liquidtight flexible metal conduit with watertight connectors installed without sharp bends and in the minimum lengths required for the application, but not longer than 6 feet [1.8 m] unless otherwise acceptable to Engineer.

e. Terminations and connections of rigid steel and intermediate metal conduit shall be taper threaded. Conduits shall be reamed free of burrs and shall be terminated with conduit bushings.

f. Exposed conduit shall be installed either parallel or perpendicular to structural members and surfaces.

g. Two or more conduits in the same general routing shall be parallel, with symmetrical bends.

h. Conduits shall be at least 6 inches [150 mm] from high temperature piping, ducts, and flues.

i. Conduit installed in corrosive chemical feed and storage areas as indicated by Area Type on the Drawings shall be rigid Schedule 80 PVC. Exposed conduit in corrosive areas shall be supported by FRP framing materials with stainless steel hardware, including nuts and bolts.

j. Rigid Schedule 40 and 80 PVC conduit shall have supports and provisions for expansion as required by NEC Article 352.

k. Metallic conduit connections to sheet metal enclosures shall be securely fastened by locknuts inside and outside.

l. Rigid Schedule 40 and 80 PVC conduit shall be secured to sheet metal device boxes using a male terminal adapter with a locknut inside or by using a box adapter inserted through the knockout and cemented into a coupling.

m. Conduits in walls or slabs, which have reinforcement in both faces, shall be installed between the reinforcing steel. In slabs with only a single layer of reinforcing steel, conduits shall be placed under the reinforcement. Conduits larger than 1/3 of the slab thickness shall be concrete encased under the slab.

n. Conduits that cross structural joints where structural movement is allowed shall be fitted with concrete-tight and watertight expansion/deflection couplings, suitable for use with metallic conduits and rigid Schedule 40 or 80 PVC conduits. The couplings shall be Appleton Type DF, Crouse-Hinds Type XD, or O-Z Type DX.

o. Conduit shall be clear of structural openings and indicated future openings.

p. Conduits through roofs or metal walls shall be flashed and sealed watertight.

q. Conduit installed through any openings cut into non-fire rated concrete or masonry structure elements shall be neatly grouted. Conduit penetrations of fire rated structure elements shall be sealed in a manner that maintains the fire rating as indicated on the Architectural Drawings.

r. Conduits shall be capped during construction to prevent entrance

of dirt, trash, and water.

s. Exposed conduit stubs for future use shall be terminated with galvanized pipe caps.

t. Concealed conduit for future use shall be terminated in equipment or fitted with couplings plugged flush with structural surfaces.

u. Where the Drawings indicate future duplication of equipment wired hereunder, concealed portions of conduits for future equipment shall be provided.

v. Horizontal conduit shall be installed to allow at least 7 feet [2.1 m] of headroom, except along structures, piping, and equipment or in other areas where headroom cannot be maintained.

w. Conduit shall not be routed across the surface of a floor, roof, or walkway unless approved by Engineer.

x. PVC-coated rigid aluminum conduit shall be threaded and installed as recommended by the conduit manufacturer's installation procedure using appropriate tools.

y. All conduits that enter enclosures shall be terminated with acceptable fittings that will not affect the NEMA rating of the enclosure.

z. Conduit which turns out of concrete slabs or walls, shall be connected to a 90 degree elbow of PVC-coated rigid aluminum conduit before it emerges. Conduits shall have PVC-coated rigid aluminum coupling embedded a minimum of 3 inches when emerging from slabs or walls and the coupling shall extend 2 inches from the wall.

3-7.02. Underground Conduit Installation. All excavation, backfilling, and concrete work shall conform to the respective sections of these Specifications. Underground conduit shall conform to the following requirements:

a. All underground conduits shall be concrete encased unless indicated otherwise on the Drawings. Concrete encasement within 15 feet of building entrances, under and within 5 feet of roadways, and within 10 feet of indicated future excavations shall be reinforced as detailed on the Drawings.

b. Concrete encased conduit shall be schedule 40 PVC. Conduits shall have PVC-coated rigid aluminum coupling embedded a minimum of 3 inches when emerging from walls and the coupling shall extend 2 inches from the wall. All PVC joints shall be solvent welded in accordance with the recommendations of the

manufacturer.

c. Concrete encasement on exposed outdoor conduit risers shall continue to 6 inches [150 mm] above grade, with top crowned and edges chamfered.

