MANATEE COUNTY UTILITIES

SOUTHEAST REGIONAL WATER RECLAMATION FACILITY: ELECTRICAL MASTER PLAN

FINAL
JULY 2018

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MANATEE COUNTY UTILITIES

NORTH REGIONAL WATER RECLAMATION FACILITY ELECTRICAL MASTER PLAN

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1.0 EXECUTIVE SUMMARY

Manatee County (County) owns and operates the Southeast Water Reclamation Facility (SEWRF), an advanced wastewater treatment facility permitted to treat 11.0 million gallons per day (mgd) at a three month rolling average daily flow (TMRADF). Located in southeast Manatee County at 3525 Lena Rd in Bradenton, FL, the SEWRF was built in 1989 and serves as one of three water reclamation facilities for the County's service territory, treating County wastewater to reuse standards and pumping its effluent to a piped network of agricultural users. Influent treatment and effluent distribution have the capacity to demand several megawatts of electricity, and this load is expected to increase as the Manatee County population grows. This growth and the natural deterioration of aging equipment drive the need for continuous plant maintenance and improvement, and for that purpose the County has hired Carollo Engineers, Inc. (Carollo) to develop an Electrical Master Plan that guides this development. In it, Carollo assessed the plant's condition and proposes projects to maintain reliable service and manage growth wisely.

Carollo has investigated the following aspects of the SEWRF's existing plant and operations:

- Condition assessment of all major electrical gear, including: the physical integrity and operability of the enclosure, doors, switches, indicator lights, and overcurrent protection; the age and remaining life of equipment; the availability of spare parts, the impacts of a corrosive environment; spare electrical capacity; and physical space available to accommodate growth.

- The reliability of the plant to receive, treat, and discharge influent. Electrically, this means that the architecture of the electrical system accommodates the staff's needs to balance plant loads across distribution sources, minimize single points of failure, provide switching capability among distribution paths, and make alternate power sources available throughout the plant.

- The safety and functionality of the facility's electrical power system and distribution equipment in normal and abnormal conditions; whether the equipment operates within its ratings; arc flash conditions, operating procedures, and maintenance practices, the equipment's ability to isolate short-circuit faults; or whether equipment can be taken out of service for maintenance or repairs. This task included a review of the 2015 Electrical System Study and the recommendations that were made as a part of that study.

- The perspective of plant staff on equipment and systems that need repair or replacement, based on their experience with functionality and failures. Staff shared their concerns about equipment that poses safety hazards, operational inefficiencies, and maintenance liabilities. Their working experience with the SEWRF systems is consistent with Carollo's observations, and this report reflects their expertise and priorities - just as it reflects Carollo's observations and judgment.

- An analysis of the SEWRF's utility service from Florida Power & Light (FP&L), including: reliability data at the plant's service entrances; billing data, by month, to build a 5-year energy profile of seasonal consumption; and a study of billing rates to determine the base rate, peak (kW) demand rate, and energy (kWH) rate for each service.

Having investigated the SEWRF plant and operations, Carollo then made recommendations to address existing deficiencies and potential problems that can be anticipated from the years 2018 to 2045. In terms of priority, Carollo recommends that the County first implement the Operational Improvements, as they have the potential to impact the quality and cost of all subsequent work. Second, Carollo recommends that the County implement the Short Term Improvements identified in Section 6. Finally, Carollo recommends that the County execute the Capital Improvement Projects identified in Section 7, in the order indicated. The recommendations are summarized as:

- Operational Improvements to improve safety, reliability, and minimum overall cost of ownership:
  - establish a stricter practice of maintaining plant documentation;
  - create a tagging system with unique identifiers that match field labeling to drawings;
  - define plant technical preferences, standards, or requirements for Electrical, Instrumentation, and Control installations (to simplify contracting and oversight of Consultants and Contractors;
  - develop an Electrical Preventive Maintenance (EPM) program that's aligned with NFPA 70B;
  - implement the Electrical Safety Plan (ESP) that Carollo provided in 2017;
  - record power meter data annually and reset meter fields (or have the data historized in SCADA and displayed on the HMI);
  - establish a procedure for taking an annual energy baseline.

- Short Term Improvements to secure the functionality of existing equipment that may be in use for many years.

- Capital Improvement Projects (CIPs) to maintain the plant's ability to treat and deliver water. Some of these projects are driven by the natural life cycle of electrical

equipment (whose materials degrade with time), some projects accommodate work being done on treatment processes, and others are recommended to match the system architecture to the evolving needs of the process. The goal is to build a resilient system at minimum overall cost to both capital and operational budgets.

1.1 Summary of Findings and Recommendations

Carollo's assessment of the SEWRF electrical distribution system (refer to one-line diagram EMP-2018) revealed that:

- The current configuration makes the plant power system vulnerable to a loss of either FP&L transformer, because SWGR-2A/B is mostly dedicated to process loads and SWGR-1A/B to effluent loads (with some overlap). Carollo proposes rearranging this configuration to dedicate each service transformer to one wing (load bus) of the replacement SWGR-1A/B. To clarify: when this report refers to SWGR-1A/B, it's referring to the existing switchgear, SWGR-1, which does not have a transfer bus (see the next paragraph for discussion of its replacement: SWGR-1A/T/B).

- The plant appears to be overinvested in standby power capacity, with 6000 kW (7200 kVA) of generator power available, but only 3000 kVA of utility transformer capacity. Some of that excess capacity will be required for starting your motors, but the largest motors are all run from VFDs so providing twice the generator capacity as transformers is excessive. Carollo recommends replacing the two separate generator switchgear assemblies with a single one that enables the plant to parallel its standby sources. The replacement SWGR-1A/T/B will have metering that allows staff to study the plant's loading patterns before deciding whether to replace Generators 1 and 2, both due for replacement in 2025. As an alternative, metering can be added before the replacement of SWGR-1A/T/B, and can provide valuable data to inform those projects. To clarify: when this report refers to SWGR-1A//T/B, it's referring to the new switchgear that will replace the existing SWGR-1A/B. The difference is that the new switchgear will have a transfer bus for receiving generator power from an external generator switchgear (SWGR-GEN).

- The original equipment, installed between 1988 and 1989, is reaching the end of its useful life. Numerous pieces of electrical equipment are obsolete due to changes in electrical technology and a lack of spare parts; others are in poor condition from 30 years of service. To maintain a reliable and safe power distribution system, electrical equipment more than 25 years old should be replaced in the next five to ten years (2023-2028).

- The overall load for the plant cannot be determined for several reasons: historical metering is absent from SWGR-1A/B, the co-generation system (Co-Gen) connects directly to SWGR-2A (limiting the value of service entrance data at SWGR-2A), and the meter on SWGR-2B is broken. By replacing SWGR-1A/B as recommended, the

overall plant load can be determined. Integration of the Co-Gen system with the remainder of the plant is outside the scope of this study.

Co-generation complicates any load study. A potential solution to this complication is to receive metering data from the SWGR-1A/B and the co-generation source at the HMI system and sum them internally for historical tracking and trends. In the short term, a rough estimate of overall plant demand can be measured at the meters on the backup generators. Unfortunately, the generators failed when we tried that during the project.

Recommendations for upgrading the power distribution system are summarized below (in Table 1), and an accounting of each cost estimate is further itemized in Sections 6 and 7. All numbers are given in 2018 dollars.

Table 1 Summary of Electrical Improvements and Related Construction Cost

No	Description	Recommended Year	Total*
0	Short Term Improvements	2019	$159,000
1	Replacements with RAS/WAS System Rehabilitation	2019	$763,000
2	Dedicated Plant Drain Station	2019	$89,000
3	Replace SWGR-1A/B and Generator Switchboards 1/2 and 2/3	2019	$1,408,000
4	Replace MCC-5 and MCC-6 (and Arc Flash Mitigation)	2019	$683,000
5	Anoxic Basins Mixer Replacements	2020	$399,000
6	Flow Equalization Tanks and Mixed Liquor Splitter Box Rehabilitation	2021	$110,000
7	Replace BFP control Panels with Belt Filter Press Upgrades	2022	$394,000
8	Secondary Clarifiers Rehabilitation	2022	$65,000
9	New MCC and Electrical Building for Anoxic/Aeration Basin #4	2026	$776,000
10	Electrical System Upgrades	2030	$2,444,000
11	VFD Replacements for Sludge Pumps	2033	$90,000
12	MARS Equipment Replacements	2035	$1,273,000
13	Replace Generator 1 in 2035	2035	$1,833,000
14	Biosolids Equipment Replacements	2038	$585,000
15	Replace Generator 2 in 2045	2045	$1,833,000
16	Electrical Equipment Replacements	2045	$415,000
OPINION OF TOTAL PROBABLE CONSTRUCTION COST			**$13,319,000**

* Class 5 estimates, based on AACE.

2.0 CONDITION ASSESSMENT, GENERAL

These observations either apply to the incoming utility service or to the system as a whole. They involve assessments of equipment condition, but apply as condition trends across the plant, rather than isolated to a particular piece of equipment.

2.1 Power Supply from external sources: Utility and Co-Generation

FP&L supplies power to SEWRF at 480 volts (V), by way of two 1,500 kVA transformers that are both connected to the same FP&L circuit. The service transformers are located in a utility vault room within the Electrical Building, adjacent to the main Electrical Room where the main circuit breakers are housed. Each of the transformers supplies one assembly of low voltage switchgear with two circuits of service conductors: each circuit connects to one side of the switchgear (which has two buses, A and B, separated by a tie circuit breaker). Refer to drawing EMP-2018 for an Overall One Line Diagram of the existing plant.

Five-years of outage data from your FP&L feeder reveals that momentary outages (less than 60 seconds) peak at 2.4 outages/month from May through September (during storm season), while they average 0.5 outages/month for the rest of the year. In total, the SEWRF experiences about 18 momentary interruptions per year. Sustained outages (more than 60 seconds) occur at 0.6 times per year, lasting for about 0.5 hours. The sustained outage pattern is low, relative to other FP&L customers in the same service territory, and the pattern of momentary interruptions is high (perhaps due to lightning strikes at the neighboring landfill, which is the tallest land for miles).

A second power supply is provided from an independent power producer, SCS Energy of Long Beach, CA, who owns and operates an onsite generator that burns methane from the neighboring landfill. The co-generation system (Co-Gen) provides a relatively constant output (1400 - 1700 Amps; or 1200 - 1600 kW) of inexpensive electricity to the SEWRF. However, this power source is non-islanding and only generates when connected in parallel to FP&L and therefore cannot be used as a standby power source.. Standby power for outages is provide by diesel engine generators, as discussed below, and the reliability of the Co-Gen system is outside the scope of this study.

2.2 System Architecture: Switchgear, Generators, & Gen Switchgear

The architecture of the SEWRF's power distribution system organizes its loads mainly by utility transformer, grouping most of the treatment process loads on SWGR-2A/B and most of the effluent pumping (MARS) loads on SWGR-1A/B (though this distribution philosophy isn't applied consistently). Separate from SWGR-1A/B and SWGR-2A/B there are four circuit breakers connected to the three generators, with Generators 1 & 2 providing standby power for SWGR-1A/B and Generators 2 & 3 providing standby power to SWGR-2A/B (see drawing EMP-2018).

Carollo disfavors this arrangement because the configuration creates an unnecessary dependence on each of the utility transformers, because failure at either transformer eliminates the availability of utility power at one of the switchgear line-ups and all of its associated loads. Standby power from the SEWRF's generators is still available during a transformer failure, but the utility service would be more reliable for the plant as a whole if both utility transformers came into the same switchgear: One transformer dedicated to each side of a split-bus switchgear. An arrangement like this would also have more operational versatility - and it would be better able to distribute power from standby generators and Co-Gen.

Currently each switchgear line-up has a dedicated standby generator (Generator 1 for SWGR-1A/B and Generator 3 for SWGR-2A/B), additionally both switchgear line-ups are capable of receiving standby power from Generator 2 (see drawing EMP-2018). Generator 1 connects to SWGR-1A/B through a dedicated generator breaker. Similarly Generator 3 connects to SWGR-2A/B through a dedicated generator breaker. Generator 2 has 2 breakers one that connects to SWGR-1A/B and the other connects to SWGR-2A/B. None of the generators are paralleled to one another. Generator 1 is capable of supplying all SWGR-1A/B demand load (if the tie breaker is closed), similarly Generator 3 is capable of supplying all SWGR-2A/B demand load. Generator 2 can supply power to either or both SWGR-1A/B or SWGR-2A/B up to it rating; however, if Generator 2 was to simultaneously supply power to both SWGR-1A/B and SWGR-2A/B the plant staff would have to monitor its loading and manually shed load in order to not overload the generator.

While this arrangement is effective at providing sufficient standby power to plant loads, it does so expensively, requiring the plant to maintain 6000 kW (7,500 kVA) of generator capacity for processes that are adequately supplied by 3000 kVA of utility transformers. A simpler, less-expensive arrangement would integrate two generators at a single assembly of generator switchgear, rather than maintaining three generators and two generator switchgears. A single assembly of paralleling generator switchgear, if connected to a transfer bus (between the two load bus wings of the switchgear), could make standby power from two generators available to run the entire plant. Deferring the replacement of Generators 1 & 2 would save the County a lot of money, and avoiding the replacement of Generator 3would save the County ~$1.5 million dollars.

2.3 System Architecture: Redundancy Loops between Twin MCCs

SWGR-1A/B and SWGR-2A/B directly power large VFD-driven loads. The remainder of distribution circuits from SWGR-1A/B and SWGR-2A/B feed motor control centers (MCCs), which in turn power process loads, building loads, and panelboards. This type of power distribution system is termed “radial." The alternative to "radial" distribution is "loop" distribution, where power is distributed from two breakers in the switchgear through a series of switches with taps for feeders between them. The “loop” distribution system essentially provides two sources of power to each load. Radial connections are simple, inexpensive,

and less reliable; loop connections are more complex, expensive, and reliable. While the SEWRF uses radial supply between service switchgear and MCCs, it does establish loop redundancy by connecting "twin-pairs" of MCCs together through a tie circuit breaker.

The benefit of the SEWRF's existing distribution system is that it gives each pair of MCCs (MCC-1 & 2, 3 &4, 7 & 8, and 11 & 12) are supplied from two feeder circuits, when the Ties are cloased. For example: MCC-1 has one feeder from SWGR-2A; MCC-2 has one feeder from SWGR-2B; and a tie between the two MCCs gives either one access to either side of SWGR-2. Each paired MCC is normally supplied from opposite sides SWGR-2 , and neither of these MCCs may be powered from SWGR-1 (or its FP&L transformer or Generator 1).

Redundant feeder circuits powering paired MCCs that have a tie breaker address some of the single point of failure concerns. The standby engine generators in conjunction with their associated FP&L transformers address the other single point of failure concerns. However, additional reliability could be achieved by sizing each FP&L transformer to power the entire plant load with each feeding separate ends of the same switchgear with tie breakers in between as depicted on EMP-2019. The replacement of SWGR-1A/B introduces this opportunity, and our recommended solution is explained below in the description of that project.

2.4 System Architecture: Co-Generation and Biosolids

The Co-Gen system is connected to the A-bus of SWGR-2A/B. It's not clear to Carollo how this system is integrated into the control, metering, and protection scheme of SWGR-2, but we see some problems with the configuration. First of all, it appears that the Co-Gen circuit breaker is intended to protect SWGR-2A at its ampacity (3200 A), but that its current transformer (CT) measurement is not summed with the CTs on its FP&L input at the Main Circuit Breaker to bus SWGR-2A (which is set for 3000 A). As such, it's possible that the process could draw current in excess of the switchgear's 3200 A capacity. A second problem with the Co-Gen system is that only SWGR-2A/B loads have access to it: if co-generation exceeds the loads on SWGR-2A/B and the County uses it at SWGR-1A/B, then the County would end up paying for the power twice: once from the Co-Gen supplier at SWGR-2/AB - and then again at SWGR-1A/B from FP&L (or possible at Biosolids MCC-1BSD, which is on a separate FP&L service entirely. We can't know when this problem occurs right now, because of the metering problems, but it might be happening any time Co-Gen supply exceeds the demand on SWGR-2A/B.

A third problem with the Co-Gen system, related to the second issue, is that the metering of the overall system does not give the plant accurate data for monitoring its loads. This is discussed further below, in Section 2.05.

Another aspect of the system architecture that's worth mentioning is that there's another service entrance in addition to the two FP&L services that were described above. The Biosolids Dryer building receives its own FP&L service directly into a 1600 A motor control

center. With its own, autonomous service, this building has no access to SEWRF standby capacity or less expensive Co-Gen power, and is inherently less reliable than the remainder of the plant (though this isn't a major concern though, as the Biosolids function is not critical). The arrangement is also problematic for having the service conductors connected directly from the utility transformer secondary to MCC-1BSD, because transformer secondaries have the most energy available for (and slowest protection against) arcing faults.

The County has expressed interest in having MCC-1BSD supplied from the same service switchgear as the rest of the plant, which would solve both problems (of having an upstream service disconnect and providing access to Co-Gen and standby generators). However, Carollo is concerned about available capacity at the service switchgear, which might be near 3600 A on a 4000 A bus, if its recommendations are followed to consolidate the service entrances into one assembly. As such, Carollo recommends that the County address its metering problems first to acquire a more accurate sense for the true demand load of the plant. If the data is favorable, then it might make sense to look at supplying MCC-1BSD from a new SWGR-1A/B.

2.5 Metering Problems at Switchgear

The overall load for the plant cannot determined for several reasons: historical metering is absent from SWGR-1A/B, the meter on SWGR-2B is broken, and the Co-Gen system connects directly to bus SWGR-2A without a local meter display (and this significantly limits the value of service entrance data at SWGR-2A). The Co-Gen system, in particular, complicates the metering scheme because it can lead to positive or negative flows through the main circuit breaker of bus SWGR-2A, and it's not clear that the two sources have been properly integrated to reflect the arrangement. This issue is problematic because the NEC sizing rules require that a project adding load demonstrate bus capacity by calculations (which presently indicate more connected load than switchgear capacity) or historical metering (which always has more favorable numbers than the sum of connected load).

Carollo recommends that a historical, digital meter be provided for each source (including generators and Co-Gen), that the data be received at the SCADA system, and that the sources for each bus are summed by SCADA for historical tracking and trends of power consumption at each switchgear bus.

2.6 Power Quality Problems at MCCs

Digital metering is present at 8 MCCs out of 16 total. These digital meters log historical highs and display measurements of power factor, harmonic current distortion, and harmonic voltage distortion. A survey of those meters found that power factor was low throughout the plant: the typical range was 0.75 to 0.85, with some buses as low as 0.25 at the time of observation. The harmonic content of voltage and current were low on most buses, in the

range of 1-3%, but the harmonic current on MCC-11 was found to be 35%, a very high value.

The measurements of low power factor can probably be attributed to the failure of power factor correction capacitors around the plant, leaving several large, across-the-line loads without a local source for their reactive power requirements. The measurement of high harmonic current at MCC-11 can be attributed to the two 75 HP, 6-pulse, variable frequency drives (VFD) for the RAS pumps, neither of which have a line reactor (or other harmonic mitigation). The County could address these problems by replacing (and maintaining) its failed power factor correction capacitors, installing of new 3% (min) line reactors for all VFDs, performing maintenance testing on your ground system, installation of digital power meters where they're not provided, and monitoring the power quality metrics with the existing meters.

3.0 CONDITION ASSESSMENT, ELECTRICAL EQUIPMENT

3.1 History of the SEWRF Power System

Carollo Engineers performed a condition assessment of the SEWRF's electrical distribution equipment, including a review of record drawings from the original construction in 1989, the major "WWTP Expansion" project in 2002, and the "10 MG Storage Tank & Interconnection" project in 2017. The following is a summary of the major electrical system projects completed or in construction since the 1989 construction:

- In 1989, the original plant was built with SWGR-1A/B (manufactured in 1986) supplying the entire process via MCCs, with one 750 kW generator connected to lugs on bus SWGR-1A. Original MCCs 1, 1A, 2, 2A (in 2002 and 2013) have all been replaced; original MCCs 3 and 4 were re-labeled MCCs 9 and 10 (in 2000); and original MCCs 5 and 6 are still in-service. Many original panelboards are also still in-service.

- In 1995, Generator 1, Generator 2, and Generators 1 & 2 Switchgear were all installed, connecting Generator 1 to bus SWGR-1A and Generator 2 to bus SWGR-1B.

- In 2002, the electrical system was expanded to connect new Effluent Pumps at SWGR-1A/B and provide SWGR-2A/B as the power source for several new MCCs to supply the equipment additions of the expanded process (present MCC-1, MCC-2, MCC-3, MCC-4, MCC-7, MCC-8, MCC-11, and MCC-12). Generators 2 & 3 Switchgear and Generator 3 were also provided at this time, realizing the switchgear configuration that's in place today.

- In 2007, the Biosolids Dryer building was added, with a new FP&L service to MCC-1BSD.

- In 2013, the co-generation system was connected to bus SWGR-2A, providing the plant with electricity generated from landfill gas.

- In 2016, the septage receiving station was installed, including new MCC-SEP that is fed from MCC-1.

- In 2017, the 10 MG storage tanks were commissioned, replacing the previous large effluent pumps with the new pumps for High Service (four pumps at 400 HP each) and Low Service (five pumps at 100 HP each). New MCC-13 & MCC-14 installed.

- 2018: refer to the Summary of the Condition Assessment, below.

3.2 Summary of the Condition Assessment of Electrical Equipment

Table 2 Condition Assessment, SEWRF Major Electrical Equipment

Equipment	Function in Distribution System	Year of Manufacture, Physical Condition(2)	Location	Action Recommended
SWGR-1A/B	Service entrance switchgear. Supply for MCCs 9, 10, 5, & 6, and for 3 of 4 High Service Pumps,	1986 Poor. Hot spots found with thermal imaging (repaired 2016). No written procedure for switching operations. Door clasps loose and status lights out on a few cubicles.	Main Electrical Room	Replace assembly as soon as possible. Replace both Generator Switchgear assemblies at the same time. Connect new Generator Switchgear to transfer bus of new SWGR-1A/B. Connect one FP&L transformer to each side of new SWGR-1A/B. Leave space for future additions, when it's time to replace SWGR-2A/B. Replace service entrance cables to SWGR-2A/B with new feeder circuits from new SWGR-1A/B.
SWGR-2A/B	Service entrance switchgear. Connection of Co-Generation Supply for MCCs 1, 2, 3, 4, 7, 8, 11, 12, & 13; and for 1 of 4 High Service Pumps,	2001 Good. Faulty meter 2B. Poor integration of Co-Gen circuit breaker. Mislabeling between protective functions and existing documentation.	Main Electrical Room	Repair or replace both power meters. Incorporate all power sources metering (utility, Co-Gen, and generators) into SCADA system for historical tracking. Replace service entrance cables to SWGR-2A/B with new feeder circuits from new SWGR-1A/T/B. Replace assembly in 2032 (as mentioned above for SWGR-1A/B). Replace or remove in 2032 (with additional vertical sections on SWGR-1A/B to supply loads currently fed by SWGR-2A/B).

Table 2 Condition Assessment, SEWRF Major Electrical Equipment

Equipment	Function in Distribution System	Year of Manufacture, Physical Condition(2)	Location	Action Recommended
Generator 1	2000 kW Standby Power	1995 Good. Lightly used. Exercise is irregular. Staff has reported "generator batteries blowing up during a recent exercise." Carollo witnessed an electrical short circuit at the fuel day tanks during an exercise in May.	Generator Room	Exercise regularly. Keep up with routine maintenance. Have Ring Power perform in-depth technical analysis (including oil analysis and fuel usage) every 3 years. Replace generator in 2035.
Generator 2	2000 kW Standby Power	1995 Good. Lightly used. Exercise is irregular.	Generator Room	Exercise regularly. Keep up with routine maintenance. Have Ring Power perform in-depth technical analysis (including oil analysis and fuel usage) every 3 years. Replace generator in 2035.
Generator 3	2000 kW Standby Power	2001 Good. Lightly used. Exercise is irregular.	Generator Room	Exercise regularly. Keep up with routine maintenance. Have Ring Power perform in-depth technical analysis (including oil analysis and fuel usage) every 3 years. Retire Generator 3 once Generators 1 & 2 are paralleled. This assessment should be re-visited once the plant's demand load pattern is verified.

Table 2 Condition Assessment, SEWRF Major Electrical Equipment

Equipment	Function in Distribution System	Year of Manufacture, Physical Condition(2)	Location	Action Recommended
Generators 1 & 2 Switchgear	Connecting Generators 1 & 2 to SWGR-1A/B	1995 Good. Indicator lights out. Poor documentation of system and switching procedures.	Main Electrical Room	Replace with a new Generator Switchgear assembly (SWGR-GEN) for two of the generators at the same time as replacement of SWGR-1A/B. This may require generator modifications to the governors, governor controllers, and voltage regulators.
Generators 2 & 3 Switchgear	Connecting Generators 3 & 2 to SWGR-2A/B	2001 Good. Poor documentation of system and switching procedures.	Main Electrical Room	Replace with a new Generator Switchgear assembly (SWGR-GEN) for two of the generators at the same time as replacement of SWGR-1A/B. This may require generator modifications to the governors, governor controllers, and voltage regulators.
MCC-9, MCC-10, MCC-5, and MCC-6	Supplies power to solids handling, filters, and two plant drain pump stations.	1986. Poor.	Belt Filter Press Electrical Room	Remove equipment and replace with new, including digital meters for each MCC.
MCC-1, MCC-2, MCC-3, MCC-4	Supplies power to EQ basin, headworks, aerators, aeration basin mixers, RML pumping, and two plant drain pump stations.	2000. Good. Capacitors bad. NEC violation on OCP to MLR pumps.	Headworks /Aeration Basin Electrical Room	Repair or replace power factor correction capacitors. Replace motor circuit protectors on feeder circuit to VFDs (for MLR pumps) with molded case circuit breakers (for OL protection, in addition to short circuit). Replace equipment in 2030 (or sooner, depending on the 4th basin).

Table 2 Condition Assessment, SEWRF Major Electrical Equipment

Equipment	Function in Distribution System	Year of Manufacture, Physical Condition(2)	Location	Action Recommended
MCC-7, MCC-8, MCC-11, MCC-12.	Supplies power to sludge thickening, filters, and two plant drain pump stations.	2000. Good. Mislabeling. Low power factor.	Headworks /Aeration Basin Electrical Room	Install power factor correction capacitors or VFDs for sludge blowers. Stock spare parts for auto-transformer starters on sludge blowers. Remove equipment and replace with new in 2030.
MCC-1A, MCC-2A	Supplies power to headworks and odor control	2013. Good. No power meters, but sub-fed from adjacent MCCs 1, 2 (metered).	Headworks /Aeration Basin Electrical Room	Replace equipment in 30 years - or possibly earlier when MCC-1 and MCC-2 are replaced (to consolidate space and update technology).
MCC-13, MCC-14	Supplies power to MARS system (low service and HS jockey pumps)	2015. Good.	MARS Electrical Room	Replace equipment in 30-years..
Panelboards & Transfer Switches	Supplies power to non-continuous loads for process & auxiliary loads.	Varies: 1989 - 2016 Varies: poor to good.	Throughout plant	Maintain circuit breakers per NFPA 70B. Replace as indicated in project descriptions. Dry-type transformers can stay in-service for the life of the building.
VFDs for RAS Pumps (3)	Separately-mounted VFD starters for RAS pumps	2000. Good.	Main Electrical Room	Replace these with the RAS/WAS rehabilitation schedule for 2018. When replacing, provide 5% line reactors and DC bus chokes to protect the VFDs from upstream voltage surges and mitigate harmonic currents.

Table 2 Condition Assessment, SEWRF Major Electrical Equipment

Equipment	Function in Distribution System	Year of Manufacture, Physical Condition(2)	Location	Action Recommended
VFDs for WAS Pumps (4)	Separately-mounted VFD starters for RAS pumps	2000. Good.	Main Electrical Room	Replace these with the RAS/WAS rehabilitation schedule for 2018. When replacing, provide 5% line reactors and DC bus chokes to protect the VFDs from upstream voltage surges and mitigate harmonic currents.
VFDs for MARS (HS, HS Jockey, and LS Pumps)	Separately-mounted VFD starters for MARS pumps	2015. Good.	Main & MARS Electrical Rooms	Replace these in a "VFD Replacements Project" in 2035. When replacing, provide 5% line reactors and DC bus chokes to protect the VFDs from upstream voltage surges and mitigate harmonic currents.
VFDs for RML Pumps	Separately-mounted VFD starters for RML pumps	2000. Good.	Gallery between Aeration Basins	RML pumps and VFDs will be demolished in 2020 with the Anoxic/Aeration Basins Enhancements project.
VFDs for Sludge Thickening Pumps (301, 302, 303, 304, 306)	Separately-mounted VFD starters for sludge thickening pumps	2000. Good.	Sludge Thickening Electrical Room	Replace these with an Arc Flash Mitigation project or Electrical Upgrade project in the timeframe of 2019-2020. When replacing, provide 5% line reactors and DC bus chokes to protect the VFDs from upstream voltage surges and mitigate harmonic currents.
VFDs for Sludge Thickening Pumps (305, 307, 308)	Separately-mounted VFD starters for sludge thickening pumps	2013. Good.	Sludge Thickening Electrical Room	Replace these in a VFD Replacements project in 2035.

Notes:

(1) Determinations of condition made by visual observation

(2) Additional specific assessment of each key electrical apparatus has been included with pertinent issues and recommendations and they are shown on figures with photographs in Appendix A.

3.3 Equipment Vulnerabilities: SWGR-1A/B

Manufactured in 1986 by Westinghouse, service entrance switchgear SWGR-1A/B is past its useful service life. Staff spoke of "hot spots" that the service contractor found during thermal imaging in 2016, and the loose connections have been corrected. Visual inspections at the site visit also found door clasps loose and status lights out on a few cubicles. The existing circuit breakers are from the discontinued Westinghouse line of "SPB" insulated case circuit breakers, using Pow-R-Trip 7 digital trip units. The metering on these assemblies is only an analog voltmeter and ammeter that measures the instantaneous voltage and line current from FP&L. No historical data is available to indicate the peak demand load and the connected load is at the 3200 A capacity of the bus, so adding any load to this switchgear would require a load study in accordance with the requirements of Article 220 of the National Electrical Code. The battery charger and batteries for control power appear to be as old as the switchgear itself, and should be replaced with the switchgear.

Most of the SEWRF's effluent pumping capacity is supplied from SWGR-1A/B - although one 400 HP High Service Pump could still be run from SWGR-2A/B during an outage at SWGR-1A/B. Considering this, the age, and the condition of SWGR-1A/B, this switchgear represents a vulnerability to the reliability of SEWRF's mission to deliver treated wastewater for re-use. The tanks for 10 MG Storage mitigate the vulnerability somewhat, as the plant would be able to store treated wastewater during outages that disrupt its capacity to distribute to its re-use (MARS) network, but that's a short term solution to maintain a minimal amount of throughput. This switchgear should be replaced as soon as possible.

3.4 Equipment Vulnerabilities: SWGR-2A/B

Manufactured in 2001 by Cutler-Hammer and installed in 2002, service entrance switchgear SWGR-2A/B is DSII Metal-Enclosed LV Switchgear. The switchgear itself it in good working condition, with an undamaged enclosure that is free of corrosion. Being located in an air-conditioned space that's sheltered from weather and other damage, this assembly should be suitable to remain in service until 2032, when it should be removed for deteriorating insulation, less reliable overcurrent protection, corrosion on electrical contacts, and availability of spare parts. However, problems with this switchgear have been observed that should be corrected to enable it to continue functioning reliably for the remainder of its service life - particularly considering the critical role that this switchgear has in powering nearly all of the SEWRF wastewater treatment processes.

Staff have reported "hot spots" in SWGR-2A/B that were found by the service contractor during the annual thermal imaging that they perform (upstream of the feeder circuit to MCC-2), and the loose connections identified in these scans have been corrected. While thermal imaging is an important step of routine preventive maintenance, the SEWRF should also perform the cleaning, inspection, and testing recommendations of NFPA 70B and the equipment manufacturer.

Another concerning set of issues for SWGR-2A/B are the metering issues discussed above. In short, the Co-Gen supply has no metering that's visible to the plant, and for that reason it's impossible to know if the digital metering on the FP&L service to bus A of SWGR-2 represents the demand load or only the demand load that exceeds the Co-Gen supply. The digital meter on the FP&L service to bus B is defective and should be replaced. A short-term solution to provide better distribution for the Co-Gen power would be to operate SWGR-2A/B with the tie breaker closed and only the main circuit breaker to bus A closed.