d. Conduit and concrete encasement installed underground for future extension shall be terminated flush at the bulkhead with a coupling and a screw plug. The termination of the duct bank shall be reinforced with bars 100 diameters long that shall be terminated 2 inches [50 mm] from the bulkhead. Matching splice bars shall be 50 bar diameters long. Each longitudinal bar shall be provided with a Lenton "Form Saver" coupler and plate or a Dayton "Superior DBR" coupler at the bulkhead. The coupler shall be threaded to accept a dowel of like diameter in the future. Threads shall be protected with screw-in plastic caps. A 1-3/4 by 3/4 inch [45 by 20 mm] deep horizontal shear key shall be formed in the concrete encasement above and below the embedded conduits. After concrete placement, conduit and bar connector ends shall be cleaned and coated with two coats of thixotropic coal tar.

e. Underground conduits indicated not to be concrete encased shall be rigid PVC-coated aluminum.

f. Underground conduit bend radius shall be at least 2 feet [600 mm] at vertical risers and at least 3 feet [900 mm] elsewhere.

g. Underground conduits and conduit banks shall have at least 2 feet [600 mm] of earth cover, except where indicated otherwise.

h. Underground conduit banks through building walls shall be cast in place, or concreted into boxouts, with water stops on all sides of the boxout. Water stops are specified in the Cast-In-Place Concrete section.

i. Underground nonmetallic conduits, which turn out of concrete or earth in outdoor locations, shall be connected to 90 degree elbows of PVC-coated rigid aluminum conduit before they emerge.

j. Conduits not encased in concrete and passing through walls, which have one side in contact with earth, shall be sealed watertight with special rubber-gasketed sleeve and joint assemblies or with sleeves and modular rubber sealing elements.

k. Underground conduits shall be sloped to drain from buildings to manholes.

l. Each 5 kV or higher voltage cable, each 250 kcmil [120 mm2] or

larger cable, and each conduit group of smaller cables shall be supported from manhole walls by Kindorf "D-990" or Unistrut "P-3259" inserts, with Kindorf "F-721-24" or Unistrut "P-2544" brackets and Unistrut "P1753" or "P1754" fiberglass reinforced polyester cable saddles.

m. Telephone cables shall not be installed in raceways, conduits, boxes, manholes, or handholes containing other types of circuits.

n. Intercommunication and instrument cables shall be separated the maximum possible distance from all power wiring in pull-boxes, manholes, and handholes.

3-7.03. Sealing of Conduits. After cable has been installed and connected, conduit ends shall be sealed by forcing nonhardening sealing compound into the conduits to a depth at least equal to the conduit diameter. This method shall be used for sealing all conduits at handholes, manholes, and building entrance junction boxes, and for 1 inch [25 mm] and larger conduit connections to equipment.

Conduits entering chlorine feed and storage rooms shall be sealed in a junction box or conduit body adjacent to the point of entrance.

Conduits entering hazardous (classified) areas and submersible or explosion proof enclosures shall have Appleton "Type ESU" or Crouse-Hinds "EYS" sealing fittings with sealing compound.

3-7.04. Reuse of Existing Conduits. Existing conduits may be reused subject to the concurrence of Engineer and compliance with the following requirements:

a. A wire brush shall be pulled through the conduit to remove any loose debris.

b. A mandrel shall be pulled through the conduit to remove sharp edges and burrs.

3-8. WIRING DEVICES, BOXES, AND FITTINGS INSTALLATION. Metallic and nonmetallic conduit boxes and fittings shall be installed in the following locations:

3-8.01. Conduit Boxes and Fittings.

a. Stainless steel boxes and fittings shall be installed in concrete walls, ceilings, and floors; in the outdoor faces of masonry walls; and in all locations where weatherproof device covers are required. These boxes and fittings shall also be installed in exposed rigid steel and intermediate metal conduit systems.

b. Stainless steel boxes shall be installed in the indoor faces of masonry walls, in interior partition walls, and in joist supported ceilings.

c. Rigid PVC device boxes shall be installed in exposed nonmetallic conduit systems.

d. PVC coated boxes and fittings shall be installed in PVC coated conduit systems.

e. Telephone conduit shall be provided with separate junction boxes and pull fittings.

3-8.02. Device Plates. Oversized plates shall be installed where standard-sized plates do not fully cover the wall opening.

3-8.03. Wall Switches.

a. Wall switches shall be mounted 3'-6" [1.05 m] above floor or grade.

b. After circuits are energized, all wall switches shall be tested for proper operation.