Labeling errors were found on the meters and protective relays on the face of the switchgear. The Basler BE1-47N protective relay for "voltage phase sequence" is labeled as 24/47-2, though protective function 24 (Volts/Hertz) is not available on the relay - while undervoltage (27) and overvoltage (59) protection both are. Likewise, the power meter is labeled 27/47-2, though it's doubtful that this relay is integrated to provide protective functions. Errors were found in the existing documentation compared to the factory drawings for this switchgear, but the new set (provided with this Electrical Master Plan) has been corrected.

3.5 Equipment Vulnerabilities: Generators 1, 2, & 3

Cummins manufactured Generators 1 & 2 in 1995 and Generator 3 in 2001. Carollo's investigation into generator operation was limited due to equipment failures and the availability of switching procedures, but those observations themselves are instructive.

During a generator exercise in May 2017, Carollo witnessed an electrical short circuit occurring in the fuel day tanks for two of the three generator units. These equipment failures were not an isolated incident, as staff reported an event of having the generator batteries "blow up" recently during a generator exercise. These problems with the generator system auxiliaries indicates that generator maintenance is not being kept up and that the units are not regularly exercised. For maintenance, inspections should be performed and levels should be replenished for lubrication, cooling, fuel, battery, and exhaust systems. Manufacturer's recommendations should be referenced for more detailed on maintenance practices.

Generator exercising, though performed under plant load, has not been performed consistently. Staff reported that they did not exercise the generators for a long time, but had recently resumed the practice. The renewed practice involved a schedule of running two of the three generators each month (units 1 & 2 in one month, 2 & 3 in the next month, 3 & 1 in the following month, etc). Monthly exercise is critical to keep engine parts adequately lubricated, inhibit oxidation of electrical contacts, and use fuel before it deteriorates.

Co-Gen only works when the plant is connected to FP&L; the Co-Gen system is not designed to parallel with the plant's standby generators. Conversely, the standby generators do not parallel with the utility, and transitions between standby generators and FP&L are open (with no overlap period to maintain power for the facility when the switching from utility power to standby - or vice versa). This transition to and from standby generators is a fundamental aspect of operating the equipment that the operators should be aware of, and which should be reflected in detailed operating procedures. When Carollo tried to perform a routine generator exercise on-site with

plant staff, a written operating procedure wasn't available and we had to call a retired, former employee, to proceed. This substantiates that periodic exercising of the standby generators has not been occurring. A written operating procedure was discovered after Carollo left, but it should be easily available to plant staff (and it included inadvisable directions, such as exercising one generator without load each month - which conflicts with manufacturer recommendations).

While the generator problems discussed above undermine the reliability of the SEWRF's standby power supply, a palliative to this vulnerability is that the plant has 6000 kW of generator capacity to dispatch from three units. This makes it more likely that at least two units will be available to serve when called upon. The County's local Caterpillar representative, Ring Power, reports that these generators can stay in service for 40-50 years (or more; they have old machines in-service that were installed in the mid-1960s). Each of the three SEWRF generators are Caterpillar's model 3516, which is one of their most popular models - with widespread availability of spare parts expected far into the future (product obsolescence is not foreseen at this point). Ring Power advises that, to achieve that kind of longevity from its generators, the County's maintenance plan for these units should follow Caterpillar guidelines.

Considering Ring Power's perspective, Carollo's first recommendation regarding the generators is that the County maintains these units to get 40 years of service from Generator 1 and 50 years of service from Generator 2. In addition to the diligent maintenance recommended above, the County should have Ring Power perform an on-site, in-depth technical analysis on all of its generators. This inspection should include oil analysis and a retrieval of fuel usage data from the generator's on-board controller. This data enables them to see how hard the machine was driven and identify any engine problems before they become detrimental. If this strategy is pursued, the County could expect to replace Generator 1 in 2035 and Generator 2 in 2045.

While Generator 3 is younger than the other two units by 6 years, its internal windings have a different pitch than units 1 and 2 - making it more difficult to parallel them together (as recommended below). With the plant's largest motors all run from VFD or RVAT starters, that means that the "overcapacity" in generators (see Section 2.2) is not needed for motor starting requirements. As such, Carollo's recommendation is that the County not use Generator 3, by either: 1) abandoning it in place, "winterizing" it until a generator is needed elsewhere in the County; 2) keeping it in-service as a standby unit that is not paralleled with Generators 1 & 2 (but still connected to the SWGR-GEN); or 3) selling it.

Carollo's design philosophy, in this regard, is to provide enough generator capacity to run the entire plant in the event of a utility failure: considered an "N" level of redundancy in standby generators. The utility service and two paralleled generators would make N+1 redundancy, and the present arrangement of utility service and three generators could be considered N+2 redundancy. Our experience has been that N+1 redundancy is most common at Florida plants and around the United States. Another factor is that MARS pumping, which represents half of the plant load, can be provided from the NEWRF or SWWRF in the unlikely event that a FP&L failure at SEWRF is coincident with a failure of one of your standby generators. An N level of redundancy is less expensive to provide, maintain, and replace than an N. The recommendations in this report develop that philosophy over the course of several projects.

3.6 Equipment Vulnerabilities: Two Assemblies of Generator Switchgear

Generators 1 &2 Switchgear (G12-SWGR) was manufactured in 1995 and Generators 2 & 3 Switchgear (G23-SWGR) was manufactured in 2001. At the time of Carollo's inspection, Generator 1 had been run for 491.3 and Generator 2 had been run for 243 hours. This translates to about 2 hours of operation per month for each generator, suggesting that the generator exercising habits mentioned in Section 3.4 are a recent aberration; that exercise has been mostly diligent for the history of the equipment.

Site visit observations found both of the Generator Switchgears to be in good condition. G12-SWGR had an active alarm for "Low Fuel Level Day Tank" on Generator 2 from the last time, a month previous, when the generator ran, and that it shut down the generator. This raises the questions: why is the alarm light still on, is there any remote notification, and how does fuel get ordered? A month should be plenty of time to address low fuel level. A push test on the G12-SWGR annunciator also found that the "Generator 2 CB Open" light is out and the "Control Voltage Failure" (for Unit 1) light is out. The standby power system should be considered a critical system with a high priority level for maintenance; any issues concerning the standby power system should be immediately addressed.

Looking only the age and condition of G12-SWGR and G23-SWGR, the equipment is suitable for a full 30 years of service. Unfortunately, their functionality is not well-matched to the present demands of the plant. Specifically, neither G12-SWGR nor G23-SWGR is able to synchronize its generators together to operate in parallel; so none of the generators are able to share duties for powering the plant. This is because the switchgear bus of Generator 1 is not physically attached to the switchgear bus of Generator 2 inside the G12-SWGR assembly (obviously, paralleling controls are absent as well). The same is true of the G23-SWGR. Instead of paralleling the generators, Generator 1 is dedicated to the A-bus of SWGR-1A/B and Generator 3 is dedicated to the B-bus of SWGR-2A/B. In both cases, a single generator could supply power to both buses of its own assembly if the tie circuit breaker is open, but neither can share the load duties with another generator. In total, the plant has four independent switchgear buses in two switchgear assemblies receive power from three standby generators. It's a confusing arrangement that's difficult for staff to use effectively. In addition, it requires over-investment in generators to make enough power available to back up all processes.

Considering the observations just described, the required replacement of SWGR-1A/B, and the benefits of improving distribution of the SEWRF's standby generators, Carollo recommends replacing this equipment early, at the same time as SWGR-1A/B. These two assemblies (G12-SWGR and G23-SWGR) should be replaced with one assembly, instead of two, that is capable of paralleling Generators 1 & 2. That paralleling generator switchgear will be referred to as SWGR-GEN in this report. The County may wish to keep Generator 3 available for non-paralleling duty - and possibly a load bank for exercising it - in which case another two circuit breakers might be needed in SWGR-GEN, but the primary purpose for the switchgear is to parallel Generator 1 and Generator 2 for distribution to the plant.

The reason that Generator 3 is difficult to parallel to the other two is the pitch of the generator windings. The two units from 1995 have pitches of 0.7619, and the generator from 2001 has a pitch of 0.6667. Ideally, paralleling is most easily achieved between generators whose pitch matches, so it's more complicated to parallel the 2001 unit with the two others. It is possible for generators with mismatched pitches to be paralleled, but Ring Power has had bad experience with the multiple winding reactors - and a 3rd generator is probably not needed (because of good utility power, N+1 redundancy, and the ability to serve MARS loads from elsewhere).

Carollo recommends that the County provide paralleling switchgear (SWGR-GEN) when replacing SWGR-1A/B, and making a connection to the service switchgear (SWGR-1A/T/B) at a transfer bus between two tie circuit breakers. (see drawing EMP-2019). Although this is ahead of schedule for the typical 30-year replacement cycle, it would be more operationally flexible, easier to use, as reliable, and less expensive (long term) than the current configuration.

3.7 Equipment Vulnerabilities: Original Motor Control Centers

Built in 1986, MCCs -5 and -6 are past their expected 30-year service life, especially considering the humid environment in which they operate. In equipment this old the insulation deteriorates, creating the potential for short circuits and arc flash incidents, the reliability of the overcurrent protection degrades as factory-lubricated mechanisms dry out over time, and repairs can be longer and more costly when spare parts aren't available. These motor control centers are critical to the operation of the solids processing performed by the SEWRF's belt filter presses, and their age and poor condition compromises reliability.

The situation for MCC-9 and MCC-10 is similar to that of MCCs -5 and -6: both are 30 years old, past their expected service life. In addition, these MCCs have an inadequate short circuit rating for the application, and they've had instances when circuit breakers failed to open on short circuit faults. They're closely linked, as well: MCC-9 (which was probably originally labeled MCC-3) is the power source for MCC-5 and MCC-10 (originally labeled MCC-4) is the source for MCC-6. All four MCCs are functional and safety liabilities, and they all should be replaced as soon as possible.

In 2018 the RAS/WAS rehabilitation project will replace the existing scum ejectors and air compressors with progressive cavity pumps, one pump (~10 HP) for each secondary clarifier, requiring four size-1 starters. Although these would ideally be supplied from MCC-11 and MCC-12 (which are in the Main Electrical Room) to match the clarifiers and RAS/WAS pumps, bucket space is not available there, and MCC-11 doesn't have room to add another vertical section. There is an existing FVNR starter for each scum ejector in MCC-10, implying that there is an underground conduit path from MCC-9 and MCC-10 to the RAS/WAS pumping area, which could be re-purposed for the new pumps.

Carollo recommends replacing MCC-9 and MCC-10 in the RAS/WAS rehabilitation project, and the replacement VFDs for the RAS and WAS pumps should be included in the replacement MCCs -9 and -10 (rather than having the units separately-mounted in the Main Electrical Room, as they are now) to provide the cleanest installation. . This option would be less expensive than

having them separately mounted, and the County could still connect to the existing conduit by a conduit extension to the new motor control center. This option, which would be less expensive than replacing the existing separately-mounted VFDs, is not reflected in the costs shown in Project Recommendations.

The outgoing feeder circuits from MCCs -9 & -10 to MCCs -5 & -6 should be extended to an upstream switchgear source: SWGR-2A/B, preferably. The placement of replacement MCCs -9 & -10 should take into account the conduit penetrations for the feeders to MCC-5 and MCC-6, so that they can be extended to a switchgear source without passing through the motor control center.

3.8 Equipment Vulnerabilities: Repair the MCCs Manufactured in 2000

Eight of the SEWRF's motor control centers were manufactured in 2000: MCCs -1, -2, -3, -4, -7, -8, -11, and -12. All are installed in a clean environment and in good condition. They all have digital metering and are operating within their ratings. They were installed as twin-pairs, with tie circuit breakers between MCCs -1&2, -3&4, -7&8, and -11&12. MCCs – 1&2 and 3&4 power the Aerators, Anoxic Mixers, RML Pumps, and EQ Pumps; MCC-7&8 power the Sludge Thickening Pumps; MCC - 11&12 power the Clarifier Drives, RAS/WAS Pumps, and Lake Gravity Filters. Together, those motor control centers are the branch circuit source for nearly all of the SEWRF water treatment processes, and as such they are critical to system reliability.

A common problem among these MCCs was low power factor, an indicator that the correction capacitors (PFCC), which are installed on the larger FVNR starters, have failed. This is also shown on the PFCC indicator lights. Carollo recommends replacing the PFCCs. MCCs -11 and -12 both have very low power factor and high harmonic current distortion: this should be investigated. The current distortion could be mitigated with input filters on the VFDs for the RAS/WAS Pumps, and a PFCC on the RVAT for the Air Scour Blower might fix the power factor. Alternatively, an active harmonic filter could solve both problems.

Considering the criticality of these MCCs (1, 2, 3, 4, 7, 8, 11, & 12) for another 12 years, Carollo recommends maintaining spare parts for these units, especially for the RVAT starters for the Sludge Blowers, which were being repaired on several visits. Other minor problems are mentioned below under Short Term Improvements, and won't be repeated here.

3.9 Equipment Vulnerabilities: Replace the Original Panelboards

The panelboards and transfer switches manufactured from 1986-1989 should be replaced as part of the capital improvement projects that have already been listed. The remaining panelboards - those installed after 1988 - can be replaced on a typical 30-year schedule. Refer to the SEWRF Equipment Condition Assessment table for years of each panelboard.

3.10 Equipment Vulnerabilities: Plan to replace VFDs at 20-year intervals

Variable frequency drives (VFD) can have a service life from 9 years to over 20 years, depending on the duty to which they're subjected and the environment in which they're installed.

Just as the corrosion of metals and deterioration of insulation happens to circuit breakers, VFDs have the additional problem of high frequency electrical switching that's required for the technology to chop up a sine wave of electricity and reconstruct it as an approximation of a sine wave. Considering that the SEWRF applications have clean environments without severe torque requirements or overloads, Carollo recommends that the SEWRF plans to replace their VFDs at 20-year intervals.

4.0 PROPOSED RECONFIGURATION OF ELECTRICAL SYSTEM

With three generators connected through four independent circuit breakers in two different switchgear line-ups, to four buses of service switchgear, the SEWRF's power system architecture is not intuitive - making it inherently confusing to operate and maintain. The theme of these proposals is consolidation and centralization: consolidating two service entrance switchgears into one; and consolidating two generator switchgears into one.

4.1 One Service Entrance Switchgear with Three Buses

Due to the age and condition of the existing SWGR-1A/T/B, as described in the condition assessment, a new service entrance switchgear, SWGR-1A/T/B, is proposed to replace SWGR-1A/B in the same location (the bulk of the plant can already by powered by SWGR-2A/B). As shown on EMP-2019, the new switchgear will be configured as the single point of connection for power from both FP&L transformers and for the standby generators. In the new arrangement, each FP&L transformer supplies one bus of SWGR-1A/T/B. Standby power connects between the tie breakers from a new Generator Switchgear (SWGR-GEN, see below). Co-Generation would remain connected at SWGR-2A. SWGR-2A/B will be fed from SWGR-1A/T/B rather than service circuits from FP&L transformers. All feeder circuits from SWGR-1A/T/B and existing SWGR-2A/B will remain as currently connected.

The new arrangement enables all plant loads to any load in the plant access to FP&L1, FP&L2, and SWGR-GEN through use of the tie breakers. Also, an outage (planned or unplanned) on any of the four switchgear buses would still provide the remaining buses access to all of its generating capacity. Similarly, an outage to any bus except SWGR-2A would retain access to Co-Gen power for the remaining two buses through the use of the tie breakers. Further, by being downstream from the service entrances, SWGR-2A/B could take outages without having energized conductors on the line side of the main breakers. A system that is convenient to take outages and intuitive to operate is safer, more reliable, and more available. Also, with the plant utilizing three different power sources (utility, co-gen, and standby), the network will be better-suited to distribute all three sources from a single switchgear assembly that still retains alternate circuit paths in the form of multiple buses and redundant feeders.

4.2 One Generator Switchgear to Parallel 2 Generators (with or without 3)

One-line drawing EMP-2018 details the current configuration where the three generators are connected to four circuit breakers in two separate generator switchgear assemblies. One-line diagram, EMP-2019, details a new generator switchgear, SWGR-GEN, that parallels all three units on a single bus. As discussed above in the Condition Assessment, the SEWRF could probably be run from two generators if they were "paralleled" to share loads on a common bus, but it's reasonable that the County would want to keep a spare standby generator and then would keep the third unit. Regardless, generator power would be much more widely available and easily dispatch-able if the units were networked in the manner described here.

The sequence of projects, dictates that the Generator system modifications occur at the same time as SWGR-1A/T/B in 2019. The 2019 switchgear replacement provides the advantage that either FP&L service would be available to the entire facility. Likewise the 2019 power system configuration makes the standby power system available to the entire facility through this service entrance switchgear. Therefore the standby power systems and service entrance switchgear projects need to be on the same timeline.

Carollo sees the biggest incentive to paralleling switchgear as the ability to eliminate the replacement cost for one generator, which would be ~$1.5 million dollars (though that cost wouldn't be incurred for several years, since the County already owns 3 generators at this plant). Granted, the paralleling switchgear will cost several hundred thousand dollars, but it will be much less expensive than replacing the third generator. If the County has a need for 2000 kW generator elsewhere at its utility facilties, then Generator 3 could be re-purposed for that application. Otherwise it could be sold or left in-place as a stand-alone unit that can't be paralleled with the other two generators.

4.3 Removing or Replacing SWGR-2A/B in 2032

SWGR-2A/B was manufactured in 2001 and installed in 2002, so in 2032 it will be 30 years old and due for replacement. One option would be for the switchgear to be replaced with a similar unit. In this scenario, the Co-Gen connection remains downstream of the same (A) bus as the FP&L main breaker to which it is tied (any other location for it is sub-optimal). Several features of this arrangement make it attractive: 1) the feeder connections and conduit are already in place; 2) with SWGR-2A/B downstream from SWGR-1A/T/B, any three (of the four) switchgear buses can serve power to their loads; and 3) it provides the plant with a second piece of distribution equipment that loads can migrate to when SWGR-1A/T/B is eventually replaced. Considering its potential to serve as replacement when the service switchgear SWGR-1A/T/B is retired, the replacement for SWGR-2A/B could be specified to "service switchgear" standards and expanded to include a transfer bus, becoming: SWGR-2A/T/B. In this instance, SWGR-2A/T/B could receive a feeder direct from SWGR-GEN. This configuration is not shown in master plan drawings, but would be very similar to EMP-2035, but with a transfer bus between SWGR-2A and SWGR-2B.

The alternative to replacing SWGR-2A/B would be to eliminate it entirely, migrating all of its loads and Co-Gen to SWGR-1A/T/B, as shown on drawing EMP-2031. The remainder of SWGR-2 loads would be migrated to SWGR-1. The downside of this arrangement is that an outage to either bus would take out half of the plant. One benefit of this arrangement is that it would be relatively inexpensive to implement if the plant installs SWGR-1A/T/B with enough space to add five vertical sections between the two buses. Another benefit would be leaving a large space where SWGR-2A/B is currently located - accommodating the future work of replacing SWGR-1A/T/B/ with similar unit that could be installed concurrently with the existing one.

The execution of one of these options for SWGR-2 will be in 2032, but choices made during the replacement of SWGR-1A/B will impact the options that are available to the County when that

project is developed. Carollo's recommendation is to leave room for expansion when SWGR-1A/T/B is installed, but defer a commitment on SWGR-2 until a later date..

4.4 Retain Ties between Twin-Pair MCCs

With the improvements described above and the existing tie circuit breaker connections between MCCs, the SEWRF will have eliminated all single points of failure between the branch circuit protection of its MCCs and the supply circuit from all its four power sources, and it will have provided all loads in the plant with redundant paths to Co-Gen power, multiple utility transformers, and multiple sources of standby power.

4.5 New MCC and Electrical Building for Anoxic/Aeration Basin #4 in 2026

Several aeration solutions are being considered for the future fourth basin, and the electrical requirements will depend on which solution is selected. The estimate here presumes that the fourth basin will match the existing Basins 1, 2, and 3 without any return mixed liquor pumps.

The drawings indicate that existing MCC-4 was intended as the source for Aeration Basin 4. However, some of the space reserved for that basin's loads has been used for two equalization pumps and one equalization blower. MCC-4 is rated for 1200 A, and its maximum historical demand load is ~900 A. Because it is unclear whether that maximum is old or recent, all of the meters need to be reset as part of an improved data-gathering practice identified in the "Short Term Improvements" of 2019 (see Section 2.1). At this MCC in particular, resetting the meters will allow for a more accurate sense of available capacity. MCC-1 and MCC-2 appear to have more available electrical capacity, but space is a constraint for both, and it is not yet clear what electrical demand MCC-SEP will place on MCC-1.

Regardless of the available capacity of the MCC-4 bus, there is not enough room in the electrical room of the existing Aeration Basin/Headworks Building to add the starters for Basin 4. However, the replacement of all of the MCCs in that space (MCC-1, -1A, -2, -2A, -3, -4) is scheduled for 2030, and the starters for Basin 4 could be incorporated into that space if the schedule for replacement of those MCCs was moved up, from 2030 to 2026.

An alternative to locating the new loads into the existing electrical room at the Aeration Basin/Headworks Building would be to provide a new building between Basins 2 & 3 (or Basins 3 & 4) to house the distribution equipment for those areas as well as for Flow Equalization Tank 2. This option relieves space constraints in the existing electrical room at the Aeration Basin/Headworks Building; however, it does incur cost for the building, its supply circuit, and a PLC (or RTU) for that space. The costs of this a new building with motor control center, panelboards, and PLC cabinet are assumed in the cost estimate for this work (see Section 7.9).

5.0 OPERATIONAL IMPROVEMENTS

This set of recommendations has the potential to improve the safety and reliability of the SEWRF - as well as minimizing its overall cost of ownership. These recommendations also have the potential to improve the quality of future construction and to lower the overall cost of ownership for the plant.

5.1 Establish a Stricter Practice of Maintaining Plant Documentation

SEWRF record drawings aren't easily accessible. In some cases, in order to understand the power system it was necessary to refer to intermediate submittals, bid drawings, and manufacturer's drawings instead of record drawings. A number of things were missing from the available drawing sets, and errors were common between the documents and the field installation.

The electrical content of the record drawings is not well developed. Resulting in poor record of an installation, and the plant's drawings become difficult to use and maintain. These even become a safety liability, as plant staff struggle to find accurate drawings to guide their safety procedures.

- Example: 10 MG Storage Tank, sheets E-0.4 and E-0.6 indicated upstream connections for the project's new motor control centers, but provided no one-line diagrams for MCC-13 or MCC-14. All MCCs should have one-line diagrams that are updated on subsequent projects as they're modified with changes that impact the expressed information.
- Example: Biosolids Dryer, Sheet-101, provides a schedule for the loads of a new MCC, but no new one-line diagram. In addition, the motor control center re-uses a tag that's already assigned to another distribution source on plant: MCC-1. This issue is discussed below.

SEWRF will benefit if it improves its system of records management for project documentation. All of the documents should be centralized, controlled, and maintained, but still accessible and usable.

- Documents required for electrical equipment maintenance include:
    - Installation instructions
    - Disassembly/assembly (interconnection) drawings
    - Wiring diagrams, control schematics, and bills of materials
    - Equipment operation (for set-up and adjustment)
    - Maintenance recommendations by manufacturer (including parts list and recommended spares)
    - Software programs and troubleshooting guides (where applicable)

- Documents required for execution of your Electrical Safety Plan are:
    - One-line diagrams
    - Coordination studies
    - Training documentation
    - Electrical Safety Plan
    - Training records for project team members

The County should use explicit language in design contracts, if it's not in there already, for Consultants to provide completed one-line diagrams for each new switchgear or MCC, and update the drawings of the equipment that is modified by their designs. Further, Contractors should be required to provide a Record Set of drawings that shows the final installation, including any deviations between the design drawings and the field work. If requirements for these services are already in Manatee County contracts, then the language should be enforced. Accurate record drawings are a requirement of NFPA 70E, the *Standard for Electrical Safety in the Workplace*.

5.2 Create a Tagging System that Uniquely Matches Labeling to Drawings

Field investigation found inconsistent use of tagging throughout the SEWRF plant. Some equipment is not tagged at all, redundant tags exist for distribution equipment, and there appear to be mismatches between drawings and load equipment. This inconsistency results in confusion by plant staff, design consultants, and contractors who work with this equipment and poses a definite safety concern. Accurate and consistent tagging is a requirement of NFPA 70E, the *Standard for Electrical Safety in the Workplace*.

The Utility should create and implement a utility-wide, standardized tagging system that can be provided to consultants and contractors for future work. A preliminary tagging standard for the SEWRF, and its application to the plant's equipment, were provided by Carollo; and a copy of the recommendations can be found in Appendixes E and F.

5.3 Define Plant Technical Standards and Preferences for Project Specs

Plant staff, expressed frustrations about their inability to control which equipment is provided for projects. They want to be able to eliminate some manufacturer's products while still maintaining competitive bids. They also want to standardize on communication protocols, instrumentation technology, and control system platforms that would enable them to limit the number of skillsets that their technicians are expected to work with.

Appendixes G, H, I, J, and K contain a sample set of Design Guidelines for this purpose, which is simply a series of lists of different types equipment, providing a template to define Owner preferences and present them to their consultants. Providing Design Guidelines to consultants will help with standardization and reduce the amount of disparate systems with the plants.

Carollo also has a few equipment-specific recommendations for all switchgear, switchboards, and motor control centers.

- Have the equipment manufacturer provide factory-installed voltage testing stations. This device facilitates the testing process that electricians use to verify the absence of voltage on distribution equipment. Having it eliminates several inconveniences of taking outages and can simplify your safety procedures.

- Where possible, eliminate Main Circuit Breakers downstream of the service entrance Main. This forces electricians to open the upstream feeder circuit breaker when taking outages for maintenance, construction, and repairs. When providing Main Circuit Breakers, provide Arc Reduction Mode (ARM) switches. When working on energized equipment, an electrician can us ARM switches to reduce the duration (and hence severity) of a blast, if one does occur.

- Carollo does not currently have a recommendation on the "arc-resistant construction" feature of this distribution equipment. Arc-resistant MCCs are built like a tank to contain a blast and have other features that channel blast energy out the top of the assembly - and keep blast energy from travelling through neighboring compartments and vertical sections and compartments, if one does occur. The County can judge the costs and benefits on their merits.

- Supplying non-continuous and non-process loads such as overhead doors, weir operators, and valve actuators from service entrance switchgear and motor controls centers is an expensive way to serve un-critical loads. Carollo recommends serving those devices from a panelboard, instead.

5.4 Implement the Electrical Safety Plan that Carollo provided in 2017

The OSHA General Duty clause essentially requires the OWNER to provide a safe work environment. The OSHA Standards incorporate NFPA 70 (the National Electrical Code) by reference, which in turn incorporates NFPA 70E. Therefore the requirements of NFPA 70E are used to provide specifics that must be met to comply with OSHA. NFPA 70E requires, among many other things, that the OWNER provide its staff with an ESP. SEWRF’s current practices do not appear to comply with the ESP, and in fact the ESP was not in use during the time of the field investigations. Therefore SEWRF's current practices do not appear to be compliant with the OSHA requirements.

In a previous project, Carollo was contracted to evaluate and review an Electrical Safety Plan that another consultant had provided to the County for its use. That investigation found several problems with the document, and Carollo provided another Electrical Safety Plan (ESP) for the County's use. The document was written to the 2015 version of NFPA 70E (*Standard for Electrical Safety in the Workplace*), which was the prevailing standard at the time. The NFPA standard has advanced to a 2018 version, but the ESP is still worth implementing if the County

is not ready yet to invest in developing an ESP to the 2018 standard. Regardless, OSHA requires updating your ESP every 3 years, so that update should be done by 2020.

5.5 Align the Electrical Preventive Maintenance program to NFPA 70B

After observing issues with SEWRF documentation, tagging, and generator maintenance, MCU may want to establish an Asset Management (AM) program or at least an Electrical Preventive Maintenance Program (EPM) based on NFPA 70B: *Recommended Practice of Electrical Equipment Maintenance*. This recommended practice or AM program can be used protect MCU's investment in their facilities by establishing a formal program to shift expenditures from expensive capital projects to less-expensive maintenance tasks,. NFPA 70E includes a requirement that employers integrate "consideration of conditions of maintenance" into their electrical safety plan, and addressing that requirement with a formal EMP based on the recommendations of NFPA 70B would then comply with the requirements of NFPA 70E and OSHA.

5.6 Record Power Meter Data Annually and Reset Meter Fields

Power meters are important instruments for monitoring the performance of an industrial process and the suitability and capacity of distribution equipment. This historical data is critical to determining the available capacity when adding loads to buses, protective equipment, and feeder circuits Power quality data such as power factor and harmonic distortion of currents and voltages, is also important is assessing the impact of additions to the power system. For the power demand, consumption, and power quality data to be used for assessing the capacity of a power system it must be historized as required by Article 220.88 (1) of the National Electrical Code.

As a minimum SEWRF should transfer or record power demand data, that is time and date stamped from all power meters on the switchgear and MCCs on a monthly basis. Once the data is gathered, the plant should reset the demand register of the meters. Historical maximums after the reset will then provide a basic power demand profile. This information provides SEWRF's operators, managers, engineers, and consultants with better data of recent and historical operating conditions. SEWRF's equipment installed before 2000 do not have digital, historical meters, but most of the more recent MCCs do (MCCs -1A and -2A do not, and the recently installed MCCs -1B and -2B have not been verified). Where possible the power demand, power factor, and harmonic information should be automatically input into the plant SCADA system, and thereby create a database of electrical power information. As new electrical equipment is added and existing equipment replaced this equipment should be specified with metering that is linked into the plant SCADA system and historized; thereby eliminating the need for staff to manually perform this task.

5.7 Establish a Procedure for taking an Annual Energy Baseline

Energy performance for a wastewater treatment plant, the energy consumed to treat a unit of raw water influent, is a valuable metric for monitoring the effectiveness of a treatment

processes. Trends in energy consumption provide insight into the impact of project and provide guidance in evaluating capital investments. The process of evaluating energy performance begins with establishing an energy baseline, and that baseline requires data.

Carollo has begun the work of establishing an energy baseline for the plant by using a spreadsheet tool, developed for this purpose by the U.S. Environmental Protection Agency, called the Energy Usage Assessment Tool (EUAT). Five years of data from electricity bills, as well as the monthly treated volumes during this time, have been entered as a start at creating a baseline for the plant. Carollo can provide the County with this spreadsheet (a file developed in MS Excel) for its use in the future, but at the time of writing, this effort is incomplete. The remaining data fields required to establish the energy baseline are the operating hours per year of the plant's major equipment, in addition to the average motor current when the loads run. The operating hours is data that can either be mined from the SCADA system historian server or estimated by plant operators. Average motor current will have to be measured manually while the load runs, until the plant acquires Smart MCCs that automatically collect this data.

Carollo recommends that the County develop a procedure for collecting average motor operating current and operating hours per year for all continuous process equipment. This could be facilitated by investing in a recording power meter that is available as a hand tool with clamp on CTs (current transformers), which are typically less than ~ $4000; however, MCU will need to establish and enforce an ESP and provide the proper Personal Protective Equipment (PPE) in order to accomplish this task in accordance with NFPA 70E. Then, using the EPA's EUAT, the MCU can establish 2018 as a "baseline year" for energy consumption. This tool then allows staff to assess the energy performance of future process improvements and observe trends in plant-wide energy consumption not seen in utility bills, process instrumentation, or live SCADA data.

6.0 SHORT TERM IMPROVEMENTS

The following short-term improvements are necessary to assess equipment functionality and identify other concerns that may not have been identified during the current study.

6.1 General Maintenance Tasks to Secure Basic Equipment Functionality

Repair or replace failed indicator lights and annunciator lights on all four switchgear assemblies.

Repair or replace failed power meter on SWGR-2B (a replacement part has been ordered at the time of writing).

Staff reported problems with circuit breakers failing to operate at the SEWRF. The recommended short term action is to exercise the breakers by opening and closing them. Further, the SEWRF should inspect and test all of its circuit breakers in accordance with ANSI/NETA Maintenance Testing Standards and correct any issues that are found. Prioritize power circuits breakers and large molded case circuit breakers (50 A and above) over small molded case circuit breakers (less than 50 A). Maintenance of motor circuit protectors should be performed with preventive maintenance on motor control equipment.

Replace the remaining power conductors to basin loads from the original construction: Aerator 1A, Aerator 1B, Aerator 1C, Aerator 2C, Anoxic Mixer 1A, Anoxic Mixer 1B, Anoxic Mixer 2A, and Anoxic Mixer 2B. Branch circuits from MCC-2 to Aerator 2A and 2B have already failed, and classified locations like an aeration basin are known to be hazardous and corrosive.

Perform a Megger test on the insulation of 30-year-old underground cables, with feeder circuits and critical equipment at the highest priority for testing. Carollo has found underground cable to be a common source of failure at wastewater treatment plants, particularly where flooding and lightning are common.

Where motor circuit protectors (MCP) are used to protect feeder circuits, replace the MCPs with molded case circuit breakers (MCCB). This installation method was used in several instances for feeder circuits to VFDs installed external to their MCC source. It's a violation of the National Electrical Code (NEC) Article 430.52 and should be corrected.

6.2 Studies and Maintenance to Remedy Power Quality Problems

Perform a harmonic study in accordance with ANSI/NETA MTS Section 6.6 and ANSI/IEEE Standard 399. Plant staff reported random circuit breaker trips throughout the system, suggesting sporadic instances of high heat at the overcurrent protective devices. This is typical of high line currents caused by a low power factor, which was observed at all motor control centers, and high harmonic currents, which was observed at MCC-11 and MCC-12.

Inspect and test the plant's grounding systems in accordance with ANSI/NETA MTS Section 7.13 and all surge arrestors in accordance with ANSI/NETA MTS Section 7.19. This recommendation is to account for corrosion problems endemic to coastal environments like

Manatee County, the high incidence of lightning strikes, the frequency of utility outages, and the observed power harmonic problems at the facility.

Replace or install power factor correction capacitors (PFCC) or line reactors for the following equipment:

- In all cases, confirm that contactors are working correctly to avoid making harmonic issues worse. PFCCs should not be left on-line when the motor with which they are associated is off-line.
- PFCCs for the nine 125 HP aerators and two 125 HP sludge blowers that are supplied by MCCs 1, 2, 3, and 4.
- PFCCs for the starters of the three 250 HP sludge blowers supplied by MCCs 7 and 8.
- Line reactors for VFDs to the 75 HP RAS Pumps and 7.5 HP WAS Pumps that are supplied by MCCs 11 and 12.
- Line reactors for VFDs to the 10 HP Sludge Feed Pumps and Gravity Belt Discharge Pumps that are supplied by MCCs 7 and 8.

Table 6.1 Probable Construction Cost - Short Term Improvements in 2019

No.	Description	Total
1	Replace MCPs with MCCBs	$8,000
2	Replace branch circuits to four aerators & four anoxic mixers	$10,000
3	Replace power meter on SWGR-2B (in-progress)	
3	Provide power meter on each new MCC	see MCC replacements 2019
4	Maintenance testing of ground system, underground cable, and harmonic study	$20,000
5	Protection study	$15,000
6	Replace power factor correction capacitors	$40,000
7	Provide line reactors for VFDs on RAS & WAS Pumps.	see RAS/WAS Rehab 2018
8	Provide line reactors for VFDs on Sludge Feed and Gravity Belt Discharge Pumps.	see Arc Flash Mitigation 2019
9	Provide line reactors for VFD-305, VFD-307, and VFD-308.	$6,000
	TOTAL DIRECT COST(1)(2)	**$99,000**
	Contingency (50%)	$49,500
	Subtotal	**$148,500**
	Sales Tax (7%)	$10,395
	TOTAL PROJECT COST(3)(4) (5)	**$159,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).

(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.0 RECOMMENDED ELECTRICAL PROJECTS (W/ COST ESTIMATE)

The projects described in this summary are for Capital Improvement Projects (CIPs) of the electrical distribution system - as well as significant additions of electrical equipment as a part of process projects. They are organized so that installation work is grouped together where possible to reduce management, administrative costs, and disruptions to operations; however, in some instances, work that could be performed concurrently is split into two or more projects to provide flexibility to the County as it prioritizes its expenditures. The 'opinions of probable construction cost' may be used in budget projections, and the project descriptions can be used to scope Requests For Proposals (RFPs) from design consultants.

7.1 Replacements with RAS/WAS System Rehabilitation in 2018

The following list details projects recommended to take place in 2018:

- Replace the VFDs for all three RAS pumps and four WAS pumps with the "RAS and WAS System Rehabilitation" project. VFDs typically last 9-20 years, and these were installed in 2000. For VFDs larger than 50 HP, use 18-pulse technology to mitigate potential damage from voltage surges upstream and prevent power quality problems at MCC-11 and MCC-12.. For VFDs less than or equal to 50 HP, use 6-pulse technology, and potentially active harmonic filters depending on the ratio of large to small VFDs and the available short circuit current at the source. With the long distance from VFD to the RAS and WAS pumps (~600 feet), load reactors or similar filtering on the output side of the VFD should be provided. Carollo recommends contacting the manufacturer to determine what mitigation techniques need to be used in order to address dv/dt and reflect wave problems on these load circuits. When the existing cables are replaced, Carollo recommends providing shielded VFD cables to protect against high carrier frequencies and the potential for corona discharge.

- Replace MCC-9 and MCC-10. Both are 30 years old, have an inadequate short circuit rating for the application, and have had instances when circuit breakers failed to open on short circuits.

- Evaluation of the control system is outside the scope of the EMP however consideration should be given to replacing the SCADA Panel SP-1, which serves MCC-9, MCC-10, and all other motor control centers in the electrical building. SP-1 uses Rockwell Automation's SLC 5/05 line PLCs. The SLC5/05 is a discontinued and unsupported platform that is no longer manufactured, does not receive firmware updates, is becoming difficult to replace when failures occur, and is vulnerable to IT security invasions. By replacing SP-1 at the same time as the MCCs, SEWRF will pay for PLC programming only once. If they are done as separate projects, SEWRF would pay twice for PLC programming. If SEWRF selects smart MCCs (as Carollo recommends), then the cost of adding the new technology could be reduced or eliminated because smart MCCs use networked I/O rather than hard-wired I/O, avoiding installing and terminating hundreds of

wires between both enclosures. The cost does not include the reprogramming costs need for the new PLC platform.

- Replace the panelboards and transfer switches built between 1988 and 1989 and fed from MCCs 9 and 10. (MTS #3, Panel P1, MTS #4, Panel LE, Sub-Panel LE, Panel PFC, Panel LFC, Panel PC/TC-1.)

- Remove Flocculator 1 Panel, Flocculator 2 Panel, and Flocculator Control Panel, they are no longer used and in general any equipment that is no longer in-use should be demolished.

Table 7.1 Probable Construction Cost - Replace VFDs for RAS/WAS Pumps in 2018

No.	Description	Total
1	Three new "engineered drive package" in separately-mounted NEMA 1 enclosure for RAS Pumps (480V, 75 HP, 18-pulse)	$135,000
2	Three new "engineered drive package" in separately-mounted NEMA 1 enclosure for WAS Pumps (480V, 6-pulse, 7.5 HP, line reactor, load reactor)	$60,000
3	Demo 12 vertical sections from 4 MCCs	$5,000
4	Replace with 6 vertical sections in 2 smart MCCs	$105,000
5	Replace SP-1 with a new PCM (CompactLogix PLC system, 6 cards of I/O, network connections to MCC). Programming cost not included.	$100,000
6	Replace 2 manual transfer switches (150A), and 6 panelboards (150A).	$40,000
6	Wiring and conduits	$30,000
	TOTAL DIRECT COST(1)(2)	**$475,000**
	Contingency (50%)	$237,500
	Subtotal	**$712,500**
	Sales Tax (7%)	$49,875
	TOTAL PROJECT COST(3)(4) (5)	**$763,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.2 Dedicated Plant Drain Station in 2018

For this project, two drain stations will be added and one drain station will be improved.

The new drain station at the biosolids dryer will need a local control panel (LCP) to house the two starters for the drain station pumps, a feeder circuit, two branch circuits from LCP to pumps,

and all associated control wiring. The pumps are both assumed to be 25 HP, so the starters will be size 2 FVNR, and the conductors will be sized to match the load. The LCP will be fed from a feeder circuit breaker in MCC-1BSD in the biosolids dryer building, and the LCP will be controlled by the PLC cabinet.

The new lift station at the septage receiving facilities is assumed to have one 10 HP pump, an LCP with a size 1 FVNR, power conductors for the branch and feeder circuits (sourced from MCC-SEP), and control conductors back to the septage receiving station PLC. This facility might qualify as a Classified Area by NFPA 820 - and if so the appropriate design requirements will have to be addressed.

The existing South Plant Drain Pump Station will be upgraded with three new 40-HP pumps replacing the three existing 25-HP pumps. A new LCP (three size 3 FVNR starters) will replace the existing LCP. The existing feeder circuit breaker at MCC-12 will be upgraded. Power and control conductors will be replaced.

Table 7.2 Probable Construction Cost - Dedicated Plant Drain Station in 2018

No.	Description	Total
1	Duplex local control panel with size 2 FVNR starters and integral disconnect in NEMA 4X enclosure.	$20,000
2	Feeder circuit: 100' of 3#4(PH) & 1#6(G) in a 2" PVC-80	$3,000
3	Branch circuits: 40' of 3#8(PH) & 1#8(G) in a 3/4" GRC	$1,500
4	Local control panel with one size 1 FVNR starter and integral disconnect in NEMA 4X enclosure.	$2,000
5	Feeder & branch circuits: 50' of 3#10(PH) & 1#10(G) in a 2" PVC-80	$1,000
6	Replace existing triplex local control panel with new: size 3 FVNR starters and integral disconnect in NEMA 4X enclosure.	$15,000
7	Feeder circuit: 200' of 3#3/0(PH) & 1#3(G) in existing conduit	$5,000
8	Branch circuits: 60' of 3#6(PH) & 1#6(G) in existing conduit	$2,500
9	Miscellaneous wiring and conduits	$5,000
	TOTAL DIRECT COST(1)(2)	**$55,000**
	Contingency (50%)	$27,500
	Subtotal	**$82,500**
	Sales Tax (7%)	$5,775
	TOTAL PROJECT COST(3)(4)(5)	**$89,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.3 Replace SWGR-1A/B and Generator Switchboards 1/2 & 2/3, in 2019

The following list details projects recommended to take place in 2019:

- Replace SWGR-1A/B with new switchgear, including new main circuit breakers with digital meters, new feeders to supply SWGR-2A/B (see drawing 03E26, Appendix L), new battery charger, and new batteries for control power.

- Replace Generators 1&2 Switchgear and Generators 2&3 Switchgear with SWGR-GEN at the same time as SWGR-1A/B. The replacement switchgear should be capable of paralleling Generator 1 and Generator 2 - and the County might wish to have Generator 3 as well, though without the ability to parallel with the other units (because of mis-matched winding pitch, as mentioned above). SWGR-GEN will connect to the distribution system at the transfer bus between two tie circuit breakers in the new SWGR-1A/T/B assembly (see drawing EMP-2019).

- Rearrange the service feeders from the FP&L transformers into the plant, dedicating one FP&L transformer to each bus of SWGR-1A/B, with SWGR-2A/B receiving its supply from SWGR-1A/B rather than directly from FP&L. One option that the plant might consider is to ask FP&L for larger transformers so that one of them could carry the load of the entire plant - in case the other transformer fails. However, this option might lead FP&L to charge the plant at a different rate to recover the cost of this service.

- An unknown variable that could impact this work is the integration of the Co-Gen with the main circuit breaker of bus SWGR-2A, which must be closed for the Co-Gen system to operate (the Co-Gen system must be grid-connected). If it's necessary to migrate that connection point to SWGR-1A/T/B, then cost would be associated with that change as well. Integration of Co-Gen is outside the scope of this study.

Table 7.3 Probable Construction Cost – Replace SWGR-1A/B, Gen Swgr in 2019

No.	Description	Total
1	Temporary power to keep existing process equipment in operation	$30,000
2	Remove SWGR-1A/B (480V, 4000A)	$4,000
3	Remove Generators 1&2 Switchgear (480V, 4000A)	$4,000
4	Remove Generators 2&3 Switchgear (480V, 4000A)	$4,000
5	Replace with new SWGR-1A/B (480V, arc-resistant low voltage switchgear, 4000A, 3-bus, nine vertical sections)	$510,000
6	Replace with new Generator Switchgear (480V, 4000A)	$200,000
7	Replace battery charger and batteries (48V, 12ADC)	$25,000
8	Miscellaneous wiring and conduits	$50,000
9	Building allowance	$50,000
	TOTAL DIRECT COST(1)(2)	**$877,000**
	Contingency (50%)	$438,500
	Subtotal	$1,315,500

	Sales Tax (7%)	$92,085
	TOTAL PROJECT COST(3)(4)(5)	**$1,408,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.4 Replace MCC-5 and MCC-6 (and Arc Flash Mitigation) in 2019

The following list details projects recommended to take place in 2019:

- Replace MCC-5 and MCC-6. They're old amd missing parts.
- Replace the SCADA Panel (SP-4) because it controls MCC-5 and MCC-6. The PLC equipment in SP-4 is all Rockwell Automation's SLC 5/05 line, and the benefits of replacing it with the MCCs they serve are discussed above.
- Replace the VFDs installed in 2000 for the sludge pumps: VFD-301, VFD-302, VFD-303, VFD-304, and VFD-306. VFDs typically last 9-20 years, and these are near the end of their service life. When replacing them, provide a line reactor on the drive input to mitigate the potential damage from voltage surges upstream, and mitigate power quality problems at their sources, MCC-7 and MCC-8.
- Replace the panelboards and manual transfer switches installed between 1988 and 1989: MTS-LD, Panel LD, MTS-LHW, Panel-LHW, and Panel PC/TC.
- Install a new service entrance circuit breaker (1600 A) between the FP&L transformer and MCC-1BSD (at the biosolids dryer) to reduce fault clearing time at MCC-1BSD. This will lower the arc flash hazard on that motor control center.
- Rehabilitate the SEWRF's equipment tagging system. See Section 5.2 of Operational Improvements.
- Update safety labeling with a plant-wide arc flash evaluation. The SEWRF's last arc flash evaluation was in 2015. NFPA 70E requires that an arc flash hazard analysis be reviewed every five years or when significant changes are made to the system. Thus, the MCU should have a new arc flash evaluation under this project, put updated labels on all its equipment, and train its staff to use the equipment in accordance with its Electrical Safety Plan (ESP). Responsibilities should be assigned as recommended in the ESP and Job Hazard Analysis procedures for common tasks written in the ESP.

Table 7.4 Probable Construction Cost - Replacement of MCC 5 & MCC 6, 2019		
No.	**Description**	**Total**
1	Demo 12 vertical sections from 4 MCCs	$5,000
2	Demo panelboard, transfer switch, SP-4	$4,000
3	Replace with 10 vertical sections in 2 Smart MCCs	$177,000
4	Replace SP-4 with a new PCM (CompactLogix PLC system, 6 cards of I/O, network connections to MCC). Programming cost not included.	$50,000
5	Five new separately-mounted VFDs in NEMA 1 enclosure for sludge pumps (480V, 6-pulse, 10 HP, line reactor and load reactor)	$53,000
6	Replace 2 manual transfer switches (150A), 3 panelboards (150A).	$28,000
7	New service entrance circuit breaker for MCC 1BSD (480V, 3PH, 1600A)	$38,000
8	Update equipment tagging across the site and in one-line drawings.	$30,000
9	Arc flash study.	$20,000
10	Miscellaneous wiring and conduits.	$20,000
	TOTAL DIRECT COST(1)(2)	**$425,000**
	Contingency (50%)	$212,500
	Subtotal	**$637,500**
	Sales Tax (7%)	$44,625
	TOTAL PROJECT COST(3)(4)(5)	**$683,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.5 Anoxic Basins Mixer Replacements, 2020

Carollo recommends replacing the anoxic mixers in basins 1, 2, and 3, with possible changes to the aerators, as well. Both new surface aerators and fine bubble diffusion are being considered, and the electrical requirements for installing that equipment would depend on which solution is selected. This estimate focus only on the mixers replacement already planned:

The following list details projects recommended to take place in 2020:

- Replace existing conductors, exposed conduit, and disconnect switches for aerators and mixers. Aeration basins are known for being corrosive and hazardous environments, and branch circuits to Aerator 2A and 2B have already failed at the SEWRF. The plant should replace them under this project. There is also a substantial risk that conduits that have been buried for a long time are filled with sand and not re-usable. If that is the case, then the underground conduit will have to be replaced and the cost will increase accordingly.

- Remove the VFDs for the RML pumps, which are also being removed.

Table 7.5 Probable Construction Cost - Anoxic/Aeration Upgrades, 2020

No.	Description	Total
1	Replace conductors in existing conduit 3200 feet of 3-#10 (PH) & 1-#10 (G) for all 6 anoxic mixers.	$87,000
2	Replace 6 60A, N4X disconnect switches for anoxic mixers.	$30,000
3	Replace conductors in existing conduit 1300 feet of 6-#3/0 (PH) & 1-#4 (G) for 4 aerators (1A, 1B, 3A, 3B).	$56,000
4	Replace 6 250A, N4X disconnect switches for aerators.	$71,000
5	Demo 4 30-HP VFDs for the RML pumps.	$4,000
	TOTAL DIRECT COST	**$248,000**
	Contingency (50%)	$124,000
	Subtotal	**$372,000**
	Sales Tax (7%)	$26,000
	TOTAL PROJECT COST(3)(4)	**$399,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.6 Flow Equalization Tanks and Mixed Liquor Splitter Box Rehab in 2021

The following list details projects recommended to take place in 2021:

- Replace existing conductors and control panels for five submersible pumps.
- Upgrade existing lighting to LEDs.

Table 7.6 Probable Construction Cost - Flow Equalization Tanks Rehab, 2021		
No.	**Description**	**Total**
	Replace conductors for 2 30-HP submersible pumps in existing conduit: 400 feet of 3-#8 (PH) & 1-#8 (G).	$8,000
	Replace conductors for 3 10-HP submersible pumps in existing conduit: 750 feet of 3-#12 (PH) & 1-#12 (G).	$8,000
	Replace local control panel for 5 submersible pumps (HOA with Start and Stop pushbuttons).	$3,000
	Replace existing lighting with LED. Assume 30 exterior pole-mounted lights on tanks and basins.	$38,000
	New conductors in existing conduit for LED lights. Assume 2,000' of 3-#12 (PH) & 1-#12 (G).	$11,000
	TOTAL DIRECT COST	**$68,000**
	Contingency (25%)	$34,000
	Subtotal	**$102,000**
	Sales Tax (7%)	$7,140
	TOTAL PROJECT COST(3)(4)	**$110,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.7 Replace BFP Control Panels with Belt Filter Press Upgrades, 2022

The following list details projects recommended to take place in 2022:

- Replace the existing BFP control panels, since they are all 30 years old and in terrible condition.

Table 7.7 Probable Construction Cost - Replacement of BFP Control Panels, 2022

No.	Description	Total
1	Replace 3 control panels for existing belt filter presses	$225,000
2	Miscellaneous wiring and conduits	$20,000
	TOTAL DIRECT COST(1)(2)	**$245,000**
	Contingency (50%)	$122,500
	Subtotal	**$367,500**
	Sales Tax (7%)	$25,725
	TOTAL PROJECT COST(3)(4)	**$394,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.8 Secondary Clarifiers Rehabilitation, 2022

The following list details projects recommended to take place in 2022:

- Replace the disconnect switch and control panel for Clarifiers 1 and 2. They appear to be the original equipment installed in 1989.
- Update arc flash study and labeling.

Table 7.8 Probable Construction Cost - Secondary Clarifiers Rehabilitation in 2022

No.	Description	Total
1	Demolition	$1,000
2	Replace 2 60A, N4X disconnect switches	$10,000
3	Replace 2 LCPs (separately mounted non-combo motor starters: 1 HP, FVNR1)	$7,000
4	Miscellaneous wiring and conduits for retrofit transitions	$2,000
5	Arc flash study	$20,000
	TOTAL DIRECT COST(1)(2)	**$40,000**
	Contingency (50%)	$20,000
	Subtotal	**$60,000**
	Sales Tax (7%)	$4,200
	TOTAL PROJECT COST(3)(4)	**$65,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.9 New MCC and Electrical Building for Anoxic/Aeration Basin #4 in 2026

The following list details the electrical portion of this project in 2026:

- 40' x 20' building with HVAC equipment.
- Eight vertical sections of new motor control center.
- One PLC cabinet.
- Two panelboards.
- New conductors and conduit in ductbank for mixers and aerators.

Table 7.9 Probable Construction Cost - Anoxic/Aeration Basin #4 in 2026

No.	Description	Total
1	New electrical building with HVAC (40' x 20' @ 250 $/sqft)	$200,000
2	New MCC 8 vertical sections	$138,000
3	New PLC cabinet	$50,000
4	New 2 panelboards (150 A)	$8,000
5	New conductors and conduit: 1200 feet of 3-#10 (PH) & 1-#10 (G) for 2 anoxic mixers.	$33,000
6	New 60A, N4X disconnect switches for 2 anoxic mixers	$10,000
7	New conductors and conduit: 700 feet of 6-#3/0 (PH) & 1-#4 (G) for 2 aerators (4A, 4B)	$20,000
8	New 250 A N4X disconnect switches for 2 aerators	$24,000
	TOTAL DIRECT COST	**$483,000**
	Contingency (50%)	$241,500
	Subtotal	**$724,500**
	Sales Tax (7%)	$50,715
	TOTAL PROJECT COST(3)(4)	**$776,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.10 Electrical System Upgrades in 2030

Many electrical components were installed in 2000, bringing them to the end of their 30-year service life in 2030 and 2031. The most significant component is SWGR-2A/B, the distribution source for nine motor control centers, one high service pump, and the connection point for the co-generation switchgear. The role of SWGR-2A/B will have changed in 2019, eliminating both its direct service connections from the FP&L transformer and its direct connections to Generators 2&3 Switchgear; it will have become a downstream distribution bus for SWGR-1A/B.

The design of the 2019 project will allocate space to accommodate the 2030 upgrades. Consolidating switchgear for Generators 1 & 2 and Generators 2 & 3 in the space that's presently occupied Generators 2&3 Switchgear (and the walking space next to it) would leave room for SWGR-1A/B to grow in either direction as it added additional vertical sections.

- The following list details projects recommended to take place in 2022:Replace MCC-1, MCC-1A, MCC-2, MCC-2A, MCC-3, MCC-4, MCC-7, MCC-8, MCC-11, and MCC-12, providing new conductors in existing conduit when possible from SWGR-1A/B. When replacing MCC-1 and MCC-2, reduce equipment, footprint, and overall cost by consolidating MCC-1 and MCC-1A into one line-up and MCC-2 and MCC- 2A into one line-up. This should include some (or all) of the space- and cost-saving measures recommended above for the project in 2026. Replacement of MCC-1, -1A, -2, -2A, -3, and -4 could be moved up to 2026, as explained above in Section 2.12.

- Replace the SCADA Panel SP-2, which serves MCC-1, MCC-1A, MCC-2, MCC-2A, MCC-3, and MCC-4. This recommendation is based on the electrical criteria discussed in this master plan - and the benefits of replacing PLC equipment at the same time as the motor control center it controls. SCADA system considerations are absent here, and a quicker replacement might be warranted based on those criteria. That is beyond the scope of this study.

- Replace the SCADA Panel SP-3 (which serves MCC-7 and MCC-8). This recommendation is based on the electrical criteria discussed in this master plan - and the benefits of replacing PLC equipment at the same time as the motor control center it controls. SCADA system considerations are absent here, and a quicker replacement might be warranted based on those criteria. That is beyond the scope of this study.

- Replace the panelboards and manual transfer switches that were built between 1988 and 1989 (MTS-L1, Panel L1, Panel-P4, Panel L4, Panel LDA, Panel L2, MTS-L2, Panel L3, MTS-L3, Panel PC/TC-3). Also replace the three control panels for sludge blowers 1, 2, and 3 in the sludge building,and the disconnect switches for the air compressor and air scour blowers in the Air Scour Blower Building - and for the equalization blowers in the Headworks Electrical Building.

- Replace the co-generation circuit breaker with a new unit that connects to SWGR-1A/B. An estimate of this work is outside the scope of this project.

- Update arc flash study and labeling.

Table 7.10 Probable Construction Cost – Electrical System Upgrades in 2030		
No.	**Description**	**Total**
1	Add 6 new vertical sections with power circuit breakers to existing SWGR-1A/B (480V, arc-resistant low voltage switchgear, 4000A, 3-bus, 9 vertical sections)	$150,000
2	Demo 20 vertical sections from 4 MCCs (MCC-1, -1A, -2, -2A)	$8,000
3	Replace with 20 new vertical sections in 2 MCCs (MCC-1, -2)	$344,000
4	Demo 13 vertical sections from 2 MCCs (MCC-3, -4)	$5,200
5	Replace with 13 new vertical sections in 2 MCCs (MCC-3, -4)	$223,600
6	Demo 10 vertical sections from 2 MCCs (MCC-7, -8)	$8,000
7	Replace with 10 new vertical sections in MCCs (MCC-7, -8)	$344,000
8	Demo 9 vertical sections from 2 MCCs (MCC-11, -12)	$3,600
9	Replace with 9 new vertical sections in 2 MCCs (MCC-11, -12)	$155,000
10	Replace SP-2 with a new PCM (using a PLC platform that's appropriate for the plant and market conditions of 2035).	$50,000
11	Replace 7 panelboards (150A) & 3 manual transfer switches (150A),	$60,000
12	Replace 1 60A disconnect switch, 2 250A disconnect switches, and 3 400A disconnect switches,	$20,000
13	Replace 3 local control panels for sludge blowers.	$20,000
14	Temporary power to keep existing process equipment in operation.	$20,000
15	Remove SWGR-2A/B (480V, 4000A)	$4,000
16	Conduit and conductor to extend feeder circuits to SWGR-1A/B from the space formerly occupied by SWGR-2A/B.	$30,000
17	Building improvement allowance.	$50,000
18	Arc flash study.	$20,000
	TOTAL DIRECT COST	**$1,522,400**
	Contingency (50%)	$761,200
	Subtotal	**$2,283,600**
	Sales Tax (7%)	$159,852
	TOTAL PROJECT COST(3)(4)	**$2,444,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.11 VFD Replacements for Sludge Pumps in 2033

The following list details projects recommended to take place in 2033:

- Replace VFDs installed in 2013 for the sludge pumps: VFD-305, VFD-307, and VFD-308. Carollo expects these last 20 years and will reach the end of service life in 2033. When replacing them, provide a line reactor on the drive input to mitigate the potential damage from voltage surges upstream and mitigate power quality problems from at their sources, MCC-7 and MCC-8.
- Update arc flash study and labeling.

Table 7.11 Probable Construction Cost - VFD Replacements in 2033

No.	Description	Total
1	Three new separately-mounted VFDs in NEMA 1 enclosure for sludge pumps (480V, 6-pulse, 10 HP, line reactor, and load reactor).	$31,000
2	Arc flash study.	$20,000
3	Miscellaneous wiring and conduits.	$5,000
	TOTAL DIRECT COST(1)(2)	**$56,000**
	Contingency (25%)	$28,000
	Subtotal	**$84,000**
	Sales Tax (7%)	$5,880
	TOTAL PROJECT COST(3)(4)	**$90,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.12 MARS Equipment Replacements in 2035

The following list details projects recommended to take place in 2035:

- Replace the five 100-HP VFDs for the MARS low service pumps. When replacing these, Carollo recommends using technology that mitigates the potential damage from voltage surges upstream and power quality problems at their sources. In 2018, we typically recommend 18-pulse drives for drives above 50 HP, but the technology that's available in 2035 should dictate the solution. Cost estimates below assume 18-pulse technology.
- Replace the two 200 HP VFDs with MARS high service jockey pumps.
- Replace the four 400 HP VFDs with MARS high service pumps.
- Replace the SCADA Panel SP-6 (for the MARS system). This recommendation is based on the electrical criteria discussed in this master plan - and the benefits of replacing PLC equipment at the same time as the motor control center it controls. SCADA system considerations are absent here, and a quicker replacement might be warranted based on those criteria. That is beyond the scope of this study.
- Update arc flash study and labeling.

Table 7.12 Probable Construction Cost - MARS Equipment Replacements in 2035

No.	Description	Total
1	Replace 5 separately-mounted VFDs in NEMA 1 enclosure with low service pumps (480V, 18-pulse 100 HP).	$190,000
2	Replace 2 separately-mounted VFDs in NEMA 1 enclosure with high service jockey pumps (480V, 18-pulse 200 HP).	$120,000
3	Replace 4 separately-mounted VFDs in NEMA 1 enclosure with high service jockey pumps (480V, 18-pulse 400 HP).	$393,000
4	Replace SP-6 with a new PCM, using a PLC platform appropriate for the plant and market conditions of 2035.	$50,000
5	Arc flash study.	$20,000
6	Miscellaneous wiring and conduits.	$20,000
	TOTAL DIRECT COST(1)(2)	**$793,000**
	Contingency (50%)	$396,500
	Subtotal	**$1,189,500**
	Sales Tax (7%)	$83,265
	TOTAL PROJECT COST(3)(4)	**$1,273,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.13 Replace Generator 1 in 2035

The following list details projects recommended to take place in 2035:

- Replace Generator 1, which will be 40 years old in 2035.
- Update arc flash study and labeling.

Table 7.13 Probable Construction Cost - Replace Generator 1, 2025

No.	Description	Total
1	Remove existing Generator 1	$14,000
2	Install new Generator 1 (480V, Standby, 2000 kW, 0.8 pf)	$1,076,000
3	New conductors in existing conduit	$32,000
4	Arc flash study	$20,000
	TOTAL DIRECT COST(1)(2)	**$1,142,000**
	Contingency (50%)	$571,000
	Subtotal	**$1,713,000**
	Sales Tax (7%)	$119,910
	TOTAL PROJECT COST(3)(4)	**$1,833,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.14 Biosolids Equipment Replacements in 2038

The following list details projects recommended to take place in 2038:

- Replace the MCC-1BSD with integral biosolids PLC section.
- Replace XFMR-UPS, Panel-UPS, XFMR-LIGHT, Panel LP-1.
- SP-1 will be replaced in 2018 and will be ready for replacement again in 20 years.
- SP-4 will be replaced in 2019 and will be ready for replacement again in 20 years.
- Update arc flash study and labeling.

Table 7.14 Probable Construction Cost - Biosolids Equipment Replacements in 2038

No.	Description	Total
1	Demo 15 vertical sections MCC-1BSD with integral PLC section.	$6,000
3	Replace with new 15 vertical section Smart MCCs with integral PLC section.	$258,000
5	Replace one transformer (7kVA) & two panelboards (150A).	$10,000
4	Replace SP-1 with a new PCM (using a PLC platform that's appropriate for the plant and market conditions of 2038).	$50,000
5	Arc flash study.	$20,000
6	Miscellaneous wiring and conduits.	$20,000
	TOTAL DIRECT COST(1)(2)(3)	**$367,000**
	Contingency (25%)	$182,000
	Subtotal	**$546,000**
	Sales Tax (7%)	$38,220
	TOTAL PROJECT COST	**$585,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.15 Replace Generator 2 in 2045

The following list details projects recommended to take place in 2045:

- Replace Generator 2, which will be 50 years old in 2045.
- Update arc flash study and labeling.

Table 7.12 Probable Construction Cost - Replace Generator 2, 2033

No.	Description	Total
1	Remove existing Generator 2	$14,000
2	Install new Generator 2 (480V, Standby, 2000 kW, 0.8 pf)	$1,076,000
3	New conductors in existing conduit	$32,000
4	Arc flash study	$20,000
	TOTAL DIRECT COST(1)(2)	**$1,142,000**
	$571,000	$571,000
	Subtotal	**$1,713,000**
	$119,910	$83,265
	TOTAL PROJECT COST(3)(4)	**$1,833,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

7.16 Electrical Equipment Replacements in 2045

The following list details projects recommended to take place in 2045:

- Eliminate MCC-13 and MCC-14, which house the feeder circuit breakers to externally-mounted VFDs for the MARS system. No motor control is provided in either of these assemblies; they transfer these loads only to SWGR-1A/B (preferred) or one of the motor control centers that are fed by it (MCC-9, -10, -11, or -12).
- Replace Panel PC/TC-2.
- Replace MCC-SEP.
- SP-2 will be replaced in 2022 and will be ready for replacement again after 20 years.
- Update arc flash study and labeling.