3-8.04. Receptacles.

a. Convenience outlets shall be 18 inches [450 mm] above the floor unless otherwise required.

b. Convenience outlets outdoors and in garages; in basements, shops, storerooms, and rooms where equipment may be hosed down; shall be 4 feet [1.2 m] above floor or grade.

c. Welding receptacles shall be surface-mounted 4 feet [1.2 m] above the floor.

d. After circuits are energized, each receptacle shall be tested for correct polarity and each GFCI receptacle shall be tested for proper operation.

e. Conduit and wire for convenience outlet installation is not shown on the Drawings and shall be sized, furnished, and installed by Contractor. Conductors shall be minimum 12 AWG and conduit shall be minimum 3/4 inch for convenience outlet installation.

3-8.05. Special Outlets.

a. Wall thermostats shall be 4'-6" [1.35 m] above the floor unless otherwise required. Thermostats on exterior walls shall be suitably insulated from wall temperature.

b. Telephone outlets shall be 18 inches [450 mm] above the floor unless otherwise required. Telephone outlets outdoors and in garages; in basements, shops, storerooms, and rooms where equipment may be hosed down; shall be 4 feet [1.2 m] above floor or grade.

c. Clock outlets shall be located 7 feet [2.1 m] above the floor.

d. Horns and strobe lights for audio/visual alarms shall be mounted a minimum of 8 feet above finished floor and shall be positioned to provide maximum penetration of the surrounding area.

3-9. EQUIPMENT INSTALLATION. Except as otherwise specified or indicated on the Drawings, the following procedures shall be used in performing electrical work.

3-9.01. Setting of Equipment. All equipment, boxes, and gutters shall be installed level and plumb. Boxes, equipment enclosures, metal raceways, and similar items mounted on water- or earth-bearing walls shall be separated from the wall by at least 1/4 inch [6 mm] thick corrosion-resistant spacers. Where boxes, enclosures, and raceways are installed at locations where walls are not suitable or available for mounting, concrete equipment pads, framing material, and associated hardware shall be provided.

3-9.02. Sealing of Equipment. All outdoor substation, switchgear, motor control center, and similar equipment shall be permanently sealed at the base, and all openings into equipment shall be screened or sealed with concrete grout to keep out rodents and insects the size of wasps and mud daubers. Small cracks and openings shall be sealed from inside with silicone sealant, Dow-Corning "795" or General Electric "SCS1200".

3-10. GROUNDING.

3-10.01. General. The electrical system and equipment shall be grounded in compliance with the National Electrical Code and the following requirements:

a. All ground conductors shall be at least 12 AWG [4 mm^2] soft drawn copper cable or bar, bare or green-insulated in accordance with the National Electrical Code.

b. Ground cable splices and joints, ground rod connections, and equipment bonding connections shall meet the requirements of IEEE 837, and shall be exothermic weld connections or irreversible high-compression connections, Cadweld "Exothermic" or Burndy "Hyground". Mechanical connectors will not be acceptable. Cable connections to bus bars shall be made with high-compression two-hole lugs.

c. Ground cable through exterior building walls shall enter within 3 feet [900 mm] below finished grade and shall be provided with a water stop. Unless otherwise indicated, installation of the water stop shall include filling the space between the strands with solder and soldering a 12 inch [300 mm] copper disc over the cable.

d. Ground cable near the base of a structure shall be installed in earth and as far from the structure as the excavation permits, but not closer than 24 inches [600 mm]. The tops of ground rods and ground cable interconnecting ground rods shall be buried a minimum of 30 inches [750 mm] below grade, or below the frost line, whichever is deeper.

e. All powered equipment, including lighting fixtures and receptacles, shall be grounded by a copper ground conductor in addition to the conduit connection.

f. Ground connections to equipment and ground buses shall be made with copper or high conductivity copper alloy ground lugs or clamps. Connections to enclosures not provided with ground buses or ground terminals shall be made with irreversible high-compression type lugs inserted under permanent assembly bolts or under new bolts drilled and inserted through enclosures, other than explosion proof enclosures, or by grounding locknuts or bushings. Ground cable connections to anchor bolts; against gaskets, paint, or varnish; or on bolts holding removable access covers will not be acceptable.

g. The grounding system shall be bonded to the station piping by connecting to the first flange inside the building, on either a suction or discharge pipe, with a copper bar or strap. The flange shall be drilled and tapped to provide a bolted connection.

h. Ground conductors shall be routed as directly as possible, avoiding unnecessary bends. Ground conductor installations for equipment ground connections to the grounding system shall have turns with minimum bend radii of 12 inches [300 mm].