Table 7.16 Probable Construction Cost - Electrical Equipment Replacements in 2045

No.	Description	Total
1	Demo 6 vertical sections from 2 MCCs (MCC-13 and MCC-14).	$2,500
2	Replace with 4 new vertical sections, retrofit to existing MCCs: 2 each added to MCC-9, -10.	$65,000
3	Demo 6 vertical sections from MCC-SEP	$2,500
4	Replace 1 panelboard (150A)	$4,200
	Replace with 6 existing sections with new MCC-SEP	$104,000
6	Replace SP-3 with a new PCM, using a PLC platform appropriate for the plant and market conditions of 2045.	$50,000
7	Arc flash study.	$20,000
8	Miscellaneous wiring and conduits.	$10,000
	TOTAL DIRECT COST(1)(2)(3)	**$258,200**
	Contingency (25%)	$129,100
	Subtotal	**$387,300**
	Sales Tax (7%)	$27,111
	TOTAL PROJECT COST	**$415,000**

Notes:
(1) Includes material, labor, general expenses, equipment, overhead (10%), and profit (5%).
(2) Market escalators for local labor and material are used in the cost estimating program. Material is 96.6% of the national average, and labor is 64% of the national average.
(3) Does not include engineering, bonds, permit, and Owner's reserve for change orders.
(4) Rounded up to the next thousand.
(5) Class 5 estimate with 50% contingency.

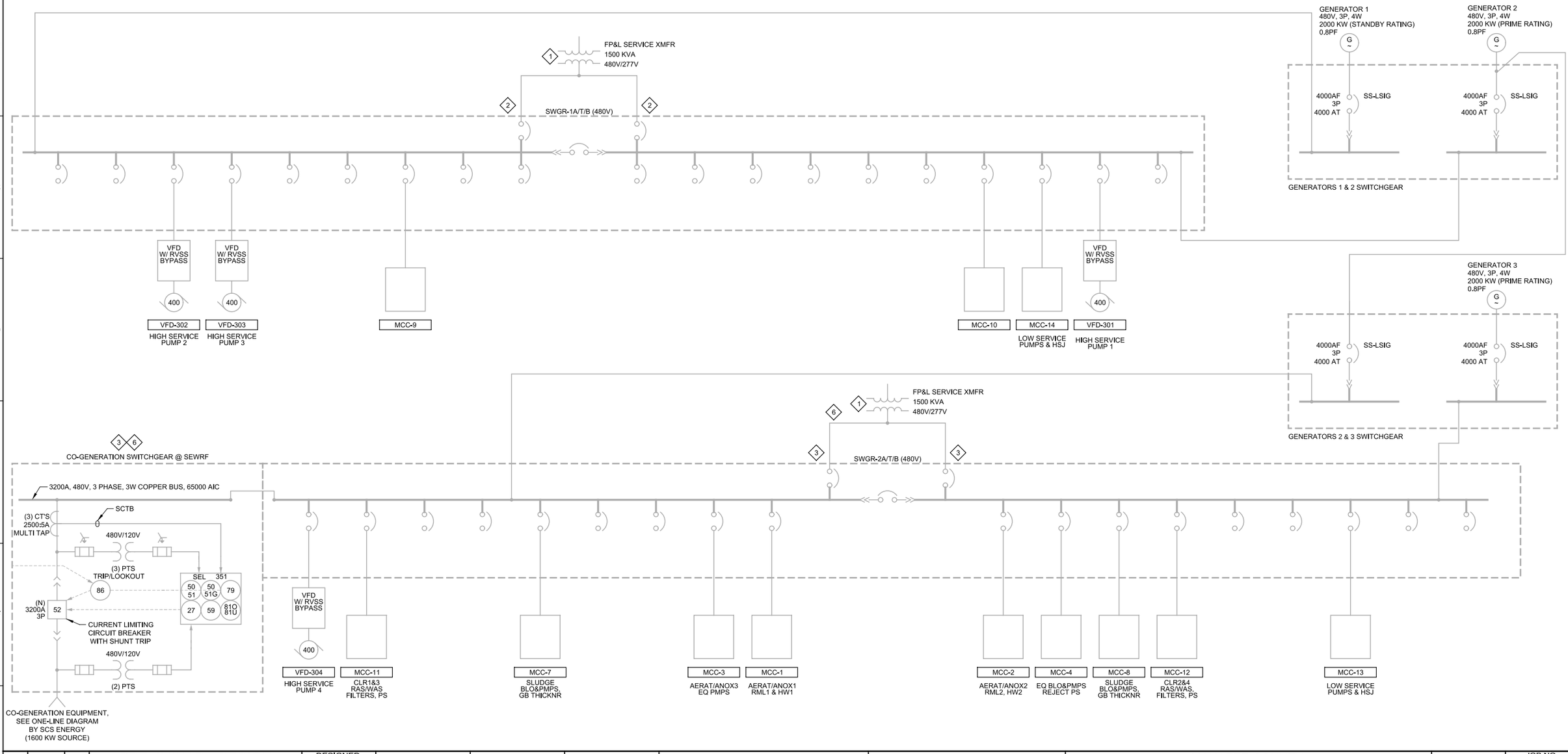
APPENDIX A: EMP-2018

GENERAL NOTES:

1. THE CONSEQUENCE OF METERING PROBLEMS AT BOTH SWITCHGEARS IS THAT IT'S NOT POSSIBLE TO DETERMINE PLANT-WIDE DEMAND LOAD WITHOUT BETTER DATA FURTHER STUDY.
2. TRANSFORMER CAPACITY WOULD BE BETTER UTILIZED IF ONE SWITCHGEAR ASSEMBLY RECIVED ONE SERVICE FROM BOTH TRANSFORMERS.
3. GENERATOR CAPACITY WOULD BE BETTER UTILIZED OF ONE SWITCHGEAR ASSEMBLY WAS CAPABLE OF PARALLELING TWO OR THREE GENERATORS. AND IF THE GENERATOR SWITCHGEAR WERE CONNECTED TO THE SYSTEM AT A TRANSFER BUS FOR THE SERVICE SWITCHGEAR.
4. CO-GENERATION CAPACITY WOULD BE BETTER UTILIZED IF THE SYSTEM WAS SUPPLIED FROM ONE SERVICE SWITCHGEAR, RATHER THAN TWO.
5. TIES BETWEEN MCCS WOULD BE CONFER A GREATER BENEFIT (OF RELIABILITY) IF THE SYSTEM WAS SUPPLIED FROM ONE SERVICE SWITCHGEAR, RATHER THAN TWO.

KEY NOTES:

1. EACH SWITCHGEAR - AND THE LOADS IT SERVES - ARE ENTIRELY DEPENDENT ON ONE SERVICE TRANSFORMER FOR UTILITY POWER.
2. SWGR-1 HAS ONLY LIVE, ANALOG METERING, NO DIGITAL, HISTORICAL METERING.
3. SWGR-2 HAS A BROKEN METER ON SWGR-2B, THE CO-GENERATION SWITCHGEAR HAS NO VISIBLE METERING, AND THE METER ON SWGR-2A IS COMPLICATED BY PRESENCE OF CO-GENERATION.
4. SEWRF HAS 3000 KVA OF CAPACITY AT ITS UTILITY TRANSFORMERS AND 6000 KW OF CAPACITY ON IT'S BACKUP GENERATORS. ALSO, THE SWITCHING SEQUENCES FOR OPERATING THE BACKUP SYSTEM ARE COMPLICATED AND SPORADICALLY EXERCISED. A SINGLE ASSEMBLY OF GENERATOR SWITCHGEAR COULD ENABLE THE PLANT TO BACK UP IT'S PROCESS WITH 2 UNITS INSTEAD OF 3.
5. TIE BREAKERS BETWEEN DOWNSTREAM MOTOR CONTROL CENTERS (SUCH AS MCC-1 AND MCC-2) PROVIDE REDUNDANT FEEDER PATHS TO THESE TIED MOTOR CONTROL CENTERS, BUT STILL LEAVES THEM DEPENDANT ON THE SAME UTILITY TRANSFORMER.
6. WHEN POWER SUPPLIED BY CO-GENERATION IS NOT ENTIRELY CONSUMED AT SWGR-2, CO-GEN POWER IS SOLD TO FP&L - AND THEN BOUGHT AGAIN FROM FP&L AT SWGR-1.



REV	DATE	BY	DESCRIPTION
			PRELIMINARY DESIGN SUBMITTAL NOT FOR CONSTRUCTION

DESIGNED AHR | DRAWN BLS | CHECKED | DATE MAY 2017

carollo

MANATEE COUNTY

SEWRF ELECTRICAL MASTER PLAN

ELECTRICAL

OVERALL ONE-LINE DIAGRAM, 2018

VERIFY SCALES
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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SHEET NO. OF XX

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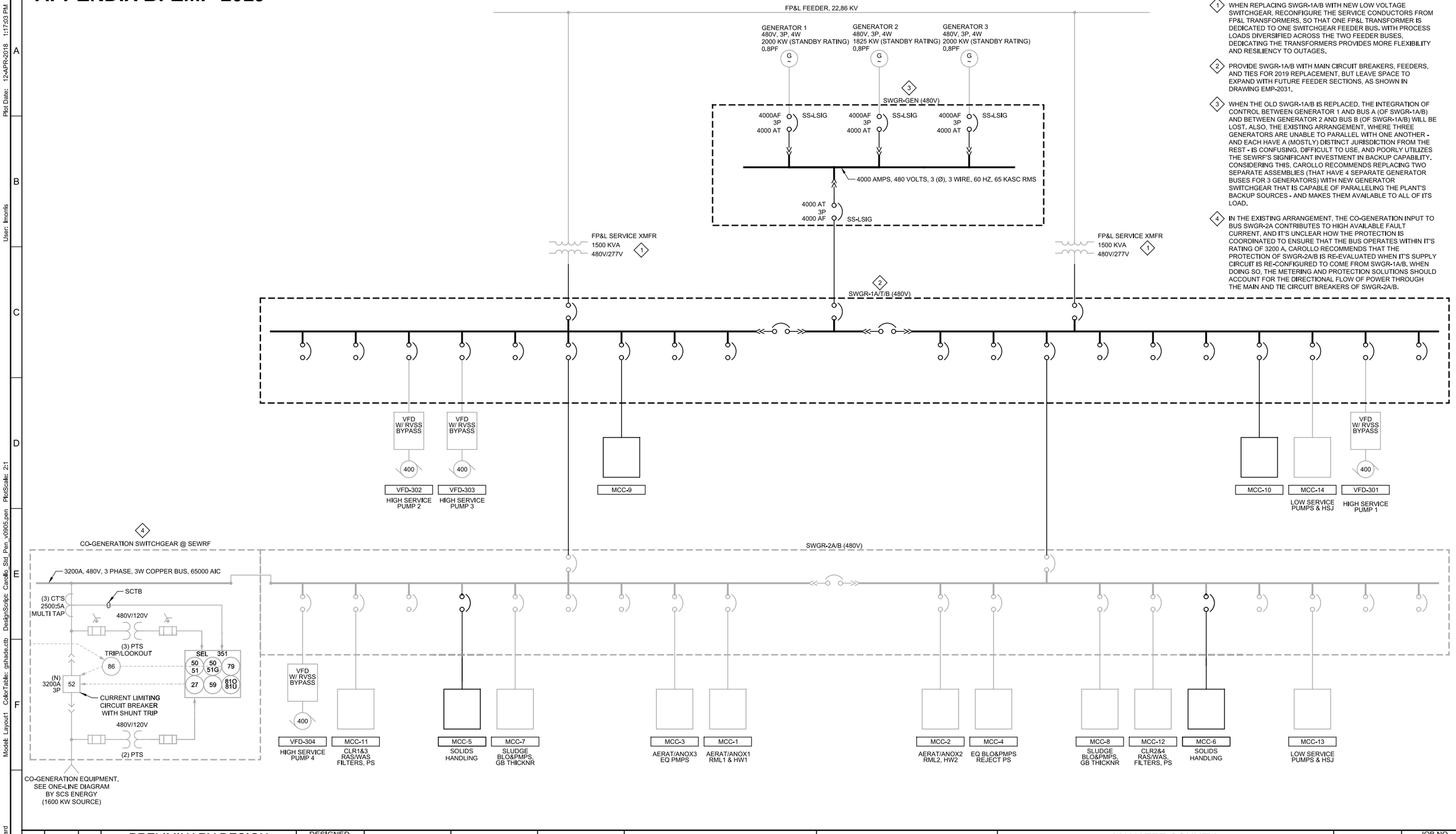
APPENDIX B: EMP-2019



KEY NOTES:

1. WHEN REPLACING SWGR-1A/B WITH NEW LOW VOLTAGE SWITCHGEAR, RECONFIGURE THE SERVICE CONDUCTORS FROM FP&L TRANSFORMERS, SO THAT ONE FP&L TRANSFORMER IS DEDICATED TO ONE SWITCHGEAR FEEDER BUS. WITH PROCESS LOADS DIVERSIFIED ACROSS THE TWO FEEDER BUSES, DEDICATING THE TRANSFORMERS PROVIDES MORE FLEXIBILITY AND RESILIENCY TO OUTAGES.
2. PROVIDE SWGR-1A/B WITH MAIN CIRCUIT BREAKERS, FEEDERS, AND TIES FOR 2019 REPLACEMENT, BUT LEAVE SPACE TO EXPAND WITH FUTURE FEEDER SECTIONS, AS SHOWN IN DRAWING EMP-2031.
3. WHEN THE OLD SWGR-1A/B IS REPLACED, THE INTEGRATION OF CONTROL BETWEEN GENERATOR 1 AND BUS A (OF SWGR-1A/B) AND BETWEEN GENERATOR 2 AND BUS B (OF SWGR-1A/B) WILL BE LOST. ALSO, THE EXISTING ARRANGEMENT, WHERE THREE GENERATORS ARE UNABLE TO PARALLEL WITH ONE ANOTHER - AND EACH HAVE A (MOSTLY) DISTINCT JURISDICTION FROM THE REST - IS CONFUSING, DIFFICULT TO USE, AND POORLY UTILIZES THE SEWRF'S SIGNIFICANT INVESTMENT IN BACKUP CAPABILITY. CONSIDERING THIS, CAROLLO RECOMMENDS REPLACING TWO SEPARATE ASSEMBLIES (THAT HAVE 4 SEPARATE GENERATOR BUSES FOR 3 GENERATORS) WITH NEW GENERATOR SWITCHGEAR THAT IS CAPABLE OF PARALLELING THE PLANT'S BACKUP SOURCES - AND MAKES THEM AVAILABLE TO ALL OF ITS LOAD.
4. IN THE EXISTING ARRANGEMENT, THE CO-GENERATION INPUT TO BUS SWGR-2A CONTRIBUTES TO HIGH AVAILABLE FAULT CURRENT, AND IT'S UNCLEAR HOW THE PROTECTION IS COORDINATED TO ENSURE THAT THE BUS OPERATES WITHIN IT'S RATING OF 3200 A. CAROLLO RECOMMENDS THAT THE PROTECTION OF SWGR-2A/B IS RE-EVALUATED WHEN IT'S SUPPLY CIRCUIT IS RE-CONFIGURED TO COME FROM SWGR-1A/B. WHEN DOING SO, THE METERING AND PROTECTION SOLUTIONS SHOULD ACCOUNT FOR THE DIRECTIONAL FLOW OF POWER THROUGH THE MAIN AND TIE CIRCUIT BREAKERS OF SWGR-2A/B.

REV	DATE	BY	DESCRIPTION
			PRELIMINARY DESIGN SUBMITTAL NOT FOR CONSTRUCTION

DESIGNED AHR
DRAWN BLS
CHECKED
DATE MAY 2017

carollo

MANATEE COUNTY
SEWRF ELECTRICAL MASTER PLAN
ELECTRICAL
OVERALL ONE-LINE DIAGRAM, 2019

VERIFY SCALES
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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SHEET NO. OF XX

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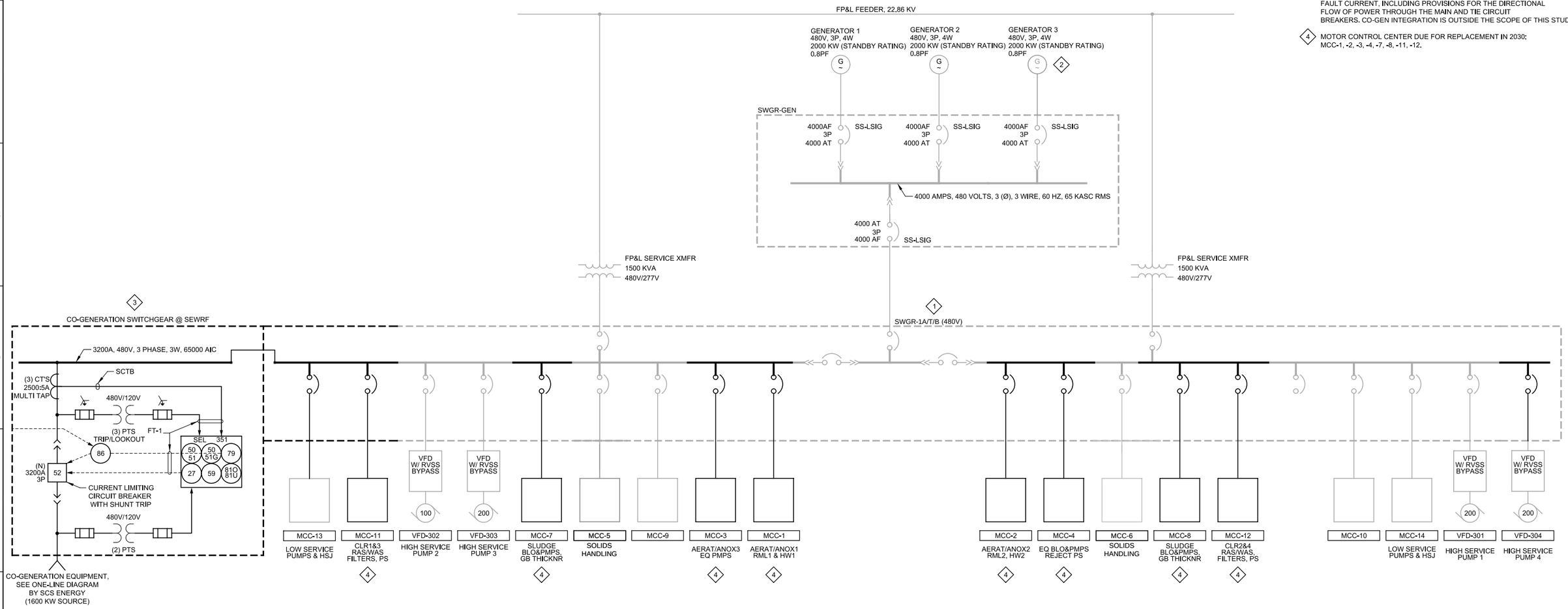
APPENDIX C: EMP-2031

KEY NOTES:

1. IF THE COUNTY PREFERS TO HAVE ONE SWITCHGEAR ASSEMBLY RATHER THAN 2, THEN THE CONFIGURATION WOULD LOOK LIKE THIS, WITH MCCS SUPPLIED DIRECTLY FROM SWGR-1A/T/B. CAROLLO RECOMMENDS MAINTAINING THE SERVICE ENTRANCE SWITCHGEAR SEPARATE FROM THE DISTRIBUTION SWITCHGEAR, AS SHOWN IN EMP-2019 AND EMP-2035.
2. GENERATOR 3 IS SHOWN DECOMISSIONED, BUT LEFT IN PLACE FOR SPARE PARTS. IT COULD ALSO BE REMOVED ENTIRELY.
3. CO-GENERATION SWITCHGEAR WILL HAVE TO BE TRANFERRED TO NEW SOURCE (AND PROBABLY REPLACED) WHEN SWGR-2A/B IS RETIRED. IF ATTACHED TO SWGR-1A/B, THE DESIGN OF THAT INSTALLATION WILL HAVE TO ADDRESS THE PROTECTION OF SWGR-2A/B WITHIN ITS RATINGS FOR NORMAL OPERATION AND FAULT CURRENT, INCLUDING PROVISIONS FOR THE DIRECTIONAL FLOW OF POWER THROUGH THE MAIN AND TIE CIRCUIT BREAKERS. CO-GEN INTEGRATION IS OUTSIDE THE SCOPE OF THIS STUDY.
4. MOTOR CONTROL CENTER DUE FOR REPLACEMENT IN 2030: MCC-1, -2, -3, -4, -7, -8, -11, -12.



PRELIMINARY DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION

DESIGNED AHR
DRAWN BLS
CHECKED
DATE MAY 2017

MANATEE COUNTY
SEWRF ELECTRICAL MASTER PLAN
ELECTRICAL
OVERALL ONE-LINE DIAGRAM, 2031

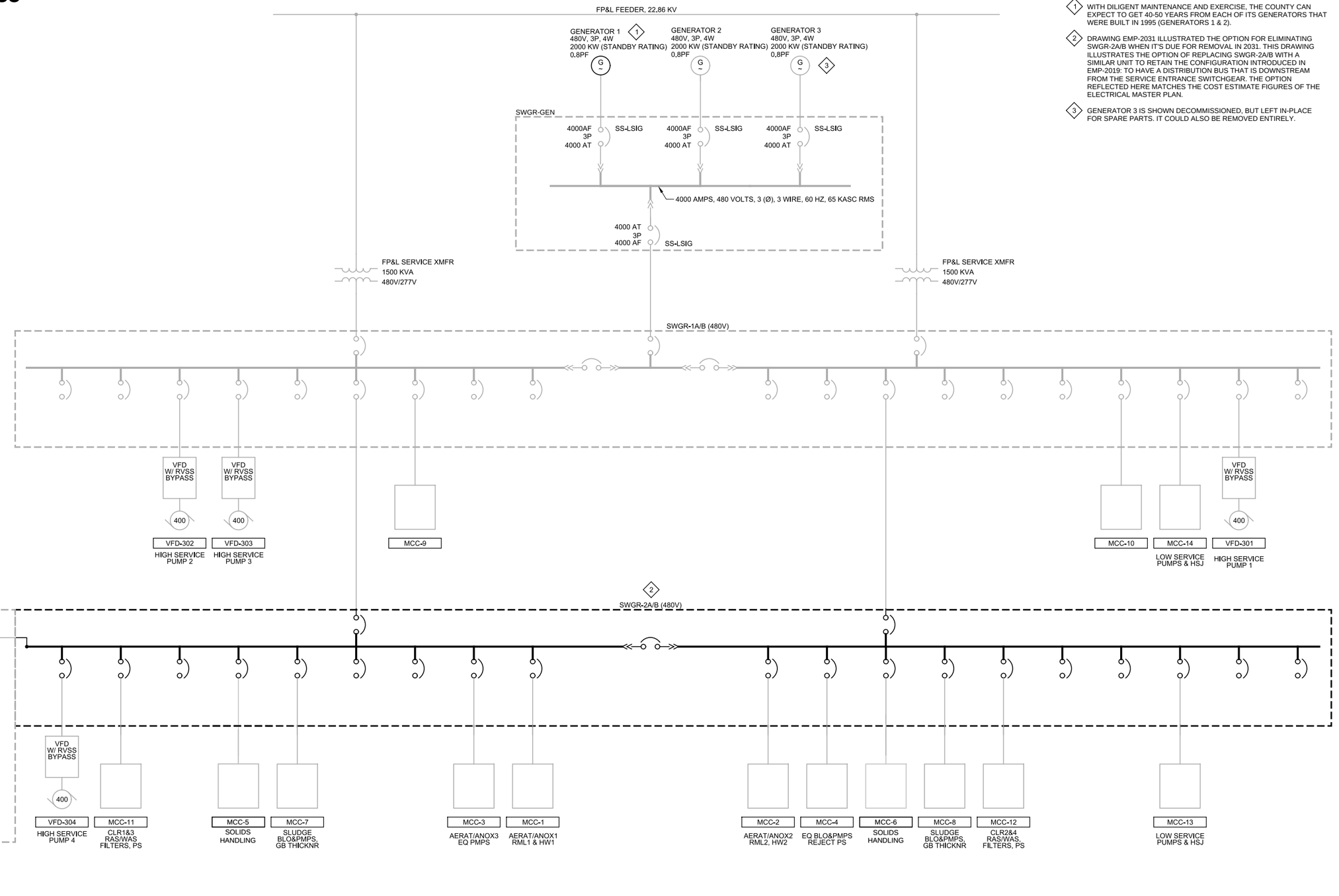
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. EMP-2031
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N00EMP-2031.dgn

Plot Date: 11-JAN-2018 4:13:39 PM
User: bshepard
PlotScale: 2:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: bshepard

APPENDIX D: EMP-2035



KEY NOTES:

1. WITH DILIGENT MAINTENANCE AND EXERCISE, THE COUNTY CAN EXPECT TO GET 40-50 YEARS FROM EACH OF ITS GENERATORS THAT WERE BUILT IN 1995 (GENERATORS 1 & 2).
2. DRAWING EMP-2031 ILLUSTRATED THE OPTION FOR ELIMINATING SWGR-2A/B WHEN IT'S DUE FOR REMOVAL IN 2031. THIS DRAWING ILLUSTRATES THE OPTION OF REPLACING SWGR-2A/B WITH A SIMILAR UNIT TO RETAIN THE CONFIGURATION INTRODUCED IN EMP-2019: TO HAVE A DISTRIBUTION BUS THAT IS DOWNSTREAM FROM THE SERVICE ENTRANCE SWITCHGEAR. THE OPTION REFLECTED HERE MATCHES THE COST ESTIMATE FIGURES OF THE ELECTRICAL MASTER PLAN.
3. GENERATOR 3 IS SHOWN DECOMMISSIONED, BUT LEFT IN-PLACE FOR SPARE PARTS. IT COULD ALSO BE REMOVED ENTIRELY.

REV	DATE	BY	DESCRIPTION

PRELIMINARY DESIGN SUBMITTAL
NOT FOR CONSTRUCTION

DESIGNED AHR
DRAWN BLS
CHECKED
DATE MAY 2017

carollo

Manatee County FLORIDA

MANATEE COUNTY
SEWRF ELECTRICAL MASTER PLAN
ELECTRICAL
OVERALL ONE-LINE DIAGRAM, 2035

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. EMP-2035
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N00EMP-2025.dgn

LAST SAVED BY: bshepard Model: Layout1 ColorTable: gshade.ctb DesignScript: Carollo_Std_Pen_v0905.pen PlotScale: 2:1 Plot Date: 11-JAN-2018 4:07:27 PM User: bshepard

Manatee County Wastewater Treatment Facility

Equipment Numbering Convention

Prepared by Andrew Rex (file name - EQUIP_ID.XLS)

September 16, 1997 Updated: 6/9/2010

APPENDIX E: Area Tags & Equipment Codes

Process / Area Numbering

Process / Area Code Number*	Process Area / Type
01	IBM Lift Station
11	Headworks / Septage Handling
12	Primary Lift Pumping Station
21	Primary Clarifiers
22	Primary Sludge Pumping Area
23	PST 4 Sludge Pumping Station
24	Gravity Thickeners / Sludge Transfer Room
25	Digester Complex
26	Resource Recovery Complex
27	Equalization Basin / Odor Treatment Complex #2
28	Co-Generation Complex
29	Biosolids De-watering Area
30	Biosolids Cake Processing Area
31	Secondary Pump Station
33	Aeration Basins
34	Blower Building
35	Odor Treatment Complex #1
~~41~~	~~Interstage Pump Station (To be De-commissioned)~~
42	Solids Contact Tanks
51	Secondary Clarifiers
52	Solids Contact Pump Gallery
53	Solids Contact MCC Room
61	NTF Pumping Station
62	NTF Other Equipment
63	Dissolved Air Flotation Thickening Complex
71	Chlorine Storage / Feed
72	So2 Storage / Feed
73	Chlorine Contact Basin
74	Nonpotable Water Pumping Station
75	Sodium Hypochlorite (at Non-Pot building)
76	UV Disinfection (Future)
81	Laboratory
82	Existing Administration Building
91	Ops Center / Filter Building Upper Level
92	Filter Building Lower Level

Equipment Prefix List

The following letters will precede the Process Area Code found to the left.

Prefix	Equipment Type	Prefix	Equipment Type
AC(U)	AIR CONDITIONER (UNIT)	HUM	HUMIDIFIER
ACF	ACTIVE COMPOST FAN	LI	LEVEL INDICATOR
ACP	AIR COMPRESSOR	LP	LIGHTING PANEL / LOCAL PANEL
AHU	AIR HANDLING UNIT	LP	LIGHTING PANEL / LOCAL PANEL
AI	MISC. ANALYSIS INDICATOR	LS	LIMIT SWITCH
ANE	ANALYSIS EQUIP. (Detectors and Analyzers)	M	MOTOR
AV	MOTOR OPERATED DAMPER	MCC	MOTOR CONTROL CENTER
B	BOILER	MME	MISC. MECHANICAL EQUIPMENT
BF	BIOFILTER	MUA	MAKE-UP AIR UNIT
BLR	AERATION BLOWER	MXR	MIXER / AGITATOR
BS	BAR SCREEN	PCL	PRIMARY CLARIFIER
CAP	CAPACITOR	PDP	POSITIVE DISPLACEMENT PUMP (Lobe, Piston)
CC	CONTACTOR CABINET	PFE	MISC. POLYMER FEED EQUIPMENT
CCF	COMPOST CURING FAN	PI	PRESSURE INDICATOR
CDR	CONDENSER	PNL	PANEL
CEN	CENTRIFUGE	PP	POWER PANEL (ELECTRIC)
CP	CENTRIFUGAL PUMP	PRV	POWER ROOF VENTILATOR
CV	CONTROL VALVE	PV	PRESSURE REGULATING OR RELIEF VALVE
CVR	CONVEYOR	PVL	PRESSURE VESSEL
DG	DRAIN GATE	SBR	AIR SCRUBBER
DGE	MISC. DIGESTER GAS EQUIPMENT	SC	SPEED CONTROLLER
DP	DISTRIBUTION PANEL (ELECTRIC)	SCL	SECONDARY CLARIFIER
ES	EMERGENCY STOP SWITCH	SCR	SCREEN
EF	EXHAUST FAN	SG	SLIDE GATE
F	FAN	SLG	SLUICE GATE
FAF	FOUL AIR FAN	SLP	SCREW LIFT PUMP
FI	FLOW INDICATOR	SP	SUMP PUMP
FLT	FILTER	SPR	SPARE (Misc.)
GCP	GAS COMPRESSOR	SV	SOLENOID VALVE
GDR	GRINDER	T	MISC. TANK / BASIN
GEN	GENERATOR	UH	UNIT HEATER
H	OVERHEAD MONORAIL HOIST	V	VALVE
HX	HEAT EXCHANGER	VLP	VERTICAL LIFT PUMP
HE	MISC. HEADWORKS EQUIPMENT	VRV	VACUUM REGULATOR
HRU	HEAT RECOVERY UNIT	WI	WEIGHT INDICATOR

* This two digit prefix will be followed by another two digits, starting at #01, and will increment by one until a series of three or more pieces of equipment are en-countered. Then the decade number will increment to the next unused series. For example, CP7401 and CP7402 would identify centrifugal pumps in the Non-pot Pumping Station. CP7411, CP7412, and CP7413 would identify three other types of centrifugal pumps there as well. Beginning with the Liquid Stream Improvements and De-watering Facility upgrades, this numbering scheme will be increased to a 5 digit number, 2 for the process area and 3 to identify equipment using the same instructions previuosly stated.