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i. Ground rods not described elsewhere shall be a minimum of 3/4 inch [19 mm] in diameter by 10 feet [3 m] long, with a copper jacket bonded to a steel core.

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j. Test wells and covers for non-traffic areas shall be molded high density polyethylene. Test wells for traffic areas shall be precast concrete construction rated for traffic duty with concrete or cast iron covers.

3-10.02. Grounding System Resistance. The grounding system design depicted on the Contract Drawings is the minimum design required for each building or structure. Each system shall comply with the maximum resistance of 5 ohms to ground. Contractor shall confirm the system grounding resistance with the results of the testing specified herein. Systems exceeding the maximum resistance specified shall be supplemented with additional grounding provisions and retested until the maximum specified resistance is achieved.

3-10.03. Grounding System Testing. The grounding system of each new building or structure and each existing building or structure indicated below, shall be tested to determine the resistance to earth. Testing shall be performed by an independent electrical or grounding system testing organization. Testing shall be completed after not less than three full days without precipitation and without any other moistening or chemical treatment of the soil.

3-10.03.01. New Grounding Systems. Grounding systems of each new building or structure shall be tested for resistance to earth utilizing the three-point fall of potential test as defined by IEEE 81. Testing shall be completed prior to installation of the electrical distribution equipment to ensure the grounding system is isolated from the utility grounding system and the systems of other structures. The current source probe for the test shall be placed in soil at a distance of 5 to 10 times the distance of the widest measurement across the grounding system ring or grid to ensure adequate measurements outside of the grounding system's sphere of influence. Test probe measurements shall be taken at a distance of one foot from the grounding system reference connection and at each 10 percent increment from the grounding system reference connection to the current source probe location. Test results shall be documented on a graphical plot with resistance in ohms on the vertical axis and distance in feet on the horizontal axis. The results shall clearly indicate a system resistance plateau which confirms a valid test procedure.

3.10.03.02. Existing Grounding Systems. Grounding systems of each existing building or structure indicated shall be tested for resistance to earth.

Existing building(s) or structure(s) to be tested	Electrical Building No. 1, No. 2

Where existing grounding systems can be isolated from the building power service or utility power service a three-point fall of potential test shall be completed as indicated above. Where isolation of the building grounding system is not practical, a clamp-on resistance test will be an acceptable alternative. Clamp-on resistance testing shall be completed utilizing a ground resistance tester specifically designed for clamp on resistance testing, such as the AEMC "Model 3711". Clamp-on resistance measurements shall be taken at the service side of the service entrance neutral, upstream of the neutral to ground bonding

connection to ensure a single path between the grounding system and the utility reference.

3.10.03.03. Grounding System Test Report. A report certified by the testing organization shall be prepared and submitted in accordance with the Submittal Procedures section. The final report shall include complete testing results for each building or structure, graphical representation of the test point results for the three-point fall of potential method, and complete observations of all site weather conditions and other environmental conditions that may affect the test results. Final acceptance of the results reported shall be subject to the review and approval of Engineer.

3-11. LIGHTING FIXTURE INSTALLATION. The Drawings indicate the general locations and arrangements of the lighting fixtures. Fixtures in rows shall be aligned both vertically and horizontally unless otherwise specified. Fixtures shall be clear of pipes, mechanical equipment, structural openings, indicated future equipment and structural openings, and other obstructions.

Conduit and wire for lighting fixture installation is not shown on the Drawings and shall be sized, furnished and installed by Contractor. Circuits to emergency lighting units, exit signs, and fixtures indicated to be night lights shall not be switched. Circuits to lighting fixtures indicated to have emergency battery packs shall include an additional un-switched hot conductor. Conductors shall be minimum 12 AWG and conduit shall be minimum 3/4 inch for lighting fixture installation.

3-12. POWER FACTOR CORRECTION CAPACITOR INSTALLATION. Not used.

3-13. HEAT-TRACED PIPING INSTALLATION. Not used.

3-14. MODIFICATIONS TO EXISTING EQUIPMENT. Modifications to existing equipment shall be completed as specified herein and indicated on the Drawings. All existing facilities shall be kept in service during construction. Temporary power or relocation of existing power and control wiring, equipment, and devices shall be provided as required during construction. Coordination and timing of outages shall be as specified in other sections of these Specifications. Electrical power interruptions will only be allowed where agreed upon in advance with Owner, and scheduling at times of low demand may be required.