APPENDIX F: Area Tags & Equipment Codes
EXAMPLE OF TAGGING SCHEME: THESE ARE NOT THE LOADS FROM YOUR PLANT

EQUIPMENT LIST REPORT

PROJECT INFORMATION

PROJECT [redacted]
CLIENT
PROJECT NUMBER
REPORT BY ANDREW REX
REPORT DATE 5/24/2017 6:30 PM

03 | MAINTENANCE BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
	SHOP AIR COMPRESSOR	43_11_52	NEW	DUTY	CONSTANT SPEED	52.5	HP	480	3	PB-85-01	N	Indoor
	BRIDGE CRANE (TRUCK BAY)		NEW	STANDBY	CONSTANT SPEED	10.0	HP	480	3	PB-85-02	N	Indoor
BMS-03.900	MAINTENANCE BUILDING BMS CONTROL PANEL		NEW	DUTY		20.0	AMP	120	1	LP-85-02	N	Indoor
EF-03.920B	MAINTENANCE BAY EXHAUST FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.3	HP	120	1	LP-85-01	N	Indoor
General Comments:	*1,000 CFM*											
EF-03.921	LOWER LEVEL STORAGE EXHAUST FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.5	HP	120	1	LP-85-01	N	Indoor
General Comments:	*2,000 CFM*											
EF-03.922	TOOL STORAGE EXHAUST FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.5	HP	120	1	LP-85-01	N	Indoor
General Comments:	*1,500 CFM*											
EF-03.923	OIL STORAGE EXHAUST FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.5	HP	120	1	LP-85-01	N	Indoor
General Comments:	*1,500 CFM*											
EF-03.924	UPPER LEVEL STORAGE EXHAUST FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.5	HP	120	1	LP-85-01	N	Indoor
EF-03.925	JANITORIAL CLOSET EXHAUST FAN	23_34_01	NEW	DUTY		0.0	KW	120	1	LP-85-01	N	Indoor
General Comments:	*50 CFM*											
EF-03.926	SHOWER EXHAUST FAN	23_34_01	NEW	DUTY		0.0	KW	120	1	LP-85-01	N	Indoor
General Comments:	*50 CFM*											
EF-03.927	MEN'S RESTROOM EXHAUST FAN	23_34_01	NEW	DUTY		0.1	KW	120	1	LP-85-01	N	Indoor
General Comments:	*50 CFM*											
EF-03.928	WOMEN'S RESTROOM EXHAUST FAN	23_34_01	NEW	DUTY		0.1	KW	120	1	LP-85-01	N	Indoor
General Comments:	*50 CFM*											
EF-03.929	LOCKER ROOM EXHAUST FAN	23_34_01	NEW	DUTY		0.1	KW	120	1	LP-85-01	N	Indoor
General Comments:	*150 CFM*											
EUH-03.956	OIL STORAGE ELECTRIC UNIT HEATER	23_83_01	NEW	DUTY		11.0	AMP	480	1	PB-85-01	N	Indoor
GUH-03.951	MAINTENANCE ROOM GAS INFRA-RED TUBE HEATER	23_83_01	NEW	DUTY		5.5	AMP	120	1	LP-85-02	N	Indoor
GUH-03.952	MAINTENANCE ROOM GAS INFRA-RED TUBE HEATER	23_83_01	NEW	DUTY		5.5	AMP	120	1	LP-85-02	N	Indoor

EQUIPMENT LIST REPORT

PROJECT INFORMATION

PROJECT [redacted]
CLIENT
PROJECT NUMBER
REPORT BY ANDREW REX
REPORT DATE 5/24/2017 6:30 PM

03 | MAINTENANCE BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
GUH-03.953	LOWER LEVEL STORAGE GAS UNIT HEATER	23_83_01	NEW	DUTY		1.9	AMP	120	1	LP-85-02	N	Indoor
GUH-03.954	TOOL STORAGE GAS UNIT HEATER	23_83_01	NEW	DUTY		1.9	AMP	120	1	LP-85-02	N	Indoor
GUH-03.955	UPPER PARTS STORAGE	23_83_01	NEW	DUTY		2.4	AMP	120	1	LP-85-02	N	Indoor
GWH-03.011	GAS WATER HEATER	22_42_01	NEW	DUTY		2.2	AMP	120	1	LP-85-02	N	Indoor
PWU-03.XXX1	SHOP PRESSURE WASHER UNIT	46_21_93	NEW	DUTY	CONSTANT SPEED	15.0	HP	480	3	PB-85-02	N	Indoor
TPV-03.001	ELECTRONIC TRAP PRIMER ASSEMBLY	22_42_01	NEW	DUTY	CONSTANT SPEED	0.3	AMP	120	1	LP-85-01	N	Indoor
TPV-03.002	ELECTRONIC TRAP PRIMER ASSEMBLY	22_42_01	NEW	DUTY	CONSTANT SPEED	0.3	AMP	120	1	LP-85-01	N	Indoor
	ROLLUP DOOR 03A (WEST)		NEW	DUTY	CONSTANT SPEED	0.8	HP	480	3	PB-85-02	N	Indoor
	General Comments: ETAP TAG RUD-81.01											
	ROLLUP DOOR 03B (EAST)		NEW	DUTY	CONSTANT SPEED	0.8	HP	480	3	PB-85-02	N	Indoor
	General Comments: ETAP TAG RUD-81.01											
HP-03.941	HEAT PUMP	23_81_44	NEW	DUTY		15.5	AMP	480	3	PB-85-01	N	Indoor
VCP-03.960	WATER PUMP FOR HEAT PUMP	23_21_23	NEW	DUTY	VARIABLE SPEED	7.4	AMP	480	3	PB-85-01	N	Indoor
EF-03.920A	MAINTENANCE BAY EXHAUST FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-85	N	Indoor
	General Comments: 9,000 CFM											
SF-03.931	MAINTENANCE BAY SUPPLY FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-85	N	Indoor
SF-03.932	MAINTENANCE BAY SUPPLY FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.8	HP	480	3	MCC-85	N	Indoor
	General Comments: 3,000 CFM											

04 | ADMIN BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
ADMIN-MISC	MISCELLANEOUS LOADS IN ADMIN BUILDING		NEW	DUTY		600.0	AMP	480	3	SWB-04	Y	Indoor

10 | NEW LIFT STATION

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
	BRIDGE CRANE (MEZZANINE)		NEW	DUTY	CONSTANT SPEED	10.0	HP	480	3	PB-10-01	N	Indoor
	MONORAIL (PUMP ROOM)		NEW	STANDBY	CONSTANT SPEED	7.5	HP	480	3	PB-10-01	N	Indoor
	MONORAIL (GRADE LEVEL)		NEW	STANDBY	CONSTANT SPEED	7.5	HP	480	3	PB-10-01	N	Indoor
BMS-10.900	CC LIFT STATION BMS CONTROL PANEL		NEW	DUTY		20.0	AMP	120	1	LP-10-01	N	Indoor
EDR-10.111	SCREEN CHANNEL 1 INFLUENT GATE		NEW	DUTY		3.0	HP	480	3	PB-10-03	N	Indoor
EDR-10.119	SCREEN CHANNEL 1 EFFLUENT GATE		NEW	DUTY		3.0	HP	480	3	PB-10-03	N	Indoor
EDR-10.121	SCREEN CHANNEL 2 INFLUENT GATE		NEW	STANDBY		3.0	HP	480	3	PB-10-02	N	Indoor
EDR-10.129	SCREEN CHANNEL 2 EFFLUENT GATE		NEW	STANDBY		3.0	HP	480	3	PB-10-02	N	Indoor
EDR-10.131	SCREEN CHANNEL 3 INFLUENT GATE		NEW	STANDBY		3.0	HP	480	3	PB-10-02	N	Indoor
EDR-10.139	SCREEN CHANNEL 3 EFFLUENT GATE		NEW	STANDBY		3.0	HP	480	3	PB-10-02	N	Indoor

EQUIPMENT LIST REPORT

PROJECT INFORMATION

PROJECT [redacted]
CLIENT
PROJECT NUMBER
REPORT BY ANDREW REX
REPORT DATE 5/24/2017 6:30 PM

10 | NEW LIFT STATION

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
EDR-10.141	BYPASS GATE 1		NEW	STANDBY	CONSTANT SPEED	3.0	HP	480	3	PB-10-01	N	Indoor
EDR-10.142	BYPASS GATE 2		NEW	STANDBY	CONSTANT SPEED	3.0	HP	480	3	PB-10-01	N	Indoor
EDR-10.150	WET WELL EQUALIZATION GATE		NEW	STANDBY		3.0	HP	480	3	PB-10-01	N	Indoor
EDR-10.211	PUMP 1 INLET KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-03	N	Indoor
EDR-10.219	PUMP 1 OUTLET KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-03	N	Indoor
EDR-10.221	PUMP 2 INLET KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-03	N	Indoor
EDR-10.229	PUMP 2 OUTLET KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-03	N	Indoor
EDR-10.231	PUMP 3 INLET KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-02	N	Indoor
EDR-10.239	PUMP 3 OUTLET KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-02	N	Indoor
EDR-10.241	PUMP 4 INLET KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-02	N	Indoor
EDR-10.249	PUMP 4 OUTLET KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-02	N	Indoor
EDR-10.251	PUMP 5 INLET KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-02	N	Indoor
EDR-10.259	PUMP 5 OUTLET KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-02	N	Indoor
EDR-10.311	EXCESS FLOW MAG METER UPSTREAM ISO KNIFE GATE		NEW	STANDBY	CONSTANT SPEED	2.0	HP	480	3	PB-10-02	N	Indoor
EDR-10.317	EXCESS FLOW MAG METER DOWNSTREAM ISO KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-02	N	Indoor
EDR-10.319	EXCESS FLOW MAG METER BYPASS KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-03	N	Indoor
EDR-10.321	HEADWORKS MAG METER UPSTREAM ISOLATION KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-02	N	Indoor
EDR-10.327	HEADWORKS MAG METER DOWNSTREAM ISO KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-01	N	Indoor
EDR-10.329	HEADWORKS MAG METER BYPASS KNIFE GATE		NEW	STANDBY		2.0	HP	480	3	PB-10-02	N	Indoor
SF-10.933	STAIRWELL SUPPLY FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.5	HP	120	1	LP-10-01	N	Indoor
TPV-10.001	ELECTRONIC TRAP PRIMER ASSEMBLY	22_42_01	NEW	DUTY	CONSTANT SPEED	0.3	AMP	120	1	LP-10-01	N	Indoor
HP-10.941	CC LS HEAT PUMP 1	23_81_44	NEW	DUTY		26.5	AMP	480	3	PB-10-01	N	Indoor
HP-10.942	CC LS HEAT PUMP 2	23_81_44	NEW	STANDBY		26.5	AMP	480	3	PB-10-01	N	Indoor
EAM-10.315	EXCESS FLOW HOLDING BASIN FCV		NEW	DUTY	CONSTANT SPEED	0.5	HP	480	3	PB-10-01	N	Indoor
	General Comments: ETAP TAG EDR-10-01											
LCP-10.400	LS SUMP PUMP 1 & 2	43-25-00.10	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	PB-10-01	Y	Indoor
	General Comments: ETAP TAG 10-PMP-01											
PPU-10.971	CNTRL ROOM POSITIVE PRESSURIZATION UNIT		NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	PB-10-01	N	Indoor
PPU-10.972	ELECT ROOM POSITIVE PRESSURIZATION UNIT		NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	PB-10-01	N	Indoor
VCP-10.960	WATER PUMPS (2) FOR HEAT PUMPS	23_21_23	NEW	DUTY	VARIABLE SPEED	7.4	AMP	480	3	PB-10-01	N	Indoor
EF-10.921	LS EXHAUST FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-10B	Y	Indoor
	General Comments: 8,800 CFM											
PMP-10.215	LIFT STATION PUMP 1	43_25_13.30	NEW	DUTY	VARIABLE SPEED	110.0	HP	480	3	MCC-10A	Y	Indoor
	General Comments: ETAP TAG 10A-PMP-1											

EQUIPMENT LIST REPORT

PROJECT INFORMATION

PROJECT [redacted]
CLIENT
PROJECT NUMBER
REPORT BY ANDREW REX
REPORT DATE 5/24/2017 6:30 PM

10 | NEW LIFT STATION

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
PMP-10.225	LIFT STATION PUMP 2	43_25_13.30	NEW	DUTY	VARIABLE SPEED	110.0	HP	480	3	MCC-10A	Y	Indoor
General Comments:	*ETAP TAG 10B-PMP-2*											
SF-10.932	WET-WELL 2 SUPPLY FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.8	HP	480	3	MCC-10B	N	Indoor
BAR-10.115	LS COARSE SCREEN 1	46_21_10	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-10A	Y	Indoor
General Comments:	*ETAP TAG LS SCR-10-1*											
BAR-10.125	LS COARSE SCREEN 2	46_21_10	FUTURE	STANDBY	CONSTANT SPEED	2.0	HP	480	3	MCC-10B	Y	Indoor
General Comments:	*ETAP TAG LS SCR-10-2*											
BAR-10.135	LS COARSE SCREEN 3	46_21_10	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-10B	Y	Indoor
General Comments:	*ETAP TAG LS SCR-10-2*											
MAU-10.911	LS MAKEUP AIR UNIT	23_83_05	NEW	DUTY	CONSTANT SPEED	8.0	HP	480	3	PB-10-01	Y	Indoor
General Comments:	*8,000 CFM*											
PMP-10.235	LIFT STATION PUMP 3	43_25_13.30	NEW	DUTY	VARIABLE SPEED	110.0	HP	480	3	MCC-10B	Y	Indoor
General Comments:	*ETAP TAG 10A-PMP-3*											
PMP-10.245	LIFT STATION PUMP 4	43_25_13.30	NEW	DUTY	VARIABLE SPEED	110.0	HP	480	3	MCC-10B	Y	Indoor
General Comments:	*ETAP TAG 10B-PMP-4*											
SF-10.931	WET-WELL 1 SUPPLY FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.8	HP	480	3	MCC-10A	N	Indoor
PMP-10.255	LIFT STATION PUMP 5	43_25_13.30	NEW	DUTY	VARIABLE SPEED	110.0	HP	480	3	MCC-10B	Y	Indoor
General Comments:	*ETAP TAG 10A-PMP-5*											
MTS-10-01	MANUAL TRANSFER SWITCH		NEW	STANDBY	CONSTANT SPEED	225.0	AMP	480	3	MCC-10B	N	Indoor

11 | EXCESS FLOW HOLDING BASIN

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
EDR-11.101	CONTROL BOX GATE		NEW	DUTY	CONSTANT SPEED	3.0	HP	480	3	PB-10-03	N	Outdoor

20 | NEW HEADWORKS

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
BMS-20.900	HEADWORKS BMS CONTROL PANEL		NEW	DUTY		20.0	AMP	120	1	LP-20-01	N	Indoor
EDR-20.111	SCREEN INLET GATE 1		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-20-03	Y	Indoor
EDR-20.119	SCREEN OUTLET GATE 1		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-20-03	Y	Indoor
EDR-20.121	SCREEN INLET GATE 2		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-20-02	Y	Indoor
EDR-20.129	SCREEN OUTLET GATE 2		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-20-02	Y	Indoor
EDR-20.131	SCREEN INLET GATE 3		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-20-02	Y	Indoor
EDR-20.139	SCREEN OUTLET GATE 3		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-20-02	Y	Indoor
EDR-20.191	BYPASS GATE TO EFHB		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-20-01	Y	Indoor
EDR-20.211	GRIT INLET GATE 1		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-20-03	Y	Indoor
EDR-20.221	GRIT INLET GATE 2		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-20-02	Y	Indoor

APPENDIX F: Area Tags & Equipment Codes
EXAMPLE OF TAGGING SCHEME: THESE ARE NOT THE LOADS FROM YOUR PLANT

EQUIPMENT LIST REPORT

PROJECT INFORMATION

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20 | NEW HEADWORKS

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
EDR-20.231	GRIT INLET GATE 3		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-20-02	Y	Indoor
MISC-HW	LIGHTING AND MISC. AT HEADWORKS		NEW	DUTY		25.0	KVA	208	3	LP-20-01	Y	Indoor
SF-20.931	STAIRWELL SUPPLY FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.5	HP	120	1	LP-20-01	N	Indoor
TPV-20.001	ELECTRONIC TRAP PRIMER ASSEMBLY	22_42_01	NEW	DUTY	CONSTANT SPEED	0.3	AMP	120	1	LP-20-01	N	Indoor
HP-20.942	HW HEAT PUMP 2		NEW	STANDBY		15.5	AMP	480	3	PB-20-01	N	Indoor
PPU-20.972	HW CNTRL ROOM POSITIVE PRESSURIZATION UNIT	23_41_51	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	PB-20-01	N	Indoor
HP-20.941	HW HEAT PUMP 1		NEW	DUTY		15.5	AMP	480	3	PB-20-01	N	Indoor
VCP-20.960	WATER PUMPS (2) FOR HEAT PUMPS	23_21_23	NEW	DUTY	VARIABLE SPEED	6.4	AMP	480	3	PB-20-01	N	Indoor
PPU-20.971	HW ELECT ROOM POSITIVE PRESSURIZATION UNIT	23_41_51	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	PB-20-01	N	Indoor
MTS-20-01	MANUAL TRANSFER SWITCH		NEW	STANDBY	CONSTANT SPEED	225.0	AMP	480	3	MCC-20B	N	Indoor
	ROLLUP DOOR D2002		NEW	STANDBY	CONSTANT SPEED	0.8	HP	480	3	PB-20-01	N	Indoor
General Comments:	*ETAP TAG RUD-81.01*											
PMP-20.323	GRIT PUMP 2		FUTURE	STANDBY	CONSTANT SPEED	10.0	HP	480	3	MCC-20B	N	Indoor
FAN-20.892	HW ODOR CONTROL FOUL AIR FAN 2	23_34_17	NEW	DUTY	VARIABLE SPEED	40.0	HP	480	3	MCC-20B	Y	Indoor
General Comments:	*ODOR CONTROL SCRUBBER FAN*											
FAN-20.894	HW ODOR CONTROL FOUL AIR FAN 4	23_34_17	NEW	DUTY	CONSTANT SPEED	10.0	HP	480	3	MCC-20B	Y	Indoor
General Comments:	*HEADWORKS ODOR CONTROL SCRUBBER FAN FOR SMALL SYSTEM*											
MAU-20.911	HW MAKEUP AIR UNIT	23_83_05	NEW	DUTY	VARIABLE SPEED	40.0	HP	480	3	PB-20-01	Y	Indoor
SWP-20.116	SCREENINGS WASHER/COMPACTOR 1	46_21_28	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-20A	Y	Indoor
SCR-20.114	FINE SCREEN 1	46_21_28	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-20A	Y	Indoor
GRD-20.411	GRIT DEWATERING UNIT 1	46_23_25	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	MCC-20A	Y	Indoor
CON-20.412	SCREW CONVEYOR 1	46_23_25	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	MCC-20A	Y	Indoor
FAN-20.891	HW ODOR CONTROL FOUL AIR FAN 1	23_34_17	NEW	DUTY	VARIABLE SPEED	40.0	HP	480	3	MCC-20A	Y	Indoor
General Comments:	*ODOR CONTROL SCRUBBER FAN*											
GRD-20.421	GRIT DEWATERING UNIT 2	46_23_25	FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	MCC-20B	Y	Indoor
CON-20.422	SCREW CONVEYOR 2	46_23_25	FUTURE	STANDBY	CONSTANT SPEED	1.5	HP	480	3	MCC-20B	Y	Indoor
SWP-20.136	SCREENINGS WASHER/COMPACTOR 3	46_21_28	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-20B	Y	Indoor
SCR-20.134	FINE SCREEN 3	46_21_28	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-20B	Y	Indoor
GRD-20.431	GRIT DEWATERING UNIT 3	46_23_25	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	MCC-20B	Y	Indoor
CON-20.432	SCREW CONVEYOR 3	46_23_25	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	MCC-20B	Y	Indoor
FAN-20.893	HW ODOR CONTROL FOUL AIR FAN 3	23_34_17	NEW	STANDBY	VARIABLE SPEED	40.0	HP	480	3	MCC-20A	N	Indoor
PMP-20.313	GRIT PUMP 1		NEW	DUTY	CONSTANT SPEED	10.0	HP	480	3	MCC-20A	N	Indoor
SWP-20.126	SCREENINGS WASHER/COMPACTOR 2	46_21_28	FUTURE	STANDBY	CONSTANT SPEED	5.0	HP	480	3	MCC-20B	Y	Indoor
SCR-20.124	FINE SCREEN 2	46_21_28	FUTURE	STANDBY	CONSTANT SPEED	2.0	HP	480	3	MCC-20B	Y	Indoor
PMP-20.333	GRIT PUMP 3		NEW	DUTY	CONSTANT SPEED	10.0	HP	480	3	MCC-20B	N	Indoor

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30 | SELECTOR BASIN

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
EDR-30.110	SELECTOR BASIN MLR PLUG VALVE 1		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-20-03	N	Indoor
EDR-30.210	SELECTOR BASIN MLR PLUG VALVE 2		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-20-03	N	Indoor
EDR-30.310	SELECTOR BASIN MLR PLUG VALVE 3		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-20-02	N	Indoor
EDR-30.410	SELECTOR BASIN MLR PLUG VALVE 4		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-20-02	N	Indoor
MIX-30.401	SELECTOR BASIN CHANNEL 4, MIXER 1	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20B	N	Indoor
MIX-30.402	SELECTOR BASIN CHANNEL 4, MIXER 2	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20B	N	Indoor
MIX-30.403	SELECTOR BASIN CHANNEL 4, MIXER 3	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20B	N	Indoor
MIX-30.404	SELECTOR BASIN CHANNEL 4, MIXER 4	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20B	N	Indoor
MIX-30.052	DENITRIFICATION ZONE 2 MIXER	46_41_25	NEW	DUTY	CONSTANT SPEED	8.3	HP	480	3	MCC-20B	N	Indoor
General Comments:	*RAS/DENITE ZONE*											
MIX-30.301	SELECTOR BASIN CHANNEL 3, MIXER 1	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20B	N	Indoor
MIX-30.302	SELECTOR BASIN CHANNEL 3, MIXER 2	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20B	N	Indoor
MIX-30.303	SELECTOR BASIN CHANNEL 3, MIXER 3	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20B	N	Indoor
MIX-30.304	SELECTOR BASIN CHANNEL 3, MIXER 4	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20B	N	Indoor
MIX-30.051	DENITRIFICATION ZONE 1 MIXER	46_41_25	NEW	DUTY	CONSTANT SPEED	8.3	HP	480	3	MCC-20A	N	Indoor
General Comments:	*RAS/DENITE ZONE*											
MIX-30.101	SELECTOR BASIN CHANNEL 1, MIXER 1	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20A	N	Indoor
MIX-30.102	SELECTOR BASIN CHANNEL 1, MIXER 2	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20A	N	Indoor
MIX-30.103	SELECTOR BASIN CHANNEL 1, MIXER 3	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20A	N	Indoor
MIX-30.104	SELECTOR BASIN CHANNEL 1, MIXER 4	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20A	N	Indoor
MIX-30.201	SELECTOR BASIN CHANNEL 2, MIXER 1	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20A	N	Indoor
MIX-30.202	SELECTOR BASIN CHANNEL 2, MIXER 2	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20A	N	Indoor
MIX-30.203	SELECTOR BASIN CHANNEL 2, MIXER 3	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20A	N	Indoor
MIX-30.204	SELECTOR BASIN CHANNEL 2, MIXER 4	46_41_25	NEW	DUTY	CONSTANT SPEED	6.0	HP	480	3	MCC-20A	N	Indoor

35 | AERATION BASINS/AB SPLITTER BOX

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
EAM-35.105	AB1 - AIR FLOW CONTROL VALVE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-36-03	N	Indoor
EAM-35.205	AB2 - AIR FLOW CONTROL VALVE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-36-03	N	Indoor
EAM-35.305	AB3 - AIR FLOW CONTROL VALVE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-36-02	N	Indoor
EAM-35.405	AB4 - AIR FLOW CONTROL VALVE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-36-02	N	Indoor
MIX-35.111	AERATION BASIN 1, MIXER 1		NEW	DUTY	CONSTANT SPEED	3.5	HP	480	3	MCC-36A	N	Indoor
MIX-35.112	AERATION BASIN 1, MIXER 2		NEW	DUTY	CONSTANT SPEED	3.5	HP	480	3	MCC-36A	N	Indoor
MIX-35.211	AERATION BASIN 2, MIXER 1		NEW	DUTY	CONSTANT SPEED	3.5	HP	480	3	MCC-36A	N	Indoor
MIX-35.212	AERATION BASIN 2, MIXER 2		NEW	DUTY	CONSTANT SPEED	3.5	HP	480	3	MCC-36A	N	Indoor

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35 | AERATION BASINS/AB SPLITTER BOX

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
MIX-35.311	AERATION BASIN 3, MIXER 1		NEW	DUTY	CONSTANT SPEED	3.5	HP	480	3	MCC-36B	N	Indoor
General Comments:	*ETAP TAG PMP-36.05*											
MIX-35.312	AERATION BASIN 3, MIXER 2		NEW	DUTY	CONSTANT SPEED	3.5	HP	480	3	MCC-36B	N	Indoor
General Comments:	*ETAP TAG PMP-36.06*											
MIX-35.411	AERATION BASIN 4, MIXER 1		NEW	DUTY	CONSTANT SPEED	3.5	HP	480	3	MCC-36B	N	Indoor
General Comments:	*ETAP TAG PMP-36.07*											
MIX-35.412	AERATION BASIN 4, MIXER 2		NEW	DUTY	CONSTANT SPEED	3.5	HP	480	3	MCC-36B	N	Indoor

36 | AERATION BASINS BLOWER BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
	MONORAIL (BLOWER ROOM)		NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	PB-36-01	N	Indoor
ABB-MISC	MISC LOADS AT AERATION BLOWER BUILDING		NEW	DUTY		15.0	KVA	208	3	LP-36-01	Y	Indoor
ALP-96.381	EMERGENCY SHOWER/EWASH STATION INSTANTANEOUS WATER HEATER	22_42_01	NEW	STANDBY	CONSTANT SPEED	108.0	KW	480	3	PB-36-01	N	Indoor
BMS-36.900	AB BLOWER BUILDING BMS CONTROL PANEL		NEW	DUTY		20.0	AMP	120	1	LP-36-01	N	Indoor
EDR-36.112	AB BLOWER 1 DISCHARGE VALVE	40_05_64	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-36-03	Y	Indoor
EDR-36.122	AB BLOWER 2 DISCHARGE VALVE	40_05_64	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-36-03	Y	Indoor
EDR-36.132	AB BLOWER 3 DISCHARGE VALVE	40_05_64	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-36-02	Y	Indoor
EDR-36.142	AB BLOWER 4 DISCHARGE VALVE	40_05_64	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-36-02	Y	Indoor
EDR-36.152	AB BLOWER 5 DISCHARGE VALVE	40_05_64	FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-36-03	Y	Indoor
EDR-36.195	AERATION MAIN HEADER BLOW OFF VALVE	40_05_64	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-36-01	N	Indoor
FV-36.115	AB BLOWER 1 BLOW-OFF VALVE	40_05_64	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-36-03	N	Indoor
FV-36.125	AB BLOWER 2 BLOW-OFF VALVE	40_05_64	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-36-03	N	Indoor
FV-36.135	AB BLOWER 3 BLOW-OFF VALVE	40_05_64	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-36-02	N	Indoor
FV-36.145	AB BLOWER 4 BLOW-OFF VALVE	40_05_64	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-36-02	N	Indoor
FV-36.155	AB BLOWER 5 BLOW-OFF VALVE	40_05_64	FUTURE	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-36-03	N	Indoor
GUH-36.951	BLOWER ROOM GAS INFRA-RED TUBE HEATER	23_83_01	NEW	DUTY		5.5	AMP	120	1	LP-36-01	N	Indoor
GUH-36.952	BLOWER ROOM GAS INFRA-RED TUBE HEATER	23_83_01	NEW	DUTY		5.5	AMP	120	1	LP-36-01	N	Indoor
HP-36.941	ABBB HEAT PUMP 1		NEW	DUTY		26.5	AMP	480	3	PB-36-01	N	Indoor
HP-36.942	ABBB HEAT PUMP 2		NEW	STANDBY		26.5	AMP	480	3	PB-36-01	N	Indoor
PPU-36.973	SWITCHGEAR ROOM POSITIVE PRESSURIZATION UNIT	23_41_51	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	PB-36-01	N	Indoor
TPV-36.001	ELECTRONIC TRAP PRIMER ASSEMBLY	22_42_01	NEW	DUTY	CONSTANT SPEED	0.3	AMP	120	1	LP-36-01	N	Indoor
VCP-36.960	WATER PUMPS (2) FOR HEAT PUMPS	23_21_23	NEW	DUTY		7.4	AMP	480	3	PB-36-01	N	Indoor
BLO-36.150	AB BLOWER 5	43_11_15	FUTURE	DUTY	VARIABLE SPEED	300.0	HP	480	3	SWG-36A	N	Indoor
PPU-36.972	ELECT ROOM POSITIVE PRESSURIZATION UNIT	23_41_51	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	PB-36-01	N	Indoor
PPU-36.971	CNTRL ROOM POSITIVE PRESSURIZATION UNIT	23_41_51	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	PB-36-01	N	Indoor

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36 | AERATION BASINS BLOWER BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
BLO-36.110	AB BLOWER 1	43_11_15	NEW	STANDBY	VARIABLE SPEED	200.0	HP	480	3	SWG-36A	N	Indoor
BLO-36.120	AB BLOWER 2	43_11_15	NEW	DUTY	VARIABLE SPEED	300.0	HP	480	3	SWG-36A	N	Indoor
BLO-36.130	AB BLOWER 3	43_11_15	NEW	DUTY	VARIABLE SPEED	300.0	HP	480	3	SWG-36B	N	Indoor
BLO-36.140	AB BLOWER 4	43_11_15	NEW	DUTY	VARIABLE SPEED	300.0	HP	480	3	SWG-36B	N	Indoor
	ROLLUP DOOR 36 (SOUTH)		NEW	STANDBY	CONSTANT SPEED	0.8	HP	480	3	PB-36-01	N	Indoor
General Comments:	*ETAP TAG RUD-81.01*											
EF-36.921	BLOWER BLDG EXHAUST FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.8	HP	480	3	MCC-36A	N	Indoor
General Comments:	*BLOWER ROOM ROOF-MOUNTED EXHAUST FAN*											
SF-36.931	BLOWER BLDG SUPPLY FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-36A	N	Indoor
General Comments:	*BLOWER ROOM INLINE SUPPLY FAN*											
MTS-36-01	MANUAL TRANSFER SWITCH		NEW	STANDBY	CONSTANT SPEED	225.0	AMP	480	3	MCC-36B	N	

40 | SECONDARY CLARIFIERS/CLARIFIERS SPLITTER BOX

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
SC-40.110	SECONDARY CLARIFIER 1 DRIVE		EXISTING	DUTY	CONSTANT SPEED	1.5	HP	480	3	MCC-45A	N	Outdoor
PMP-40.116	SC 1&2 SCUM PIT PUMP 1	43_25_13.32	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-45A	N	Outdoor
PMP-40.117	SC 1&2 SCUM PIT PUMP 2	43_25_13.32	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-45A	N	Outdoor
SC-40.120	SECONDARY CLARIFIER 2 DRIVE		EXISTING	DUTY	CONSTANT SPEED	1.5	HP	480	3	MCC-45A	N	Outdoor
SC-40.130	SECONDARY CLARIFIER 3 DRIVE		EXISTING	DUTY	CONSTANT SPEED	1.5	HP	480	3	MCC-45A	N	Outdoor
PMP-40.136	SC 3&4 SCUM PIT PUMP 1	43_25_13.32	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-45A	N	Outdoor
PMP-40.137	SC 3&4 SCUM PIT PUMP 2	43_25_13.32	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-45A	N	Outdoor
SC-40.140	SECONDARY CLARIFIER 4 DRIVE		EXISTING	DUTY	CONSTANT SPEED	1.5	HP	480	3	MCC-45A	N	Outdoor
SC-40.150	SECONDARY CLARIFIER 5 DRIVE	46_43_24	FUTURE	DUTY	CONSTANT SPEED	1.5	HP	480	3	MCC-45B	N	Outdoor
PMP-40.156	SC 5&6 SCUM PIT PUMP 1	43_25_13.32	FUTURE	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-45B	N	Outdoor
PMP-40.157	SC 5&6 SCUM PIT PUMP 2	43_25_13.32	FUTURE	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-45B	N	Outdoor
SC-40.160	SECONDARY CLARIFIER 6 DRIVE	46_43_24	FUTURE	DUTY	CONSTANT SPEED	1.5	HP	480	3	MCC-45B	N	Outdoor
SC-40.170	SECONDARY CLARIFIER 7 DRIVE	46_43_24	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	MCC-45B	N	Outdoor
PMP-40.176	SC 7&8 SCUM PIT PUMP 1	43_25_13.32	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-45B	N	Outdoor
PMP-40.177	SC 7&8 SCUM PIT PUMP 2	43_25_13.32	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-45B	N	Outdoor
SC-40.180	SECONDARY CLARIFIER 8 DRIVE	46_43_24	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	MCC-45B	N	Outdoor

45 | RECYCLE PUMP STATION

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
	RECYCLE PS BRIDGE CRANE TROLLEY	41_22_16	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-01	N	Outdoor
BMS-45.900	RPS BMS CONTROL PANEL		NEW	DUTY		20.0	AMP	120	1	LP-45-01	N	Outdoor