3-14.01. Demolition. Unless otherwise specified or indicated on the Drawings, all cable and all exposed conduit for power and control signals of equipment indicated to be removed shall be demolished. Conduit supports and electrical equipment mounting hardware shall be removed, and holes or damage remaining shall be grouted or sealed flush. Conduit partially concealed shall be removed where exposed, and plugged with expanding grout flush with the floor

or wall. Repairs shall be refinished to match the existing surrounding surfaces. Demolished equipment shall be discarded or salvaged as indicated on the Drawings and as specified in other sections of these Specifications.

End of Section

STANDARD SPECIFICATIONS

REFERENCE: UL 83, ICEA S-95-658 (NEMA WC70).

CONDUCTOR: Solid, uncoated copper. Maximum operating temperature 90°C dry, 75°C wet.

INSULATION: Polyvinyl chloride, UL 83, Type THHN and THWN, ICEA S-95-658.

SHIELD: None.

JACKET: Conductor: Nylon, 4 mils (100 µm) minimum thickness, UL 83.

FACTORY TESTS: Cable shall meet the requirements of UL 83 for Type THHN and THWN.

Cable Details

Size		Number of Strands	Conductor Insulation Thickness*		Maximum Outside Diameter	
AWG or kcmil	mm^2		in.	µm	in.	mm
12	4.0	1	0.015	380	0.17	4.32
10	6.0	1	0.020	510	0.20	5.08

*The average thickness shall be not less than that indicated above. The minimum thickness shall not be less than 90 percent of the values indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, THWN or THHN, conductor size, and 600 volt.

600 Volt, Single Conductor Lighting Cable (600-1-PVC-THHN-THWN)

BLACK & VEATCH	Cable Data	Figure 1-16050

STANDARD SPECIFICATIONS

REFERENCE: ICEA S-95-658 (NEMA WC 70).

CONDUCTOR: Concentric-lay, uncoated copper; strand Class B. Wet/dry maximum operating temperature 90°C.

INSULATION: Cross-linked thermosetting polyethylene, ICEA S-95-658, Paragraph 3.6.

SHIELD: None.

JACKET: None.

FACTORY TESTS: Cable shall meet the requirements of ICEA S-95-658.

Cable Details

Size		Number of Strands	Conductor Insulation Thickness*		Maximum Outside Diameter	
AWG or kcmil	mm^2		in.	μm	in.	mm
14	2.5	7	0.030	760	0.17	4.32
12	4.0	7	0.030	760	0.19	4.83
10	6.0	7	0.030	760	0.21	5.33
8	10.0	7	0.045	1140	0.27	6.86
6	16.0	7	0.045	1140	0.31	7.87
4	25.0	7	0.045	1140	0.36	9.14
2	35.0	7	0.045	1140	0.42	10.67
1	40.0	19	0.055	1400	0.48	12.19
1/0	50.0	19	0.055	1400	0.52	13.21
2/0	70.0	19	0.055	1400	0.57	14.48
4/0	95.0	19	0.055	1400	0.68	17.27
250	120.0	37	0.065	1650	0.75	19.05
350	185.0	37	0.065	1650	0.85	21.59
500	300.0	37	0.065	1650	0.98	24.89
750	400.0	61	0.080	2030	1.22	31.00
1,000	500.0	61	0.080	2030	1.37	34.80

*The average thickness shall be not less than that indicated above. The minimum thickness shall be not less than 90 percent of the values indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, XLP, XHHW-2, conductor size, and voltage class.

600 Volt, Single Conductor Lighting/Power Cable (600-1-XLP-NONE-XHHW-2)

BLACK & VEATCH	Cable Data	Figure 2-16050

STANDARD SPECIFICATIONS

REFERENCE: UL 83, ICEA S-95-658 (NEMA WC 70).

CONDUCTOR: Stranded, uncoated copper. Maximum operating temperature 90°C dry, 75°C wet.

INSULATION: Polyvinyl chloride, UL 83, Type THHN and THWN, ICEA S-95-658.

SHIELD: None.

JACKET: Conductor: Nylon, 4 mils (100 μm) minimum thickness, UL 83.

FACTORY TESTS: Cable shall meet the requirements of UL 83 for Type THHN and THWN.

Cable Details

Size		Number of Strands	Conductor Insulation Thickness*		Maximum Outside Diameter	
AWG or kcmil	mm^2		in.	μm	in.	mm
14	2.5	19	0.015	381	0.12	3.05
12	4.0	19	0.015	381	0.14	3.56
10	6.0	19	0.020	508	0.17	4.32
8	10.0	19	0.030	762	0.23	5.84
6	16.0	19	0.030	762	0.26	6.60
4	25.0	19	0.040	1016	0.33	8.38
2	35.0	19	0.040	1016	0.39	9.91
1	40.0	19	0.050	1270	0.44	11.18
1/0	50.0	19	0.050	1270	0.50	12.70
2/0	70.0	19	0.050	1270	0.54	13.72
4/0	95.0	19	0.050	1270	0.66	16.76
250	120.0	37	0.060	1520	0.72	18.29
350	185.0	37	0.060	1520	0.83	21.08
500	300.0	37	0.060	1520	0.96	24.38
750	400.0	61	0.070	1780	1.17	29.72
1,000	500.0	61	0.070	1780	1.32	33.53

*The average thickness shall be not less than that indicated above. The minimum thickness shall be not less than 90 percent of the values indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, THWN or THHN, conductor size, and 600 volt.

600 Volt, Single Conductor Power Cable (600-1-PVC-THHN-THWN)

BLACK & VEATCH	Cable Data	Figure 3-16050

Section 16100

ELECTRICAL EQUIPMENT INSTALLATION

PART 1 – GENERAL

1-1. SCOPE. This section covers the installation of electrical equipment.

1-2. GENERAL. Equipment specified to be installed under this section shall be erected, and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

The electrical equipment identified as being provided by others will be furnished complete for installation by Contractor. Technical specifications under which the equipment will be purchased are available.

1-2.01. Coordination. When manufacturer's field services are provided by the equipment manufacturer, Contractor shall coordinate the services with the equipment manufacturer. Contractor shall give Engineer written notice at least 14 days prior to the need for manufacturer's field services furnished by others.

Submittals for equipment furnished under the original procurement contract will be furnished to Contractor upon completion of review by Engineer. Contractor shall review equipment submittals and coordinate with the requirements of the Work and the Contract Documents. Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, and field construction criteria.

1-3. DELIVERY, STORAGE, AND HANDLING.

1-3.01. Delivery. When sills are required for electrical equipment, they shall be shipped ahead of the scheduled equipment delivery to permit installation before concrete is placed.

1-3.02. Storage. Upon delivery, all equipment and materials shall immediately be stored and protected by Contractor in accordance with Product Storage and Handling Requirements section, and in accordance with manufacturer's written instructions, until installed in the Work. Equipment shall be protected by Contractor against damage and exposure from the elements. At no time shall the equipment be stored on earth or grass surfaces or come into contact with earth or grass. Contractor shall keep the equipment clean and dry at all times. Openings shall be plugged or capped (or otherwise sealed by packaging) during temporary storage.

1-3.03. Handling. Electrical equipment shall be moved by lifting, jacking, or skidding on rollers as described in the manufacturer's instructions. Special lifting harness or apparatus shall be used when required. Lifting and jacking points shall be used when identified on the equipment. Contractor shall have required unloading equipment on site to perform unloading work on the date of equipment delivery.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3-1. INSTALLATION, TESTING, AND COMMISSIONING. All installation work shall be in accordance with manufacturer's written instructions.

All material, equipment, and components specified to be installed according to this section shall be installed, tested, and commissioned for operation in compliance with NECA 1000 – NEIS Specification System. Where required in NECA 1000, testing and commissioning procedures shall be followed prior to energizing equipment.

Electrical equipment cubicles and vertical sections shall be installed plumb and level. Draw-out equipment carriages, circuit breakers, and other removable components shall operate free and easy without binding or distortion.

Unless otherwise indicated or specified, all indoor floor-mounted electrical equipment and control cabinets shall be installed on concrete equipment pads four inches [102 mm] in height.

Indoor metalclad switchgear shall be bolted to steel floor channels which are installed level and flush with the top of the concrete floor or equipment pad.

Outdoor metalclad switchgear and interrupter gear with integral floor channels or beams shall be secured to concrete pads with anchor bolts and clips.

Motor control centers with integral floor sills shall be secured to concrete floors or equipment pads with anchor bolts.

Adequate bracing shall be provided for seismic forces. The bracing shall be designed to meet the requirements of the Meteorological and Seismic Design Criteria section.

3-1.01. Cleaning. All deposits of oil, grease, mud, dirt or debris shall be cleaned from the electrical equipment following installation and field wiring. A detergent

water based solution, or other liquid cleaners not harmful to material or equipment finishes, shall be used as recommended by the manufacturer.

End of Section

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