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45 | RECYCLE PUMP STATION

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
EDR-45.110	MLR PUMP 1 SUCTION PLUG VALVE	40_05_62	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.114	MLR PUMP 1 DISCHARGE PLUG VALVE	40_05_62	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.120	MLR PUMP 2 SUCTION PLUG VALVE	40_05_62	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
EDR-45.124	MLR PUMP 2 DISCHARGE PLUG VALVE	40_05_62	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
EDR-45.130	MLR PUMP 3 SUCTION PLUG VALVE	40_05_62	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.134	MLR PUMP 3 DISCHARGE PLUG VALVE	40_05_62	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.140	MLR PUMP 4 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
EDR-45.144	MLR PUMP 4 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
EDR-45.150	MLR PUMP 5 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.154	MLR PUMP 5 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.201	SC NO. 1 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.202	SC NO. 2 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.203	SC NO. 3 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.204	SC NO. 4 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.205	SC NO. 5 PLUG VALVE	40_05_62	FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
EDR-45.206	SC NO. 6 PLUG VALVE	40_05_62	FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
EDR-45.207	SC NO. 7 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
EDR-45.208	SC NO. 8 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
EDR-45.210	RAS PUMP 1 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.214	RAS PUMP 1 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.215	RAS PUMP 2 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.219	RAS PUMP 2 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.220	RAS PUMP 3 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.224	RAS PUMP 3 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.225	RAS SUCTION HEADER PUMPS 1-2 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.226	RAS SUCTION HEADER PUMPS 2-3 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.227	RAS SUCTION HEADER PUMPS 3-4 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.228	RAS SUCTION HEADER PUMPS 4-5 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.229	RAS SUCTION HEADER PUMPS 5-6 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.230	RAS PUMP 4 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.234	RAS PUMP 4 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.235	RAS PUMP 5 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.239	RAS PUMP 5 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.240	RAS PUMP 6 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor
EDR-45.244	RAS PUMP 6 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-05	N	Outdoor

APPENDIX F: Area Tags & Equipment Codes
EXAMPLE OF TAGGING SCHEME: THESE ARE NOT THE LOADS FROM YOUR PLANT

EQUIPMENT LIST REPORT

PROJECT INFORMATION

PROJECT [redacted]

CLIENT

PROJECT NUMBER

REPORT BY ANDREW REX

REPORT DATE 5/24/2017 6:30 PM

45 | RECYCLE PUMP STATION

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
EDR-45.250	RAS PUMP 7 SUCTION PLUG VALVE	40_05_62	FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
EDR-45.254	RAS PUMP 7 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
EDR-45.255	RAS PUMP 8 SUCTION PLUG VALVE	40_05_62	FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.259	RAS PUMP 8 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.260	RAS PUMP 9 SUCTION PLUG VALVE	40_05_62	FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.264	RAS PUMP 9 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.265	RAS SUCTION HEADER PUMPS 7-8 PLUG VALVE	40_05_62	FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.266	RAS SUCTION HEADER PUMPS 8-9 PLUG VALVE	40_05_62	FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.267	RAS SUCTION HEADER PUMPS 9-10 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.268	RAS SUCTION HEADER PUMPS 10-11 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.269	RAS SUCTION HEADER PUMPS 11-12 PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.270	RAS PUMP 10 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.274	RAS PUMP 10 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.275	RAS PUMP 11 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.279	RAS PUMP 11 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.280	RAS PUMP 12 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.284	RAS PUMP 12 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-04	N	Outdoor
EDR-45.300	WAS PUMP BYPASS VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-01	N	Outdoor
EDR-45.301	WAS SUCTION HEADER ISOLATION VALVE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-45-01	N	Outdoor
EDR-45.303	WAS DISCHARGE MM ISO VALVE 1	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-01	N	Outdoor
EDR-45.307	WAS DISCHARGE MM ISO VALVE 2	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-01	N	Outdoor
EDR-45.310	WAS PUMP 1 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.314	WAS PUMP 1 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-03	N	Outdoor
EDR-45.320	WAS PUMP 2 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
EDR-45.324	WAS PUMP 2 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
EDR-45.330	WAS PUMP 3 SUCTION PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
EDR-45.334	WAS PUMP 3 DISCHARGE PLUG VALVE	40_05_62	NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-45-02	N	Outdoor
HP-45.941	RPS HEAT PUMP 1		NEW	DUTY		39.9	AMP	480	3	PB-45-01	N	Outdoor
TPV-45.001	ELECTRONIC TRAP PRIMER ASSEMBLY	22_42_01	NEW	DUTY	CONSTANT SPEED	0.3	AMP	120	1	LP-45-01	N	Outdoor
PPU-45.971	ELECT ROOM POSITIVE PRESSURIZATION UNIT	23_41_51	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	PB-45-01	N	Outdoor
PMP-45.111	MLR PUMP 1	43_23_31.30	NEW	DUTY	VARIABLE SPEED	100.0	HP	480	3	SWG-45A	N	Outdoor
PMP-45.121	MLR PUMP 2	43_23_31.30	NEW	DUTY	VARIABLE SPEED	100.0	HP	480	3	SWG-45B	N	Outdoor
MTS-45-01	MANUAL TRANSFER SWITCH		NEW	STANDBY	CONSTANT SPEED	225.0	AMP	480	3	MCC-45B	N	Outdoor
VCP-45.960	WATER PUMPS (2) FOR HEAT PUMPS	23_21_23	NEW	DUTY	VARIABLE SPEED	7.4	AMP	480	3	PB-45-01	N	Outdoor
PMP-45.131	MLR PUMP 3	43_23_31.30	NEW	DUTY	VARIABLE SPEED	100.0	HP	480	3	SWG-45A	N	Outdoor

EQUIPMENT LIST REPORT

PROJECT INFORMATION

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PROJECT NUMBER
REPORT BY ANDREW REX
REPORT DATE 5/24/2017 6:30 PM

45 | RECYCLE PUMP STATION

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
PMP-45.141	MLR PUMP 4	43_23_31.30	NEW	DUTY	VARIABLE SPEED	100.0	HP	480	3	SWG-45B	N	Outdoor
PMP-45.151	MLR PUMP 5	43_23_31.30	FUTURE	DUTY	VARIABLE SPEED	100.0	HP	480	3	SWG-45B	N	Outdoor
HP-45.942	RPS HEAT PUMP 2		NEW	STANDBY		39.9	AMP	480	3	PB-45-01	N	Outdoor
	RECYCLE PS BRIDGE MOTOR 2		NEW	STANDBY	CONSTANT SPEED	0.8	HP	480	3	PB-45-01	N	Outdoor
	RECYCLE PS BRIDGE CRANE HOIST		NEW	DUTY	CONSTANT SPEED	7.5	HP	480	3	PB-45-01	N	Outdoor
PPU-45.972	CNTRL ROOM POSITIVE PRESSURIZATION UNIT	23_41_51	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	PB-45-01	N	Outdoor
EF-45.921	RPS EXHAUST FAN 1	23_34_01	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-45A	N	Outdoor
General Comments:	*6,000 CFM SIDEWALL MOUNTED FAN*											
EF-45.923	RPS EXHAUST FAN 3	23_34_01	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-45A	N	Outdoor
General Comments:	*6,000 CFM SIDEWALL MOUNTED FAN*											
MAU-45.911	RPS MAKEUP AIR UNIT	23_83_05	NEW	DUTY	CONSTANT SPEED	15.0	HP	480	3	MCC-45A	N	Outdoor
	ROLLUP DOOR 45 (EAST)		NEW	STANDBY	CONSTANT SPEED	0.8	HP	480	3	PB-45-01	N	Outdoor
General Comments:	*ETAP TAG RUD-81.01*											
PMP-45.211	RAS PUMP 1	43_23_31.30	NEW	DUTY	VARIABLE SPEED	15.0	HP	480	3	MCC-45A	N	Outdoor
PMP-45.216	RAS PUMP 2	43_23_31.30	NEW	STANDBY	VARIABLE SPEED	15.0	HP	480	3	MCC-45A	N	Outdoor
PMP-45.331	WAS PUMP 3	43_23_57.10	FUTURE	DUTY	VARIABLE SPEED	25.0	HP	480	3	MCC-45B	N	Outdoor
PMP-45.221	RAS PUMP 3	43_23_31.30	NEW	DUTY	VARIABLE SPEED	15.0	HP	480	3	MCC-45A	N	Outdoor
PMP-45.321	WAS PUMP 2	43_23_57.10	NEW	DUTY	VARIABLE SPEED	25.0	HP	480	3	MCC-45B	N	Outdoor
PMP-45.251	RAS PUMP 7	43_23_31.30	FUTURE	DUTY	VARIABLE SPEED	20.0	HP	480	3	MCC-45B	N	Outdoor
PMP-45.256	RAS PUMP 8	43_23_31.30	FUTURE	STANDBY	VARIABLE SPEED	20.0	HP	480	3	MCC-45B	N	Outdoor
PMP-45.261	RAS PUMP 9	43_23_31.30	FUTURE	DUTY	VARIABLE SPEED	20.0	HP	480	3	MCC-45B	N	Outdoor
PMP-45.271	RAS PUMP 10	43_23_31.30	NEW	DUTY	VARIABLE SPEED	20.0	HP	480	3	MCC-45B	N	Outdoor
PMP-45.276	RAS PUMP 11	43_23_31.30	NEW	STANDBY	VARIABLE SPEED	20.0	HP	480	3	MCC-45B	N	Outdoor
PMP-45.281	RAS PUMP 12	43_23_31.30	NEW	DUTY	VARIABLE SPEED	20.0	HP	480	3	MCC-45B	N	Outdoor
PMP-45.231	RAS PUMP 4	43_23_31.30	NEW	DUTY	VARIABLE SPEED	15.0	HP	480	3	MCC-45A	N	Outdoor
PMP-45.241	RAS PUMP 6	43_23_31.30	NEW	DUTY	VARIABLE SPEED	15.0	HP	480	3	MCC-45A	N	Outdoor
PMP-45.236	RAS PUMP 5	43_23_31.30	NEW	STANDBY	VARIABLE SPEED	15.0	HP	480	3	MCC-45A	N	Outdoor
PMP-45.311	WAS PUMP 1	43_23_57.10	NEW	DUTY	VARIABLE SPEED	25.0	HP	480	3	MCC-45A	N	Outdoor
EF-45.922	RPS EXHAUST FAN 2	23_34_01	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-45B	N	Outdoor
General Comments:	*6,000 CFM SIDEWALL MOUNTED FAN*											
EF-45.924	RPS EXHAUST FAN 4	23_34_01	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-45B	N	Outdoor
General Comments:	*6,000 CFM SIDEWALL MOUNTED FAN*											

55 | FILTERS

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
	EFFLUENT AERATION BLOWER 1		DEMO	DUTY	CONSTANT SPEED	15.0	HP	480	3	MCC-3A	N	Outdoor

Date/Time displayed in this report reflect time in PST

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TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
	EFFLUENT AERATION BLOWER 2		DEMO	DUTY	CONSTANT SPEED	15.0	HP	480	3	MCC-3B	N	Outdoor
EDR-55.110	FILTER NO. 1 INLET VALVE		EXISTING	DUTY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.100	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.111	FILTER NO. 1 BACKWASH WASTE VALVE		EXISTING	DUTY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.100	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.112	FILTER NO. 1 AIR WASH SUPPLY VALVE		EXISTING	DUTY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.100	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.120	FILTER NO. 2 INLET VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.100	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.121	FILTER NO. 2 BACKWASH WASTE VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.100	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.122	FILTER NO. 2 AIR WASH SUPPLY VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.100	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.130	FILTER NO. 3 INLET VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.100	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.131	FILTER NO. 3 BACKWASH WASTE VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.100	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.132	FILTER NO. 3 AIR WASH SUPPLY VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.100	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.140	FILTER NO. 4 INLET VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.100	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.141	FILTER NO. 4 BACKWASH WASTE VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.100	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.142	FILTER NO. 4 AIR WASH SUPPLY VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.100	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.210	FILTER NO. 5 INLET VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.200	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.211	FILTER NO. 5 BACKWASH WASTE VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.200	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.212	FILTER NO. 5 AIR WASH SUPPLY VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.200	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.220	FILTER NO. 6 INLET VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.200	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.221	FILTER NO. 6 BACKWASH WASTE VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.200	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.222	FILTER NO. 6 AIR WASH SUPPLY VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.200	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.230	FILTER NO. 7 INLET VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.200	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											

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PROJECT INFORMATION

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55 | FILTERS

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
EDR-55.231	FILTER NO. 7 BACKWASH WASTE VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.200	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.232	FILTER NO. 7 AIR WASH SUPPLY VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.200	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.240	FILTER NO. 8 INLET VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.200	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.241	FILTER NO. 8 BACKWASH WASTE VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.200	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
EDR-55.242	FILTER NO. 8 AIR WASH SUPPLY VALVE		EXISTING	STANDBY	CONSTANT SPEED	1.0	HP	120	1	VCP-55.200	N	Outdoor
General Comments:	*BUTTERFLY VALVE*											
BLO-55.413	FILTER AIRWASH BLOWER 1		NEW	DUTY	CONSTANT SPEED	50.0	HP	480	3	MCC-60A	N	Outdoor
General Comments:	*ETAP TAG BLO-60.01*											
PMP-55.520	AUXILIARY BACKWASH PUMP 2		FUTURE	DUTY	CONSTANT SPEED	20.0	HP	480	3	MCC-60B	N	Indoor
General Comments:	*ETAP TAG PMP-60-06*											
PMP-55.510	AUXILIARY BACKWASH PUMP 1		EXISTING	DUTY	CONSTANT SPEED	20.0	HP	480	3	MCC-60A	N	Outdoor
General Comments:	*ETAP TAG PMP-60.01*											
EDR-55.052	F SPLITTER MOTORIZED GATE 2		FUTURE	DUTY	CONSTANT SPEED	0.5	HP	480	3	PB-60-02	N	Outdoor
General Comments:	*ETAP TAG GAT-60.02*											
BLO-55.423	FILTER AIRWASH BLOWER 2		FUTURE	DUTY	CONSTANT SPEED	50.0	HP	480	3	MCC-60B	N	Outdoor
General Comments:	*ETAP TAG BLO-60.2*											
EDR-55.051	F SPLITTER MOTORIZED GATE 1		FUTURE	DUTY	CONSTANT SPEED	0.5	HP	480	3	PB-60-03	N	Outdoor
General Comments:	*ETAP TAG GAT-60.01*											

60 | DISINFECTION BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
BMS-60.900	DISINFECTION BLDG BMS CONTROL PANEL		NEW	DUTY		20.0	AMP	120	1	LP-60-01	N	Indoor
COS-60.010	AUTOMATIC SAMPLER	11_53_02	NEW	DUTY		0.5	HP	120	0	LP-60-01	N	Indoor
EDR-60.090	FILTER AUXILLIARY BACKWASH INLET GATE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-60-01	N	Indoor
EDR-60.110	UV CHANNEL 1 INFLUENT GATE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-60-03	N	Indoor
EDR-60.134	UV CHANNEL 1 EFFLUENT GATE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-60-03	N	Indoor
EDR-60.210	UV CHANNEL 2 INFLUENT GATE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-60-02	N	Indoor
EDR-60.234	UV CHANNEL 2 EFFLUENT GATE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-60-02	N	Indoor
EDR-60.310	PLANT WATER PUMP STATION INLET GATE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-60-01	N	Indoor
EDR-60.324	3W PUMP 1 DISCHARGE VALVE		NEW	DUTY		1.0	HP	480	0	PB-60-03	N	Indoor
EDR-60.334	3W PUMP 2 DISCHARGE VALVE		NEW	DUTY		1.0	HP	480	0	PB-60-02	N	Indoor
GUH-60-951	3W ROOM GAS INFRA-RED TUBE HEATER		NEW	DUTY		5.5	AMP	120	1	LP-60-01	N	Indoor
GUH-60-952	BLOWER ROOM GAS INFRA-RED TUBE HEATER		NEW	DUTY		5.5	AMP	120	1	LP-60-01	N	Indoor

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60 | DISINFECTION BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
TPV-60.001	ELECTRONIC TRAP PRIMER ASSEMBLY	22_42_01	NEW	DUTY	CONSTANT SPEED	0.3	AMP	120	1	LP-60-01	N	Indoor
SF-60.932	3W ROOM SUPPLY FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.3	HP	480	3	MCC-60B	N	Indoor
General Comments:	*1,500 CFM ROOF MOUNTED SUPPLY FAN*											
HP-60.942	DISINFECTION HEAT PUMP 2		NEW	STANDBY		30.9	AMP	480	3	PB-60-01	N	Indoor
HP-60.941	DISINFECTION HEAT PUMP 1		NEW	DUTY		30.9	AMP	480	3	PB-60-01	N	Indoor
PMP-60.330	3W PUMP 2	43_24_50.10	NEW	DUTY	VARIABLE SPEED	40.0	HP	480	3	MCC-60B	N	Indoor
General Comments:	*ETAP TAG NPW-60.02*											
PMP-60.320	3W PUMP 1	43_24_50.10	NEW	DUTY	VARIABLE SPEED	40.0	HP	480	3	MCC-60A	N	Indoor
General Comments:	*ETAP TAG NPW-60.01*											
EF-60.922	3W ROOM EXHAUST FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.3	HP	120	1	LP-60-01	N	Indoor
General Comments:	*1,500 CFM ROOF MOUNTED SUPPLY FAN*											
PPU-60.971	ELECT & CNTRL ROOM POSITIVE PRESSURIZATION UNIT	23_41_51	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	PB-60-01	N	Indoor
VCP-60-960	WATER PUMPS (2) FOR HEAT PUMPS	23_21_23	NEW	DUTY	VARIABLE SPEED	7.4	AMP	480	3	PB-60-01	N	Indoor
UVR-60.211	UV CHANNEL 2, REACTOR 1	43_32_64	NEW	DUTY		37.5	AMP	480	3	MCC-60B	Y	Indoor
General Comments:	*ETAP TAG UV PDC-60.03*											
UVR-60.221	UV CHANNEL 2, REACTOR 2	43_32_64	NEW	DUTY		37.5	AMP	480	3	MCC-60B	Y	Indoor
General Comments:	*ETAP TAG UV PDC-60.04*											
EF-60.921	BLOWER ROOM EXHAUST FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.8	HP	480	3	MCC-60A	N	Indoor
General Comments:	*2,500 CFM ROOF MOUNTED EXHAUST FAN*											
MTS-60-01	MANUAL TRANSFER SWITCH		NEW	STANDBY	CONSTANT SPEED	225.0	AMP	480	3	MCC-60B	N	Indoor
SF-60.931	BLOWER ROOM SUPPLY FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.8	HP	480	3	MCC-60A	N	Indoor
General Comments:	*2,500 CFM ROOF MOUNTED SUPPLY FAN*											
UVR-60.111	UV CHANNEL 1 REACTOR 1	43_32_64	NEW	DUTY		37.5	AMP	480	3	MCC-60A	Y	Indoor
General Comments:	*ETAP TAG UV PDC-60.01*											
UVR-60.121	UV CHANNEL 1, REACTOR 2	43_32_64	NEW	DUTY		37.5	AMP	480	3	MCC-60A	Y	Indoor
General Comments:	*ETAP TAG UV PDC-60.02*											

61 | POST AERATION BASIN AND EFFLUENT PUMPING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
EDM-61.311	BLOWER 1 AMBIENT AIR SUCTION VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-60-03	N	Indoor
EDM-61.321	BLOWER 2 AMBIENT AIR SUCTION VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-60-02	N	Indoor
EDR-61.110	PAB 1 GATE 1		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-60-03	N	Indoor
EDR-61.111	PAB 1 GATE 2		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-60-03	N	Indoor
EDR-61.113	PAB 1 DIFFUSER VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-60-03	N	Indoor
EDR-61.210	PAB 2 GATE 1		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-60-02	N	Indoor
EDR-61.211	PAB 2 GATE 2		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-60-02	N	Indoor
EDR-61.213	PAB 2 DIFFUSER VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-60-02	N	Indoor

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61 | POST AERATION BASIN AND EFFLUENT PUMPING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
EDR-61.318	BLOWER 1 DISCHARGE VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-60-03	N	Indoor
EDR-61.328	BLOWER 2 DISCHARGE VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-60-02	N	Indoor
EDR-61.460	EFFLUENT WET WELL GATE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-60-01	N	Indoor
BLO-61.323	POST AERATION BLOWER 2	43_11_19	NEW	DUTY	CONSTANT SPEED	40.0	HP	480	3	MCC-60B	N	Indoor
BLO-61.313	POST AERATION BLOWER 1	43_11_19	NEW	DUTY	CONSTANT SPEED	40.0	HP	480	3	MCC-60A	N	Indoor
General Comments:	*ETAP TAG BLO-60.110*											
PMP-61.430	EFFLUENT PUMP STATION PUMP NO. 2	43_24_50.10	NEW	DUTY	VARIABLE SPEED	75.0	HP	480	3	MCC-60B	N	Indoor
General Comments:	*ETAP TAG EPMP-60-02*											
PMP-61.420	EFFLUENT PUMP STATION PUMP NO. 1	43_24_50.10	NEW	DUTY	VARIABLE SPEED	75.0	HP	480	3	MCC-60A	N	Indoor
General Comments:	*ETAP TAG EPMP-60.01*											
PMP-61.450	EFFLUENT PUMP STATION PUMP NO. 4	43_24_50.10	FUTURE	DUTY	VARIABLE SPEED	75.0	HP	480	3	MCC-60B	N	Indoor
General Comments:	*ETAP TAG EPMP-60-04*											
PMP-61.440	EFFLUENT PUMP STATION PUMP NO. 3	43_24_50.10	NEW	DUTY	VARIABLE SPEED	75.0	HP	480	3	MCC-60A	N	Indoor
General Comments:	*ETAP TAG EPMP-60.03*											

80 | DIGESTERS

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
EAM-80.112	AD 1A - AIRFLOW CONTROL VALVE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-82-03	N	Indoor
EAM-80.162	AD 1B - AIRFLOW CONTROL VALVE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-82-03	N	Indoor
EAM-80.212	AD 2A - AIRFLOW CONTROL VALVE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-82-02	N	Indoor
EAM-80.262	AD 2B - AIRFLOW CONTROL VALVE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-82-02	N	Indoor
EAM-80.312	AD 3A - AIRFLOW CONTROL VALVE		FUTURE	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-82-03	N	Indoor
EAM-80.362	AD 3B - AIRFLOW CONTROL VALVE		FUTURE	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-82-03	N	Indoor
MIX-80.100	AD 1A - HYPERBOLOID MIXER	46_41_10	NEW	DUTY	CONSTANT SPEED	40.0	HP	480	3	MCC-82A	N	Indoor
General Comments:	*ETAP TAG MIX-82.101*											
MIX-80.150	AD 1B - HYPERBOLOID MIXER	46_41_10	NEW	DUTY	CONSTANT SPEED	40.0	HP	480	3	MCC-82A	N	Indoor
General Comments:	*ETAP TAG MIX-82.201*											
MIX-80.350	AD 3B - HYPERBOLOID MIXER	46_41_10	FUTURE	DUTY	CONSTANT SPEED	40.0	HP	480	3	MCC-82B	N	Indoor
General Comments:	*ETAP TAG MIX-82.203*											
MIX-80.300	AD 3A - HYPERBOLOID MIXER	46_41_10	FUTURE	DUTY	CONSTANT SPEED	40.0	HP	480	3	MCC-82B	N	Indoor
General Comments:	*FUTURE*											
MIX-80.250	AD 2B - HYPERBOLOID MIXER	46_41_10	NEW	DUTY	CONSTANT SPEED	40.0	HP	480	3	MCC-82B	N	Indoor
MIX-80.200	AD 2A - HYPERBOLOID MIXER	46_41_10	NEW	DUTY	CONSTANT SPEED	40.0	HP	480	3	MCC-82B	N	Indoor

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81 | DIGESTER THICKENING BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
	MONORAIL (BLOWER ROOM)		NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	PB-81-01	N	Indoor
	MONORAIL (MEMBRANE THICKENING ROOM)		NEW	STANDBY	CONSTANT SPEED	7.5	HP	480	3	PB-81-01	N	Indoor
	MONORAIL (PUMP ROOM)		NEW	STANDBY	CONSTANT SPEED	5.0	HP	480	3	PB-81-01	N	Indoor
BMS-81.900	DIGESTER THICKENING BLDG BMS CONTROL PANEL		NEW	DUTY		20.0	AMP	120	1	LP-81-01	N	Indoor
EDR-81.104	MBT 1 MM ISO VALVE 1		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.106	MBT 1 MM ISO VALVE 2		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.111	MEMBRANE TANK 1 EFFLUENT		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-81-02	N	Indoor
EDR-81.125	MBT 1 DISCHARGE AIR VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-02	N	Indoor
EDR-81.134	MBT 2 MM ISO VALVE 1		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.136	MBT 2 MM ISO VALVE 2		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.141	MEMBRANE TANK 2 EFFLUENT		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.155	MBT 2 DISCHARGE AIR VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-02	N	Indoor
EDR-81.164	MBT 3 MM ISO VALVE 1		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.166	MBT 3 MM ISO VALVE 2		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.171	MEMBRANE TANK 3 EFFLUENT		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-02	N	Indoor
EDR-81.185	MBT 3 DISCHARGE AIR VALVE		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-02	N	Indoor
EDR-81.302	WAS SCREEN 1 SUCTION VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-02	N	Indoor
EDR-81.306	WAS SCREEN 1 DISCHARGE VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-02	N	Indoor
EDR-81.322	WAS SCREEN 2 SUCTION VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.326	WAS SCREEN 2 DISCHARGE VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.351	WAS SCREENS MM ISO VALVE 1		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.352	WAS SCREENS MM ISO VALVE 2		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.361	DIGESTER 1 INFLUENT CONTROL VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-02	N	Indoor
EDR-81.362	DIGESTER 2 INFLUENT CONTROL VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.363	DIGESTER 3 INFLUENT CONTROL VALVE		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-02	N	Indoor
EDR-81.419	MEMBRANE AIR SCOUR BLOWER 1 DISCHARGE VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.429	MEMBRANE AIR SCOUR BLOWER 2 DISCHARGE VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.439	MEMBRANE AIR SCOUR BLOWER 3 DISCHARGE VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-02	N	Indoor
EDR-81.449	MEMBRANE AIR SCOUR BLOWER 4 DISCHARGE VALVE		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-02	N	Indoor
EDR-81.451	MEMBRANE AIR SCOUR DISCHARGE VALVE 1		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-02	N	Indoor
EDR-81.452	MEMBRANE AIR SCOUR DISCHARGE VALVE 2		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-03	N	Indoor
EDR-81.453	MEMBRANE AIR SCOUR DISCHARGE VALVE 3		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-81-02	N	Indoor
GUH-81.951	BLOWER ROOM GAS INFRA-RED HIGH INTENSITY HEATER	23_83_01	NEW	DUTY		5.5	AMP	120	1	LP-81-01	N	Indoor
GUH-81.952	BLOWER ROOM GAS INFRA-RED TUBE HEATER	23_83_01	NEW	DUTY		5.5	AMP	120	1	LP-81-01	N	Indoor
HP-81.941	MT BLDG HEAT PUMP 1		NEW	DUTY		15.3	AMP	480	3	PB-81-01	N	Indoor

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81 | DIGESTER THICKENING BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
HP-81.942	MT BLDG HEAT PUMP 2		NEW	STANDBY		15.3	AMP	480	3	PB-81-01	N	Indoor
PPU-81.971	ELECTRICAL ROOM PPU	23_41_51	NEW	DUTY	VARIABLE SPEED	1.5	HP	480	3	PB-81-01	N	Indoor
SF-81.931	STAIRWELL SUPPLY FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.5	HP	120	1	LP-81-01	N	Indoor
TPV-81.001	ELECTRONIC TRAP PRIMER ASSEMBLY	22_42_01	NEW	DUTY	CONSTANT SPEED	0.3	AMP	120	1	LP-81-01	N	Indoor
VCP-81.960	WATER PUMPS (2) FOR HEAT PUMPS	23_21_23	NEW	DUTY	VARIABLE SPEED	7.4	AMP	480	3	PB-81-01	N	Indoor
BLO-81.411	AIR SCOUR BLOWER 1		NEW	DUTY	VARIABLE SPEED	30.0	HP	480	3	MCC-81	N	Indoor
General Comments:	*ETAP TAG COMP-81-01*											
PMP-81.213	PERMEATE PUMP 1	43_23_57.10	NEW	DUTY	VARIABLE SPEED	5.0	HP	480	3	MCC-81	N	Indoor
BLO-81.421	AIR SCOUR BLOWER 2		NEW	DUTY	VARIABLE SPEED	30.0	HP	480	3	MCC-81	N	Indoor
PMP-81.223	PERMEATE PUMP 2	43_23_57.10	NEW	DUTY	VARIABLE SPEED	5.0	HP	480	3	MCC-81	N	Indoor
BLO-81.431	AIR SCOUR BLOWER 3		NEW	STANDBY	VARIABLE SPEED	30.0	HP	480	3	MCC-81	N	Indoor
PMP-81.233	PERMEATE PUMP 3	43_23_57.10	NEW	STANDBY	VARIABLE SPEED	5.0	HP	480	3	MCC-81	N	Indoor
General Comments:	*ETAP TAG PMP-81.03*											
BLO-81.441	AIR SCOUR BLOWER 4		FUTURE	DUTY	VARIABLE SPEED	30.0	HP	480	3	MCC-81	N	Indoor
PMP-81.243	PERMEATE PUMP 4	43_23_57.10	FUTURE	DUTY	VARIABLE SPEED	5.0	HP	480	3	MCC-81	N	Indoor
	ROLLUP DOOR (2ND FLOOR)		NEW	STANDBY	CONSTANT SPEED	5.0	HP	480	3	PB-81-01	N	Indoor
General Comments:	*ETAP TAG RUD-81.01*											
	ROLLUP DOOR 81 (EAST)		NEW	STANDBY	CONSTANT SPEED	0.8	HP	480	3	PB-81-01	N	Indoor
General Comments:	*ETAP TAG RUD-81.01*											
SCR-81.325	WAS SCREEN 2	46_21_90	NEW	STANDBY	CONSTANT SPEED	5.0	HP	480	3	MCC-81	N	Indoor
SCR-81.305	WAS SCREEN 1	46_21_90	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-81	N	Indoor
General Comments:	*PROVIDE 15A CIRCUIT TO VCP. ETAP TAG PMP-81.321*											
EF-81.921	BLOWER ROOM EXHAUST FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	3.0	HP	480	3	MCC-81	N	Indoor
EF-81.922	BLOWER ROOM EXHAUST FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	3.0	HP	480	3	MCC-81	N	Indoor
EF-81.923	SCREENING ROOM EXHAUST FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	MCC-81	N	Indoor
General Comments:	*ROOF MOUNTED UPBLAST EXHAUST FAN*											
MAU-81.911	THCKNG BLDG MAKEUP AIR UNIT	23_83_05	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-81	N	Indoor

82 | DIGESTER CONTROL BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
	BRIDGE CRANE		NEW	DUTY	CONSTANT SPEED	10.0	HP	480	3	PB-82-01	N	Indoor
BMS-82.900	DIGESTER PUMPING BLDG BMS CONTROL PANEL		NEW	DUTY		20.0	AMP	120	1	LP-82-01	N	Indoor
EDR-82.001	DIGESTER 1 EFFLUENT VALVE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-82-03	N	Indoor
EDR-82.003	DIGESTER 2 EFFLUENT VALVE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-82-02	N	Indoor
EDR-82.005	DIGESTER 3 EFFLUENT VALVE		FUTURE	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-82-03	N	Indoor
EDR-82.105	BFP FEED PUMP SUCTION HEADER ISO VALVE 1		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-82-03	N	Indoor

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82 | DIGESTER CONTROL BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
EDR-82.106	BFP FEED PUMP SUCTION HEADER ISO VALVE 2		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-03	N	Indoor
EDR-82.107	BFP FEED PUMP SUCTION HEADER ISO VALVE 3		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-02	N	Indoor
EDR-82.108	BFP FEED PUMP SUCTION HEADER ISO VALVE 4		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-02	N	Indoor
EDR-82.111	BFP FEED PUMP 1 SUCTION VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.115	BFP FEED PUMP 1 DISCHARGE VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.121	BFP FEED PUMP 2 SUCTION VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.125	BFP FEED PUMP 2 DISCHARGE VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.131	BFP FEED PUMP 3 SUCTION VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.135	BFP FEED PUMP 3 DISCHARGE VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.141	BFP FEED PUMP 4 SUCTION VALVE		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.145	BFP FEED PUMP 4 DISCHARGE VALVE		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.190	BFP FEED PUMP DISCHARGE HEADER ISO VALVE 1		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.192	BFP FEED PUMP DISCHARGE HEADER ISO VALVE 2		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.194	BFP FEED PUMP DISCHARGE HEADER ISO VALVE 3		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.196	BFP FEED PUMP DISCHARGE HEADER ISO VALVE 4		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.205	MBT FEED PUMP SUCTION HEADER ISO VALVE 1		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.206	MBT FEED PUMP SUCTION HEADER ISO VALVE 2		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.207	MBT FEED PUMP SUCTION HEADER ISO VALVE 3		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.208	MBT FEED PUMP SUCTION HEADER ISO VALVE 4		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.211	MBT FEED PUMP 1 SUCTION VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.215	MBT FEED PUMP 1 DISCHARGE VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.221	MBT FEED PUMP 2 SUCTION VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.225	MBT FEED PUMP 2 DISCHARGE VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.231	MBT FEED PUMP 3 SUCTION VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.235	MBT FEED PUMP 3 DISCHARGE VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.241	MBT FEED PUMP 4 SUCTION VALVE		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.245	MBT FEED PUMP 4 DISCHARGE VALVE		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.251	MBT TANK 1 ISO VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.252	MBT FEED PUMP DISCHARGE HEADER ISO VALVE 1		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.253	MBT TANK 2 ISO VALVE B		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.254	MBT TANK 2 ISO VALVE A		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-05	N	Indoor
EDR-82.255	MBT FEED PUMP DISCHARGE HEADER ISO VALVE 2		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
EDR-82.256	MBT TANK 3 ISO VALVE		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-04	N	Indoor
HP-82.943	DP BLDG HEAT PUMP 3		NEW	STANDBY		26.5	AMP	480	3	PB-82-01	N	Indoor
SF-82.931	STAIRWELL SUPPLY FAN	23_34_01	NEW	DUTY	CONSTANT SPEED	0.5	HP	120	1	LP-82-01	N	Indoor

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82 | DIGESTER CONTROL BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
TPV-82.001	ELECTRONIC TRAP PRIMER ASSEMBLY	22_42_01	NEW	DUTY	CONSTANT SPEED	0.3	AMP	120	1	LP-82-01	N	Indoor
VCP-82.960	WATER PUMPS (3) FOR HEAT PUMPS	23_21_23	NEW	DUTY	VARIABLE SPEED	15.2	AMP	480	3	PB-82-01	N	Indoor
HP-82.942	DP BLDG HEAT PUMP 2		NEW	DUTY		26.5	AMP	480	3	PB-82-01	N	Indoor
HP-82.941	DP BLDG HEAT PUMP 1		NEW	DUTY		26.5	AMP	480	3	PB-82-01	N	Indoor
PPU-82.972	CONTROL ROOM PPU	23_41_51	NEW	DUTY	VARIABLE SPEED	1.5	HP	480	3	PB-82-01	N	Indoor
PPU-82.971	ELECTRICAL ROOM PPU	23_41_51	NEW	DUTY	VARIABLE SPEED	1.5	HP	480	3	PB-82-01	N	Indoor
EF-82.922	PUMP ROOM EXHAUST FAN 2	23_34_01	NEW	DUTY	CONSTANT SPEED	0.8	HP	480	3	MCC-82B	N	Indoor
General Comments:	*CENTRIFUGAL ROOF-MOUNTED UPBLAST EXHAUST FAN*											
	ROLLUP DOOR 82 (EAST)		NEW	STANDBY	CONSTANT SPEED	0.8	HP	480	3	PB-82-01	N	Indoor
General Comments:	*ETAP TAG RUD-81.01*											
PMP-82.113	BFP FEED PUMP 1	43_23_57.10	NEW	DUTY	VARIABLE SPEED	30.0	HP	480	3	MCC-82A	N	Indoor
General Comments:	*ETAP TAG BFP-20.01*											
PMP-82.123	BFP FEED PUMP 2	43_23_57.10	NEW	DUTY	VARIABLE SPEED	30.0	HP	480	3	MCC-82A	N	Indoor
General Comments:	*ETAP TAG BFP-82.02*											
PMP-82.213	MBT FEED PUMP 1	43_23_57.10	NEW	DUTY	VARIABLE SPEED	25.0	HP	480	3	MCC-82A	N	Indoor
General Comments:	*ETAP TAG PMP-82.01*											
PMP-82.223	MBT FEED PUMP 2	43_23_57.10	NEW	DUTY	VARIABLE SPEED	25.0	HP	480	3	MCC-82A	N	Indoor
General Comments:	*ETAP TAG PMP-82.02*											
EF-82.921	PUMP ROOM EXHAUST FAN 1	23_34_01	NEW	DUTY	CONSTANT SPEED	0.8	HP	480	3	MCC-82A	N	Indoor
General Comments:	*CENTRIFUGAL ROOF-MOUNTED UPBLAST EXHAUST FAN*											
PMP-82.243	MBT FEED PUMP 4	43_23_57.10	FUTURE	DUTY	VARIABLE SPEED	25.0	HP	480	3	MCC-82B	N	Indoor
General Comments:	*ETAP TAG PMP-82.04*											
PMP-82.233	MBT FEED PUMP 3	43_23_57.10	NEW	STANDBY	VARIABLE SPEED	25.0	HP	480	3	MCC-82B	N	Indoor
General Comments:	*ETAP TAG PMP-82.03*											
PMP-82.143	BFP FEED PUMP 4	43_23_57.10	FUTURE	STANDBY	VARIABLE SPEED	30.0	HP	480	3	MCC-82B	N	Indoor
MAU-82.911	PUMP ROOM MAKEUP AIR UNIT	23_83_05	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	PB-82-01	N	Indoor
PMP-82.133	BFP FEED PUMP 3	43_23_57.10	NEW	STANDBY	VARIABLE SPEED	30.0	HP	480	3	MCC-82B	N	Indoor
General Comments:	*ETAP TAG BFP-20.03*											
MTS-82-01	MANUAL TRANSFER SWITCH		NEW	STANDBY	CONSTANT SPEED	225.0	AMP	480	3	MCC-82B	N	Indoor

83 | DIGESTER BLOWER BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
GUH-83.951	BLOWER ROOM GAS INFRA-RED TUBE HEATER	23_83_01	NEW	DUTY		5.5	AMP	120	1	LP-82-01	N	Indoor
GUH-83.952	BLOWER ROOM GAS INFRA-RED TUBE HEATER		NEW	DUTY		5.5	AMP	120	1	LP-82-01	N	Indoor
TPV-83.001	ELECTRONIC TRAP PRIMER ASSEMBLY	22_42_01	NEW	DUTY	CONSTANT SPEED	0.3	AMP	120	1	LP-82-01	N	Indoor
VCP-83.122	DIGESTER BLOWER NO. 2 VENDOR CONTROL PANEL		NEW	DUTY		10.0	AMP	480	3	MCC-82A	N	Indoor
VCP-83.142	DIGESTER BLOWER NO. 4 VENDOR CONTROL PANEL		FUTURE	STANDBY		10.0	AMP	480	3	MCC-82B	N	Indoor

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83 | DIGESTER BLOWER BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
BLO-83.131	DIGESTER BLOWER 3	43_11_38	NEW	DUTY	VARIABLE SPEED	300.0	HP	480	3	SWG-82B	N	Indoor
EDR-83.135	DIGESTER BLOWER NO. 3 DISCHARGE ISOLATION VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-02	Y	Indoor
BLO-83.111	DIGESTER BLOWER 1	43_11_38	NEW	DUTY	VARIABLE SPEED	300.0	HP	480	3	SWG-82A	N	Indoor
BLO-83.121	DIGESTER BLOWER 2	43_11_38	NEW	DUTY	VARIABLE SPEED	300.0	HP	480	3	SWG-82A	N	Indoor
BLO-83.141	DIGESTER BLOWER 4	43_11_38	FUTURE	STANDBY	VARIABLE SPEED	300.0	HP	480	3	SWG-82B	N	Indoor
EDR-83.125	DIGESTER BLOWER NO. 2 DISCHARGE ISOLATION VALVE		NEW	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-03	Y	Indoor
EDR-83.115	DIGESTER BLOWER NO. 1 DISCHARGE ISOLATION VALVE		NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	PB-82-03	Y	Indoor
EDR-83.145	DIGESTER BLOWER NO. 4 DISCHARGE ISOLATION VALVE		FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	PB-82-02	Y	Indoor
EF-83.922	BLOWER ROOM EXHAUST FAN 2	23_34_01	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-82B	Y	Indoor
General Comments:	*HOODED ROOF-MOUNTED EXHAUST FAN*											
EF-83.924	BLOWER ROOM EXHAUST FAN 4	23_34_01	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-82B	N	Indoor
	ROLLUP DOOR 83 (SOUTH)		NEW	STANDBY	CONSTANT SPEED	0.8	HP	480	3	PB-82-01	N	Indoor
General Comments:	*ETAP TAG RUD-81.01*											
SF-83.932	BLOWER ROOM SUPPLY FAN 2	23_34_01	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-82B	N	Indoor
General Comments:	*FILTERED LOUVERED ROOM SUPPLY FAN*											
SF-83.934	BLOWER ROOM SUPPLY FAN 4	23_34_01	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-82B	N	Indoor
General Comments:	*FILTERED LOUVERED ROOF SUPPLY FAN*											
VCP-83.112	DIGESTER BLOWER NO. 1 VENDOR CONTROL PANEL		NEW	DUTY		10.0	AMP	480	3	MCC-82A	N	Indoor
VCP-83.132	DIGESTER BLOWER NO. 3 VENDOR CONTROL PANEL		NEW	DUTY		10.0	AMP	480	3	MCC-82B	N	Indoor
EF-83.921	BLOWER ROOM EXHAUST FAN 1	23_34_01	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-82A	Y	Indoor
General Comments:	*HOODED ROOF-MOUNTED EXHAUST FAN*											
EF-83.923	BLOWER ROOM EXHAUST FAN 3	23_34_01	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	MCC-82A	Y	Indoor
General Comments:	*HOODED ROOF-MOUNTED EXHAUST FAN*											
SF-83.931	BLOWER ROOM SUPPLY FAN 1	23_34_01	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-82A	N	Indoor
SF-83.933	BLOWER ROOM SUPPLY FAN 3	23_34_01	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-82A	N	Indoor
General Comments:	*FILTERED LOUVERED ROOF SUPPLY FAN*											

85 | DEWATERING BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
ALP-85.323	EMERGENCY SHOWER/EYEWASH STATION INSTANTANEOUS HOT WATER HEATER	22_42_01	NEW	DUTY		108.0	KW	480	3	PB-85-02	N	Indoor
BMS-85.900	DEWATERING BLDG BMS CONTROL PANEL		NEW	DUTY		20.0	AMP	120	1	LP-85-02	N	Indoor
DW-MISC	LIGHTING AND MISC. AT DEWATERING BUILDING		NEW	DUTY		15.0	KVA	208	3	LP-85-02	Y	Indoor
EDR-85.117	BFP1 MM ISO VALVE 1		NEW	STANDBY		1.0	HP	480	3	PB-85-02	N	Indoor
EDR-85.119	BFP1 MM ISO VALVE 2		NEW	STANDBY		1.0	HP	480	3	PB-85-02	N	Indoor
EDR-85.127	BFP2 MM ISO VALVE 1		NEW	STANDBY		1.0	HP	480	3	PB-85-02	N	Indoor
EDR-85.129	BFP2 MM ISO VALVE 2		NEW	STANDBY		1.0	HP	480	3	PB-85-02	N	Indoor

APPENDIX F: Area Tags & Equipment Codes
EXAMPLE OF TAGGING SCHEME: THESE ARE NOT THE LOADS FROM YOUR PLANT

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85 | DEWATERING BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
EF-85.921	POLYMER ROOM EXHAUST FAN		NEW	DUTY	CONSTANT SPEED	0.5	HP	120	1	LP-85-01	N	Indoor
FAN-86.810	BIOSOLIDS PAD FAN		NEW	DUTY	VARIABLE SPEED	2.0	HP	480	3	PB-85-01	N	Indoor
FAN-86.820	BIOSOLIDS PAD FAN		NEW	DUTY	VARIABLE SPEED	2.0	HP	480	3	PB-85-01	N	Indoor
FAN-86.830	BIOSOLIDS PAD FAN		NEW	DUTY	VARIABLE SPEED	2.0	HP	480	3	PB-85-01	N	Indoor
GUH-85.951	POLYMER ROOM GAS UNIT HEATER	23_83_01	NEW	DUTY		1.9	AMP	120	1	LP-85-02	N	Indoor
GUH-85.952	POLYMER ROOM GAS UNIT HEATER	23_83_01	NEW	DUTY		1.9	AMP	120	1	LP-85-02	N	Indoor
PMP-85.361	POLYMER ROOM SUBMERSIBLE PUMP 1	43_25_00.10	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	PB-85-01	N	Indoor
PMP-85.362	POLYMER ROOM SUBMERSIBLE PUMP 2	43_25_00.10	NEW	DUTY	CONSTANT SPEED	2.0	HP	480	3	PB-85-01	N	Indoor
TPV-85.001	ELECTRONIC TRAP PRIMER ASSEMBLY	22_42_01	NEW	DUTY	CONSTANT SPEED	0.3	AMP	120	1	LP-85-01	N	Indoor
	ROLLUP DOOR 85A (WEST)		NEW	STANDBY	CONSTANT SPEED	0.8	HP	480	3	PB-85-02	N	Indoor
General Comments:	*ETAP TAG RUD-81.01*											
	ROLLUP DOOR 85B (MIDDLE)		NEW	STANDBY	CONSTANT SPEED	0.8	HP	480	3	PB-85-02	N	Indoor
	ROLLUP DOOR 85C (EAST)		NEW	STANDBY	CONSTANT SPEED	0.8	HP	480	3	PB-85-01	N	Indoor
General Comments:	*ETAP TAG RUD-85.01*											
PPU-85.971	ELECT ROOM POSITIVE PRESSURIZATION UNIT	23_41_51	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	PB-85-01	N	Indoor
PPU-85.972	CNTRL ROOM POSITIVE PRESSURIZATION UNIT	23_41_51	NEW	DUTY	CONSTANT SPEED	1.5	HP	480	3	PB-85-01	N	Indoor
PMP-85.210	WASHWATER BOOSTER PUMP 1	46_76_21	NEW	DUTY	CONSTANT SPEED	20.0	HP	480	3	MCC-85	N	Indoor
PMP-85.111	HYDRAULIC PUMP 1	46_76_21	NEW	DUTY	VARIABLE SPEED	2.0	HP	480	3	MCC-85	Y	Indoor
MTR-85.112	FEED BOX PADDLE MOTOR	46_76_21	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	MCC-85	N	
MTR-85.113	GBT DRIVE	46_76_21	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-85	N	
MTR-85.114	PRESS 1M-1 DRIVE	46_76_21	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-85	N	
MTR-85.115	PRESS 1M-2 DRIVE	46_76_21	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-85	N	
PBU-85.330	POLYMER BLENDER UNIT 1	46_33_35	NEW	DUTY	VARIABLE SPEED	1.0	HP	120	1	LP-85-02	N	Indoor
PBU-85.340	POLYMER BLENDER UNIT 2	46_33_35	NEW	DUTY	VARIABLE SPEED	1.0	HP	120	1	LP-85-02	N	Indoor
PBU-85.350	POLYMER BLENDER UNIT 3	46_33_35	FUTURE	STANDBY	VARIABLE SPEED	1.0	HP	120	1	LP-85-02	N	Indoor
PMP-85.220	WASHWATER BOOSTER PUMP 2	46_76_21	NEW	DUTY	CONSTANT SPEED	20.0	HP	480	3	MCC-85	N	Indoor
PMP-85.121	HYDRAULIC PUMP 2	46_76_21	NEW	DUTY	VARIABLE SPEED	2.0	HP	480	3	MCC-85	Y	Indoor
MTR-85.122	FEED BOX PADDLE MOTOR	46_76_21	NEW	DUTY	CONSTANT SPEED	1.0	HP	480	3	MCC-85	N	
MTR-85.123	GBT DRIVE	46_76_21	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-85	N	
MTR-85.124	PRESS 2M-1 DRIVE	46_76_21	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-85	N	
MTR-85.125	PRESS 2M-2 DRIVE	46_76_21	NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-85	N	
PMP-85.230	WASHWATER BOOSTER PUMP 3	46_76_21	FUTURE	STANDBY	CONSTANT SPEED	20.0	HP	480	3	MCC-85	N	Indoor
PMP-85.131	HYDRAULIC PUMP 3	46_76_21	FUTURE	STANDBY	VARIABLE SPEED	2.0	HP	480	3	MCC-85	Y	Indoor
MTR-85.132	FEED BOX PADDLE MOTOR	46_76_21	FUTURE	STANDBY	CONSTANT SPEED	1.0	HP	480	3	MCC-85	N	
MTR-85.133	GBT DRIVE	46_76_21	FUTURE	STANDBY	CONSTANT SPEED	5.0	HP	480	3	MCC-85	N	

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85 | DEWATERING BUILDING

TAG	DESCRIPTION	SPEC SECTION	STATUS	SERVICE	LOAD TYPE	LOAD VALUE	LOAD UNITS	VOLTS	PHASE	POWER SOURCE	GEN POWER	ENVIRONMENT
MTR-85.134	PRESS 3M-1 DRIVE	46_76_21	FUTURE	STANDBY	CONSTANT SPEED	5.0	HP	480	3	MCC-85	N	
MTR-85.135	PRESS 3M-2 DRIVE	46_76_21	FUTURE	STANDBY	CONSTANT SPEED	5.0	HP	480	3	MCC-85	N	
MIX-85.310	POLYMER TANK MIXER 1	46_41_12	NEW	DUTY	CONSTANT SPEED	3.0	HP	480	3	MCC-85	N	Indoor
MIX-85.320	POLYMER TANK MIXER 2	46_41_12	NEW	DUTY	CONSTANT SPEED	3.0	HP	480	3	MCC-85	N	Indoor
CON-85.410	DEWATERING BELT CONVEYOR		NEW	DUTY	CONSTANT SPEED	5.0	HP	480	3	MCC-85	N	Indoor
HP-85.941	DB HEAT PUMP 1		NEW	DUTY		19.7	AMP	480	3	PB-85-01	N	Indoor
VCP-85.960	WATER PUMPS (2) FOR HEAT PUMPS	23_21_23	NEW	DUTY		7.4	AMP	480	3	PB-85-01	N	Indoor
HP-85.942	DB HEAT PUMP 2		NEW	STANDBY		19.7	AMP	480	3	PB-85-01	N	Indoor
EF-85.922	DEWATERING BLDG FUME EXHAUST FAN	23_34_01	NEW	DUTY	VARIABLE SPEED	50.0	HP	480	3	MCC-85	N	Indoor
MAU-85.911	DEWATERING BLDG MAKEUP AIR UNIT	23_83_05	NEW	DUTY	VARIABLE SPEED	40.0	HP	480	3	MCC-85	N	Indoor
FAN-85.891	ODOR CONTROL FOUL AIR FAN 1	23_34_17	NEW	DUTY	VARIABLE SPEED	40.0	HP	480	3	MCC-85	N	Indoor
	General Comments: *FAN-85.991 IS NOW PART OF BID ALTERNATE.*											
FAN-85.892	ODOR CONTROL FOUL AIR FAN 2	23_34_17	NEW	DUTY	VARIABLE SPEED	40.0	HP	480	3	MCC-85	N	Indoor
	General Comments: *FAN-85.992 IS NOW PART OF BID ALTERNATE.*											
FAN-85.893	ODOR CONTROL FOUL AIR FAN 3	23_34_17	NEW	STANDBY	VARIABLE SPEED	40.0	HP	480	3	MCC-85	N	Indoor
	General Comments: *FAN-85.993 IS NOW PART OF BID ALTERNATE.*											

APPENDIX G: Standards Example, Design Checklist

DESIGN CHECKLIST: ELECTRICAL

ELECTRICAL		
Motor Control Centers		
Designation:	Cutler Hammer	
Manufacturers:		
Communications:	DeviceNet	
Thermal Magnetic Breakers, not Motor Circuit Protectors		
Variable Frequency Drives - Low Voltage		
Manufacturers:	Cutler-Hammer	
Communications:	DeviceNet	
Fail-safe System		
Requirements:	None	
Philosophy for fail-safe systems?	System is dual power fed, Generator on site – load shed required	
Lightning Panels		
Manufacturers:	No preference	
Notes:	SPDs required at each panel	
Voltage Requirements:	240/120VAC – Some locations vary	
Conductors		
Color coding:	BYO	
Insulation Class:	THHN for control wires	
Labeling:	?	
Motor winding heaters		
Motors located inside:	No	
Motors located outside:	No	
Horsepower Constraints:	No	
Uninterruptible Power Supplies		
Manufacturer:	APC – On line units	
Location:	Centralized:	Centralized UPS in the control room□
	Distributed:	Distributed in PAC cabinets
Back-up Time:	15-20 Minutes	
Alarms:	Discrete Alarms	
Network communication:	None	
Disconnects		

APPENDIX G: Standards Example, Design Checklist

DESIGN CHECKLIST: ELECTRICAL

Process Motors:	Y	
HVAC:	Y	
Instruments:	N	
Position indication:	N	
Power Monitoring		
Designation:		
Manufacturers:	CH Power Expert.	
Network communications:	Ethernet is desired – CH communications is not Ethernet based.	
Desired Data:	Phase-Phase Voltage, KW, PF, Phase Current, No Harmonics.	
Locations:		
Generators and Power Failures		
Manufacturers:	Wakashaws 300KW – Qty 2	
Fuel Type:	Duel Fule – Natural gas and Methane	
Fuel Storage:	1000 Gal/Generator	
Network communications:	None	
Data:		
Secondary Power Source:		
Loss of power generator start:	Manual	
Return to primary power:	Manual	
Source Transfer Transition:	Open	Cogen
	Closed	?
Load shed requirements?		
Load shedding is required – Generators are not sized to pick up all plant loads		
Information from other specific loads (UV system, etc)?		
Lightning - Outdoor		
Outdoor lightning lamp style:	Metal halide	

APPENDIX G: Standards Example, Design Checklist

DESIGN CHECKLIST: ELECTRICAL

Does the client follow Dark Sky policy?	Yes
Is lighting required to walk around or to work in?	Yes
Lightning - Indoor	
Indoor lighting lamp style:	Metal halide
Emergency lights or battery backup in fixtures?	Yes Emergency lighting is deployed.
	Yes Night lights are used.
Conduit Systems	
List material preferences for corrosive areas:	PCS – Commonly used
	PVC – Commonly used
List material preferences for non-corrosive areas:	Aluminum - Optional for Exposed areas
	Galvanized steel – Commonly used
Duct bank Construction	
Separate manholes or hand holes for the following:	
480VAC, 120VAC and Analog:	Separate the 480VAC – Analog and discrete can share
	No
Electrical Safety Philosophy Isolated electrical rooms desired?	Isolated electrical rooms are desired
Remote control/racking capacity desired?	Needs to be determined
Arc resistant gear desired?	Needs to be determined
Infrared scanning windows desired? Needs to be determined	
Maintenance switches desired?	Needs to be determined
Discuss arc flash labeling requirements here:	Needs to be determined
Utility Coordination and Requirements	Xcel standards apply
Minimum HP where reduced voltage soft starts are required: None	

APPENDIX G: Standards Example, Design Checklist

DESIGN CHECKLIST: ELECTRICAL

Is there a power factor penalty?	Yes
Any installation requirements/details pertinent to the project?	No

APPENDIX H: Standards Example, Design Checklist

DESIGN CHECKLIST: FIELDBUS STANDARDS

FIELDBUS STANDARDS	
Digital Bus Field Networks	
DeviceNet:	[X]
EtherNet/IP:	[X]
Profibus DP:	[X]
Profibus PA:	[X]
Foundation H1:	☐
Foundation HSE:	☐
Other:	
Other:	
Communications Modules	
Prosoft:	
SST:	
Other:	
Other:	
Fieldgates	
Endress Hauser Fieldgate	
Repeaters	
Procentec Profihub	
Diagnostic Equipment	
Profitrace Software with mobile communication:	☐
Profitrace Control Panel hardware is desired:	☐
Procentic Diagnostic Module:	☐
Terminators	
Phoenix Contact (screw type DB):	
Procentec:	
Couplers	
CompactLogix:	☐
ENTPA:	☐
ControlLogix:	☐
P&F PowerHub:	☐
Profibus Component Accessories	
Multimaster Control:	ComSoft PRS Switch

APPENDIX H: Standards Example, Design Checklist

DESIGN CHECKLIST: FIELDBUS STANDARDS

Redundancy Media Module:	RLM
Fiber Transceivers:	Hirschman OZD
Terminations	
Valves Profibus DP:	Repeater
	Manufacturer Hub Hardwired connections
Valves Profibus PA:	
Standard PA Junction Box	
Eurofast Connections	
Hardwired	
Instrument Profibus DP	
Eurofast Connections	
Hardwired	
Instrument Profibus PA	
Standard PA Junction Box	
Eurofast Connections	
Hardwired	
Profibus DP Configuration	
Profibus DP networks connecting field devices will have the following busparameter settings. A baudrate of 187.5k should be used for all Profibus networks extending into the field. A baudrate of 187.5k will allow for electrical Profibus segment lengths of up to 3,250 feet and eliminates many of the noise issues in higher speed networks. Segments can be extended an additional 700 feet by reducing the baudrate to 93.75k. Reducing the baudrate below 93.75k offers no additional segment length and should only be done if there are significant noise issues or bit errors on the network.	
Primary Master Node Address – 1	
Secondary Master Node Address – 2	
Network Baudrate – 187.5k	
Slot Time (T_{SL}) – 1000	
Minimum Station Delay Responder (minT_{SDR}) – 11	
Maximum Station Delay Responder (maxT_{SDR}) – 800	
Quiet Time (T_{QUI}) – 9	
Setup Time (T_{SET}) – 95	
GAP Update Factor (G) – 10	
Highest Station Address (HSA) – 126	
Max Retry Limit – 5	

DESIGN CHECKLIST: FIELDBUS STANDARDS

The values of T_{SL}, maxT_{SDR}, and T_{SET} must be configured to the above values when the Pepperl+Fuchs Power Hub DP/PA coupler is used. The GAP Update Factor must be set to 10 for multiple master networks, otherwise secondary masters will never be allowed to respond.	
When ABB S800 I/O is used, it will typically operate on its own Profibus DP network. If the only nodes on the network are S800 I/O, the default settings for CI854 modules should be used (differences shown below).	
Network Baudrate – 1.5M	
Slot Time (T_{SL}) – 300	
Maximum Station Delay Responder (maxT_{SDR}) – 150	
Quiet Time (T_{QUI}) – 0	
Setup Time (T_{SET}) – 20	
GAP Update Factor (G) – 1	
Max Retry Limit – 3	
Control Cabinet Standards	

APPENDIX I: Standards Example, Design Checklist

DESIGN CHECKLIST: GENERAL

General		Last Update:
Client Naming/Tagging Conventions:		
List tagging and loop number convention		See attached
Left to Right		X
Pilot Devices		
Control Station Controls Location:	Field:	X
	PTT	X – No transformer
	MCC/VFD	X – HIM modules
Pilot Light Types – located on Buckets	LED:	X
	Push to test:	X
Red:	Running	
Green:	Standby/Ready	
White:	Power On	
Blue:	2 speed - Run Slow	
Amber: Fail	Fault	
Packaged Equipment Preferences		
Packaged equipment with starters		
Sump Pumps		
Starter Location:	Field:	X
	MCC:	
Controls:	Plant:	
	Vendor:	X
Monitoring:	Plant PCS:	X
Level Element Type:	Floats:	X
HVAC Air Handling/Make up Air Units/Evaporative Coolers:		
Starter Location:	Field :	X
	MCC:	X
Controls:	Plant	Separate Controls – Soldyn MTEC
	Vendor	X
Monitoring	Plant PCS:	X

APPENDIX I: Standards Example, Design Checklist

DESIGN CHECKLIST: GENERAL

Fire Alarms		
Fire Alarm Control Panel:	X	
Third Party Monitored:	No	
Signal Type:	Traditional:	X
	Addressable:	
Security Alarms		
Security system control panel required?	N	
Third party vendor supported?	N	
Local panels:	N	
Card Access:	Entry Gate only – Staff doesn't like	
Security System Software		
N/A		
Security System Hardware		
CCTV: Internally controlled	Gate Monitoring Only	
Physical Installation Requirements:	No formal standards.	
Phone System		
Phone:	VOIP based, CISCO and Clarion	
Support:	City IT services	
Paging System		
Manufacturer:	City IT maintains phone system - Cisco	
	Maintenance takes care of paging system	
	Phone system controls through PAX	
System Requirements:	None.	
Energy Management System		
Manufacturer:	Nothing currently in place for management.	

APPENDIX I: Standards Example, Design Checklist

DESIGN CHECKLIST: GENERAL

Building Management	
Manufacturer:	Nothing in place.
Lightning Protection:	
Is lightning protection required?	Yes – Ground Rods and Ground Loop

APPENDIX J: Standards Example, Design Checklist

DESIGN CHECKLIST: INSTRUMENTATION

INSTRUMENTATION	Last Update:	
Instrument Preferences		
Digital Bus Required:	DeviceNet Motor Control – Instruments are pending	
FDT/DTM requirement for instruments?	Yes 4-20mA HART	
Flow Switches	No preference	
Flow Meters Coriolis:	No preference	
Flow Meters Thermal:	Sierra	
Flow Meters Magnetic:	Endress+Hauser 53W	
	Bypass preference	Spool piece X
	Spool piece material	PVC X - Typical
		Steel X – in special cases
Level Switches:	Standard Floats and Tuning Forks	
Level Ultrasonic instruments:	Endress+Hauser SP1, 4 wire, Integral (in most applications)	
Level Radar instruments:	No preferences	
Pressure Switches:	Ashcroft DPDT	
Pressure Gauges:	Ashcroft – 1279 Glycerin filled	
Pressure Transmitters:	Endress+Hauser Cerebar.	
DO:	Endress+Hauser	
pH:	Endress+Hauser	
ORP:	Endress+Hauser	
Turbidity:	HACH, Endress+Hauser	
Gas Detection:	Sierra Monitor Corp – Sentry Q with remote transmitter	
Analyzers:	Ammonia: Endress+Hauser ISOMax	Nitrate: Endress+Hauser ISOMax
Control Philosophy		
Two Wire (HOA) or three-wire (LOR+Start/Stop pushbuttons) controls desired?		
Three-wire control:	Yes	
Reset preferences:	Reset pushbuttons	
Interlocks		
Software:	Mostly Software	
Hardware:	Where required	
Device Networking Preferences		

APPENDIX J: Standards Example, Design Checklist

DESIGN CHECKLIST: INSTRUMENTATION

Need to evaluate on a project basis if applicable based on data needs or economic constraints.	
Non-Modulating valves:	
Modulating valves:	
MCC:	X
VFD:	X
Switchgear:	
Motor Protection Relays:	
Control Cabinet Standards	
Lighting inside control cabinets:	X
Automatically on as door opens :	X
Cabinet Temperature Monitoring:	Switch to start fans – not alarmed
Intrusion contacts:	No
Alarm horns:	Control Room Only
Alarm Strobes:	On buildings not panels
Control Panel Depths:	Colors: Red = Signal, Black = Hot, White = Neutral. Green = Ground Wire shall be stranded MTW
Panduit	Grey
Terminal Blocks	Screw Terminals
Analog Terminal Blocks	Fused (min Fuses), Disconnect and test point.
Discrete	Circuit Breaker
Surge Protection	SPD on panels and SPD on field instruments located outside
Control Panel Names	ACC-xx where xx = process area abbreviation
Ethernet Switches	Cisco IE3000 located in the ACC
Fiber Patch Panel	Located in ACC
Ventilation	Fan vents located on Top front corners on ACC
Wiring Standards:	Conductor Field Labeling: Tag Based
	Conductor Panel Labeling: TAG-S-1 (analog) TAG-C-! (discrete)
	25% spare I/O per card
Any specific layout standards:	25% spare rack space
	All spare I/O is wired to filed terminal blocks
Controller Preferences	
Existing system	GE based – Mainly GE RX3i

APPENDIX J: Standards Example, Design Checklist

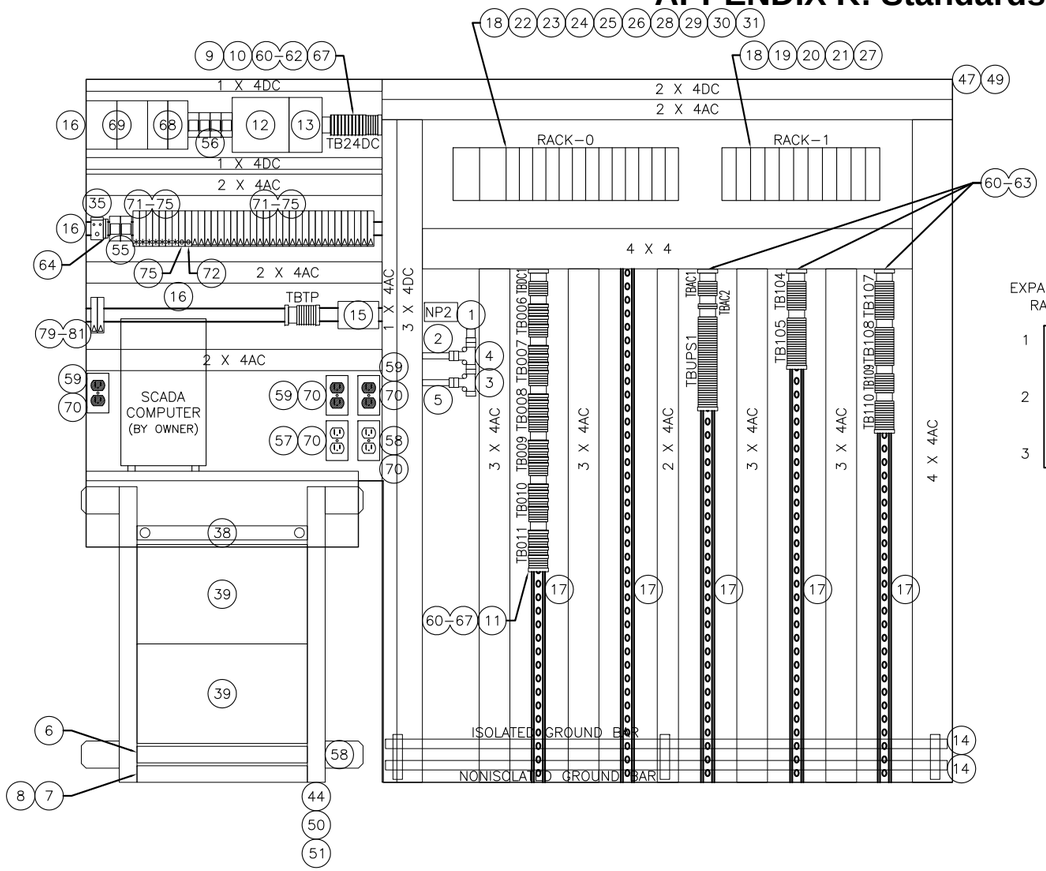
DESIGN CHECKLIST: INSTRUMENTATION

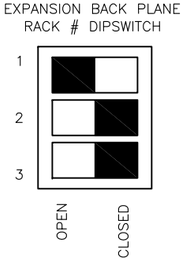
Manufacturer preference	GE RX3i PAC 120VAC
Processor redundancy required?	Not typically but could vary based on the installation requirements
Power Supply Redundancy	
24 VDC:	X
UPS:	X
Fail contacts monitored:	Yes
I/O Standards: DI and DO:	
24 VDC	
120 VAC	
Isolated Inputs:	Yes
Isolated Outputs:	PLC cabinet X
Interposing relays location:	Relay Cabinet X
	Starter X
Analog Voltage	4-20mA
Communication protocol preference?	IP Backbone
	Modbus TCP
Field Networks:	Ethernet is desired
HMIs	
HMI required on PLCs?	iFix Proficy
HMI hardware preference?	No real preference – ACP may be desirable
PCS/SCADA Preferences:	
List applicable communication requirements: [Internal/External/Others]	Others?
	Thin client deployment is desired, Thick in control room.
Will the operator workstations have run-time, development or thin client licenses?	Large Process display screen
Any specific operator workstation requirements?	CCTV Display screen(s)
	Currently under review - Firewall exists between corporate in the plant but corporate controls the firewall

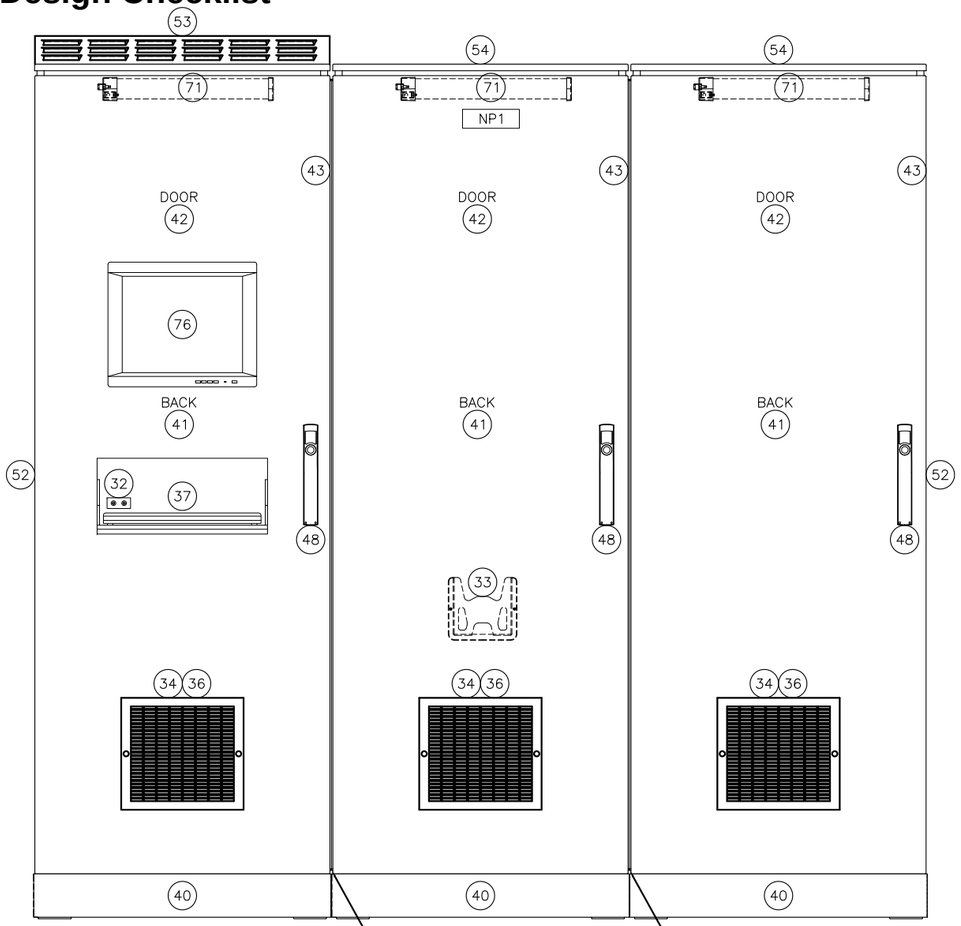
APPENDIX J: Standards Example, Design Checklist

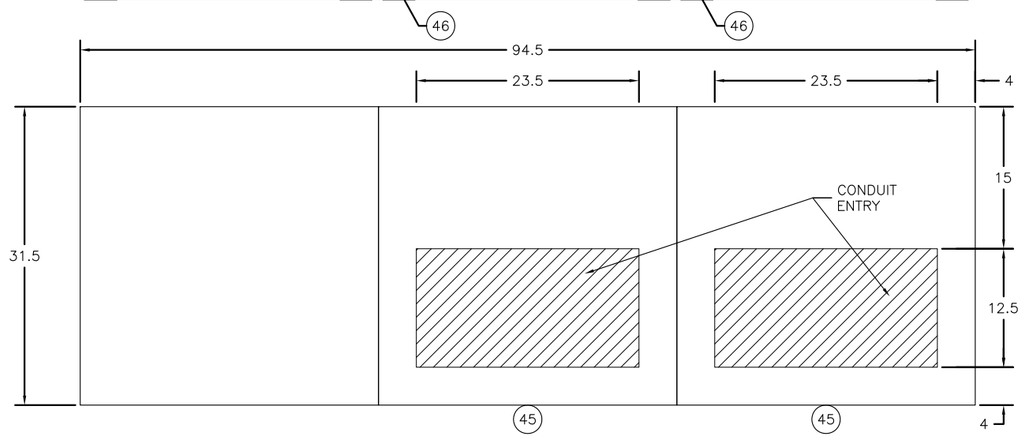
DESIGN CHECKLIST: INSTRUMENTATION

List any currently deployed SCADA security measures like firewall rules etc.	Currently under review - Firewall exists between corporate in the plant but corporate controls the firewall
Virtualization Requirements:	iHistorian – potentially Thin Client Manager
SCADA Server Notes	Dual SCADA servers – not virtualized one on site and a second offsite. GE Webspace is used and located on the offsite server
Communication System Network	
List Internal and External Communication requirements:	Plant Corporate: VPN on T1
	Control System: VPN access
List network preferences for equipment:	Switches IT for large infrastructure
Equipment furnished by?	Cabinet switches by Contractor









RACK–0 LAYOUT

0 1	2 3	4	5	6	7	8	9	10	11	12	13	14 15	16
POWER SUPPLY IC695PSA140	CPU IC695CPU320	ETHERNET, 2 PORTS IC95ETM001	DEVICENET MASTER IC694DNM200	ANALOG INPUT IC695AL0608	ANALOG INPUT IC695AL0608	ANALOG INPUT IC695AL0608	ANALOG INPUT IC695AL0608	ANALOG INPUT IC695AL0608	ANALOG INPUT IC695AL0608	SPACE – BLANK COVER IC694ACC310	SPACE – BLANK COVER IC694ACC310	POWER SUPPLY IC695PSA140	EXPANSION MODULE IC695LRE001

RACK–1 LAYOUT

0	1	2	3	4	5	6	7	8	9	10
POWER SUPPLY IC694PWR330	SPACE – BLANK COVER IC694ACC310	SPACE – BLANK COVER IC694ACC310	SPACE – BLANK COVER IC694ACC310	DIGITAL INPUT IC694MDL240	DIGITAL INPUT IC694MDL240	SPACE – BLANK COVER IC694ACC310	DIGITAL OUTPUT IC694MDL930	DIGITAL OUTPUT IC694MDL930	DIGITAL OUTPUT IC694MDL930	DIGITAL OUTPUT IC694MDL930

REV	DATE	BY	DESCRIPTION

DESIGNED -
DRAWN -
CHECKED -
DATE MONTH YEAR
PROJECT ENGINEER
PROJECT MANAGER
PRINCIPAL

CITY OF BOULDER WWTF
PROCESS AUTOMATION SYSTEM
INSTRUMENTATION
BOULDER WWTF
ACC-XXX

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. XXXXX.XX
DRAWING NO. I-007
SHEET NO. 1 OF XX

LAST SAVED BY: USER
PROJECT NO.
FILE NAME: General For Review.cel

BILL OF MATERIALS

ITEM	MANUFACTURER	DESCRIPTION	QTY	PART NUMBER
1	Allen-Bradley	MiniStyle Devicenet 5-Pin Female Terminator	1	1485A-T1N5
2	Allen-Bradley	MiniStyle Devicenet Cordset, 5-Pin Male Connector to Cable, 3.3 Feet	1	1485C-P1M5-C
3	Allen-Bradley	MiniStyle Devicenet T -Port 5 -Pin Devicenet Connector with 1 4-Pin Male Power Drop	1	1485T-P1M4-MN5KF
		Connection		
4	Allen-Bradley	MiniStyle Devicenet T -Port 5 -Pin Devicenet Connector with 1 5-Pin Female Drop	1	1485P-P15-MN5KF
		Connection		
5	Allen-Bradley	MiniStyle Devicenet Cordset, 4-Pin Female Connector to Cable, 6 Feet	1	889N-F4AFC-6F
6	APC	Rack Mounted Automatic Transfer Switch, 120 V AC 15 A	1	AP7750
7	APC	1000V A Rack Mount Uninterruptible Power Supply with Relay Card	1	SUA1 OOORMI UIAP961 0
8	Bryant	5-15P 15Amp, 120V AC Plug	1	5266NP
9	Bussmann	4A 5mmx 20 mm Fast-Acting Glass Fuse	1	GMA-4-R
10	Bussmann	2A 5mmx 20 mm Fast-Acting Glass Fuse	9	GMA-2-R
11	Bussmann	1/2A 5mmx20 mm Fast-Acting Glass Fuse	24	GMA-500-R
12	Cisco	Industrial Ethernet Switch, 4 10/100 ports, 2 dual purpose uplink ports	1	IE-3000-4TC
13	Cisco	Ethernet Expansion Module for IE3000, 8 10/100 ports TX Ports	1	IEM-3000-8TM
14	Custom	Grounding Bar - 1/4" x 1" x Panel Length	2	By Description
15	Cutler-Hammer	Aegis Surge Protective Device	1	AGSHWCH120N20XC
16	Entrelec	Standard DIN Rail	1 Lot	0101 598.26
17	Entrelec	30^0 Raised DIN Rail	1 Lot	0101 875.23
18	General Electric	Fanuc RX3i Blank Cover	10	IC694ACC310
19	General Electric	Fanuc RX3i 10 Slot Expansion Chassis	1	IC694CHS392
20	General Electric	Fanuc RX3i 16 Point Digital Input Module, 120V AC	2	IC694MDL240
21	General Electric	Fanuc RX3i 8 Point Relay Digital Output Module, Isolated	4	IC694MDL930
22	General Electric	Fanuc RX3i 4 Point Current Analog Input Module, Differential	6	IC695ALG608
23	General Electric	Fanuc RX3i Terminal Connector for Analog Input Modules	6	IC694TBB032
24	General Electric	Fanuc RX3i 16 Slot Universal Chassis	1	IC695CHS016
25	General Electric	Fanuc RX3i Expansion Cable, 6 ft (2 Meters)	1	IC693CBL301
26	General Electric	Fanuc RX3i Devicenet Communication Module	1	IC694DNM200
27	General Electric	Fanuc RX3i Expansion Rack Power Supply	1	IC694PWR330
28	General Electric	Fanuc RX3i CPU 64MB User RAM w/ Auxiliary Battery	1	IC695CPU320 / IC693ACC302
29	General Electric	Fanuc RX3i Ethernet Communication Module	1	IC695ETM001
30	General Electric	Fanuc RX3i Serial Expansion Module	1	IC695LRE001
31	General Electric	Fanuc RX3i CPU Rack Power Supply	2	IC695PSA140
32	Graceport	PS 2 /Keyboard/Mouse/USB Interface/RJ45 Interface	1	P-P3P5P11P11R2-B3R0
33	Hoffman	Large Plastic Data Pocket	1	ADP2
34	Hoffman	Filter, 8 x 14	3	AFLT812
35	Hoffman	Temperature Control Switch	1	A-TEMNO
36	Hoffman	Louver P1ate 8 x 14	3	AVK812
37	Hoffman	Keyboard Box	1	CKBC24
38	Hoffman	Proline Pull Out Shelf, 19" Deep	2	P19PSH6
39	Hoffman	Proline Rack Panel - 6 U	2	P19RP6UP
40	Hoffman	Proline 100mm Plinth Base 800 x 800	3	PB188
41	Hoffman	Proline Solid Cover, 2000 x 800	3	PCS208
42	Hoffman	Proline Solid Door, 2000 x 800	3	PDS208
43	Hoffman	Proline Single Bay Frame, 2000 x 800 x 800, Nema-12	3	PF2088
44	Hoffman	Proline 1-Hole Grid Strap (Pair)	3	PGH1S8
45	Hoffman	Proline G1 and Plate, 800 x 800	2	PGP88
46	Hoffman	Proline Frame Joining Gasket Kit	2	PJ2F
47	Hoffman	Proline Joining Panel	2	PJP20
48	Hoffman	Proline L-Handle	3	PLHK
49	Hoffman	Proline Full Panel, 2000 x 800	3	PPF208
50	Hoffman	Proline 19" Rack Angle, 73" Longwith Tapped Holes (pair)	4	PRA1920TP
51	Hoffman	Proline 19" Rack Angle, 22" Longwith Tapped Holes (pair)	1	PRA197TP
52	Hoffman	Proline Solid Side, 2000 x 800	2	PSS208
53	Hoffman	Proline Vented Top Fan, 800 x 800, 115 V AC	1	PVT3F881
54	Hoffman	Proline Solid Top, 800 x 800	2	PT88
55	Idec	DPDT Relay, 120V AC with Indicator and Base	2	RH2B-UL-AC120/SH2B-05
56	Idec	DPDT Relay, 24VDC with indicator and Base	4	RH2B -UL-DC24/SH2B-05
57	Leviton	120 V AC, 15A Duplex Receptacle	1	5252-I
58	Leviton	120 V AC, 20A Duplex Receptacle	1	5352-I
59	Leviton	15A Isolated Ground Duplex Receptacle	3	8200-IG
60	Phoenix Contact	E/UK End S top	12	1201442
61	Phoenix Contact	D-UT 2,514-TWIN Terminal Cover	12	3047141
62	Phoenix Contact	UBE/D Terminal Strip Marker Carrier	18	800307
63	Phoenix Contact	UT4 Terminal Block	148	3044102
64	Phoenix Contact	UT10 Terminal Block	2	3044160
65	Phoenix Contact	UT4 Grounding Terminal Block	2	3044128
66	Phoenix Contact	UT4 Grounding Terminal Block	2	3044128
67	Phoenix Contact	UT4-MTD Terminal Block	57	3046184
68	Phoenix Contact	Fused Disconnect Type Terminal Block with Light Indicator, 24V DC	34	3046090
68	Phoenix Contact	24V DC 5A Power Supply	2	QUINT/PS/1 AC/24DC/5
69	Phoenix Contact	24V DC 10A Power Supply	2	QUINT/PS/1 AC/24DC/10
70	Raco	Handy Box and Duplex Receptacle Cover	5	670RAC/684
71	Saginaw	24" Door Activated Fluorescent Light	3	SCE-LF146D24
72	Siemens	1 Pole, 3A Circuit Breaker	26	5SJ4103-7HG41
73	Siemens	1 Pole, 6A Circuit Breaker	7	5SJ4106-7HG41
74	Siemens	1 Pole, 15A Circuit Breaker	4	5SJ4118-7HG41
75	Siemens	1 Pole, 20A Circuit Breaker	2	5SJ4120-7HG41
76	Siemens	15" Industrial Color Flat Panel Touchscreen Monitor	1	6AV7861-2TB00-1 AA0
77	General Electric	iFIX iClient Runtime Software	1	IC6471FCLNTCRNM

LEGEND SCHEDULE
MATERIAL: GRAVOPLY–II, BLACK FIELD WITH WHITE 3/16" LETTERS

LEGEND				
IDENT	SIZE	LINE 1	LINE 2	LINE 3
NP1	2 X 6	ACC–DIG	AREA CONTROL CENTER	
NP2	2 X 4	DEVICENET	TO MCC–D1	

LEGEND SCHEDULE
MATERIAL: GRAVOPLY–II, YELLOW FIELD WITH BLACK LETTERS

LEGEND					
IDENT	SIZE	TEXT SIZE	LINE 1	LINE 2	LINE 3
NP2	2 X 6	1/4"	** SEE DETAIL AT RIGHT**		

REV	DATE	BY	DESCRIPTION

DESIGNED -
DRAWN -
CHECKED -
DATE MONTH YEAR
PROJECT ENGINEER
PROJECT MANAGER
PRINCIPAL

CITY OF BOULDER WWTF
PROCESS AUTOMATION SYSTEM
INSTRUMENTATION
BOULDER WWTF
ACC-XXX

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. XXXXX.XX
DRAWING NO. I-008
SHEET NO. 2 OF XX

LAST SAVED BY: USER

ELECTRICAL PLAN SYMBOLS

IDENTIFICATION SYMBOLS

EQUIP # — EQUIPMENT AND INSTRUMENT IDENTIFICATION

EQUIPMENT/INSTRUMENT LOCATOR

LUMINAIRE IDENTIFICATION
- a = CIRCUIT DESIGNATION
- b = DEVICE SWITCHED FROM
- c = MOUNTING HEIGHT IN FEET TO BOTTOM OF FIXTURE

XXXX — CONDUIT IDENTIFICATION
- XXXX = CONDUIT NUMBER, REFER TO CONDUIT SCHEDULE

UNLESS OTHERWISE NOTED, GROUPED CONDUITS ARE LABELED LEFT TO RIGHT OR TOP TO BOTTOM.

INDICATES KEYNOTE X (PERTAINS ONLY TO SHEET WHERE NOTE IS FOUND)

DISCONNECT SWITCH
- A = TYPE, REFER TO DISCONNECT SCHEDULE

LUMINAIRES

LINEAR FIXTURE

2' X 2' LAY-IN TROFFER

2' X 4' LAY-IN TROFFER

LUMINAIRE POLE MOUNTED

GO/NO-GO PANEL - STROBE AND HORN
- R = RED LIGHT
- G = GREEN LIGHT
- H = HORN

GO/NO-GO PANEL - SOLID

GO/NO-GO PANEL - STROBE

LUMINAIRE, EMERGENCY BATTERY-POWERED

LUMINAIRE, EMERGENCY/EXIT BATTERY-POWERED

LUMINAIRE, EMERGENCY BATTERY-POWERED REMOTE

LUMINAIRE, SURFACE OR PENDANT MOUNTED

LUMINAIRE, WALL MOUNTED

LUMINAIRE, FLOOD/SPOT

LUMINAIRE, EXIT ONE OR TWO FACES AS INDICATED. ARROW POINTS IN DIRECTION OF EGRESS.

LUMINAIRE, WALL WASHER

SWITCHES/RECEPTACLES

SINGLE POLE SWITCH
- a = CIRCUIT DESIGNATION
- b = DEVICE SWITCHED DESIGNATION
- c = TYPE
  - 2 = DOUBLE POLE SWITCH
  - 3 = THREE-WAY SWITCH
  - 3P = THREE POSITION SWITCH
  - 4 = FOUR-WAY SWITCH
  - K = KEY OPERATED SWITCH
  - F = SWITCH AND FUSESTAT HOLDER
  - P = SWITCH AND PILOT LIGHT
  - T = THERMOSTAT
  - D = DIMMER SWITCH
  - L = LOW VOLTAGE LIGHT SWITCH
  - M = MANUAL MOTOR STARTER
  - N = NETWORKED SINGLE OR MULTIPLE SWITCH LOCATIONS

REFER TO ABBREVIATIONS LEGEND FOR ALL OTHER DESIGNATIONS.

OCCUPANCY SENSOR
- X = REFERENCE LIGHTING CONTROL COMPONENT SCHEDULE
- a = CIRCUIT DESIGNATION
- b = DEVICE SWITCHED DESIGNATION
- c = MOUNTING HEIGHT IN FEET TO BOTTOM OF SENSOR

PE — PHOTOCELL

SWITCH AND SINGLE RECEPTACLE
- a = CIRCUIT DESIGNATION
- b = DEVICE TYPE DESIGNATION

DUPLEX RECEPTACLE

QUADRUPLEX RECEPTACLE

IN FLOOR DUPLEX RECEPTACLE

IN FLOOR QUADRUPLEX RECEPTACLE

DUPLEX RECEPTACLE w/SPLIT WIRE

APPLIANCE RECEPTACLE

SPECIAL PURPOSE RECEPTACLE

WELDING RECEPTACLE
- a = CIRCUIT DESIGNATION
- b = DISCONNECT TYPE

TWIST LOCK RECEPTACLE
- a = AMP RATING

TELEPHONE OUTLET
- a = CIRCUIT DESIGNATION
- b = MOUNTING HEIGHT

DATA COMMUNICATIONS OUTLET
- a = CIRCUIT DESIGNATION
- b = MOUNTING HEIGHT

FIRE ALARM

SMOKE DETECTOR
- a = TYPE
- I = IONIZATION
- P = PHOTOELECTRIC
- d = DUCT DETECTOR

FACP — FIRE ALARM CONTROL PANEL

FIRE ALARM PULL STATION

FIRE ALARM HORN/STROBE COMBINATION

FIRE ALARM STROBE

FIRE SPRINKLER
- F = FLOW SWITCH
- T = TAMPER SWITCH

RACEWAY

EXPOSED CONDUIT

BREAK AND CONTINUATION IN CONDUIT RUN

EXPOSED CONDUIT HIDDEN BEHIND WALLS, FLOORS OR OTHER STRUCTURES

UNDERGROUND CONDUIT, DIRECT BURIED OR IN DUCT BANK

CONDUIT IN SLAB

CONDUIT VERTICAL CHANGE IN DIRECTION

CONDUIT CAP

JUNCTION BOX

CONDUIT SEAL

CONDUIT TEE

DUCT BANK APPROXIMATE DIMENSIONS SHOWN ON DUCT BANK SECTIONS

CONDUIT SIZE AND CONDUCTORS

INDIVIDUAL CONDUCTORS

W"C-(3-X (Ø), 1-Y (N) & 1-Z (G))

W"C (WHERE INDICATED): W = CONDUIT TRADE SIZE

3-X (Ø):
- 3 = QUANTITY
- X = SIZE OF CONDUCTORS
- (Ø) = DESIGNATES PHASE CONDUCTORS

1-Y (N)(WHERE INDICATED):
- 1 = QUANTITY
- Y = SIZE OF CONDUCTORS
- (N) = DESIGNATES NEUTRAL CONDUCTORS

1-Z (G)(WHERE INDICATED):
- 1 = QUANTITY
- Z = SIZE OF CONDUCTORS
- (G) = DESIGNATES GROUND CONDUCTORS

U(3-X (Ø) & 1-X (G))

U = NUMBER OF PARALLEL RUNS

MULTI CONDUCTOR CABLES

K/2/C#16S
- K (WHERE INDICATED) = NUMBER OF PAIRS
- 2/C#16S = TWO CONDUCTOR, 16 GAUGE, TWISTED SHIELDED PAIR

K/3/C#16S
- K (WHERE INDICATED) = NUMBER OF TRIPLETS
- 3/C#16S = THREE CONDUCTOR, 16 GAUGE, TWISTED SHIELDED TRIPLETS

N/CX
- N = NUMBER OF CONDUCTORS IN THE CABLE
- X = SIZE OF CONDUCTORS

FIBER OPTIC CABLES

FO/N
- N = NUMBER OF INDIVIDUAL FIBERS

GROUNDING

UNDERGROUND GROUND CABLE #4/0 SDBC UNLESS OTHERWISE NOTED

GROUND ROD

GROUND ROD AND GROUND WELL

ELECTRICAL ONE-LINE SYMBOLS

MEDIUM VOLTAGE

CIRCUIT BREAKER, MEDIUM VOLTAGE
- a = CIRCUIT BREAKER NUMBER
- b = FRAME SIZE

ANSI RELAY DEVICE
- a = ANSI DEVICE FUNCTION
- b = QUANTITY

MEDIUM VOLTAGE DISCONNECT SWITCH NON-FUSED CUT OUT

MEDIUM VOLTAGE DISCONNECTING FUSE SINGLE FUSE CUT OUT

MEDIUM VOLTAGE DISCONNECTING FUSE DOUBLE FUSE CUT OUT

MEDIUM VOLTAGE SINGLE FUSE

MEDIUM VOLTAGE DOUBLE FUSE

MEDIUM VOLTAGE LIVE FRONT TERMINATOR

MEDIUM VOLTAGE ELBOW

MEDIUM VOLTAGE TEE

MEDIUM VOLTAGE CONTACTOR

MEDIUM VOLTAGE STARTER

MOV-ELBOW ARRESTER

LOW VOLTAGE

LOW VOLTAGE CIRCUIT BREAKER
- a = TYPE
  - MCP = MOTOR CIRCUIT PROTECTOR
  - TM = THERMAL MAGNETIC
  - SS = SOLID STATE
- b = FRAME SIZE (MANUFACTURER TO DETERMINE FRAME SIZE UNLESS INDICATED)
- c = NUMBER OF POLES
- d = TRIP SETTING (AT = AMP TRIP) (AC = MCP CONTINUOUS RATING)
- e = DESIGNATION
- f = INTERRUPTING RATING

LOW VOLTAGE CIRCUIT BREAKER AUXILIARY OPERATOR
- * = S = SHUNT TRIP
- = G = GROUND FAULT INTERRUPTER
- = V = SOLENOID KEY RELEASE

DISCONNECT SWITCH
- A = TYPE, REFER TO DISCONNECT SCHEDULE

FUSED DISCONNECT SWITCH
- B = TYPE, REFER TO DISCONNECT SCHEDULE
- b = FUSE RATING

FUSE

COMBINATION STARTER WITH CONTROL POWER TRANSFORMER
- a = CIRCUIT BREAKER DISCONNECT, TYPE AS NOTED
- b = STARTER TYPE
- c = NEMA STARTER SIZE
- d = OVERLOAD

MOTOR STARTER/DRIVES:
- a = DEVICE TYPE
  - VFD-6 = 6-PULSE VFD
  - VFD-18 = 18-PULSE VFD
  - RVSS = REDUCED VOLTAGE SOLID STATE STARTER
  - RVAT = REDUCED VOLTAGE AUTO TRANSFORMER
  - a/B = DEVICE WITH BYPASS STARTER. REFER TO THE SPECIFICATIONS
- b = INPUT OPTIONS
  - LL = LINE REACTOR
  - PHF = PASSIVE HARMONIC FILTER
- c = OUTPUT OPTIONS
  - LR = LOAD REACTOR
  - DV/DT = Dv/dt FILTER
  - SWF = SINE WAVE FILTER

EQUIPMENT ENCLOSURE

MISCELLANEOUS

MOTOR
- HP = HORSEPOWER RATING
- FULL LOAD AMPS AS NOTED

PACKAGED EQUIPMENT
- LOAD RATING AS INDICATED
- a = RATED LOAD
- b = UNIT(HP, KW, KVA) AS INDICATED

TRANSFORMER
- a = DEVICE I.D.
- b = KVA RATING
- c = NUMBER OF PHASES
- d = PRIMARY VOLTAGE
- e = SECONDARY VOLTAGE
- f,g = CONNECTION TYPE SYMBOL
- h = IMPEDANCE

GROUNDED WYE CONNECTION

DELTA CONNECTION

ENGINE-GENERATOR RATINGS AS INDICATED ON THE DRAWINGS
- a = KVA/KW
- b = VOLTAGE/CONNECTION
- c = PHASE
- d = WIRE
- e = PF

CURRENT TRANSFORMER WITH SHORTING TERMINAL BLOCK
- a = QUANTITY
- b = RATIO

POTENTIAL TRANSFORMER
- a = QUANTITY
- b = RATIO
- c,d = CONNECTION TYPE SYMBOL

SSM — SOLID STATE MULTIFUNCTION METER

ATP — AMPERE TEST POINT

VTP — VOLTAGE TEST POINT

UTILITY METER

LIGHTNING ARRESTER

SPD — SURGE PROTECTIVE DEVICE

DRAWOUT CONNECTION

GROUND

CAPACITOR

BATTERY

KIRK KEY INTERLOCK

LOAD BANK

REV	DATE	BY	DESCRIPTION

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CHECKED: CE
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PROJECT NO. 10096N.00 FILE NAME: 10096N0000GE001.dgn

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ABBREVIATIONS

A	AMP
ABS	ABSOLUTE
AC	ALTERNATING CURRENT
ACK	ACKNOWLEDGE
ACTR	ACTUATOR
AF	AMP FRAME
AFC	AUTOMATIC FREQUENCY CONTROL
AIC	AMP INTERRUPTING CAPACITY
AM	AMMETER
ANN	ANNUNCIATOR
ANT	ANTENNA
APU	AUXILIARY POWER UNIT
ARM	ARMORED CABLE
AS	AMMETER SWITCH
ASYM	ASYMMETRICAL
AT	AMP TRIP
ATO	AUTOMATIC THROW OVER
ATP	AMMETER TEST POINT
ATS	AUTOMATIC TRANSFER SWITCH
AUTO XFMR	AUTOMATIC TRANSFORMER
AUX	AUXILIARY
AWG	AMERICAN WIRE GAGE
B	BELL
BAT	BATTERY
BFG	BELOW FINISHED GRADE
BHP	BRAKE HORSEPOWER
BKR	BREAKER
BRF	BELOW RAISED FLOOR
C	CONDUIT / CONTINUOUS LOAD
CB	CIRCUIT BREAKER
CCTV	CLOSED CIRCUIT TELEVISION
CCW	COUNTER CLOCKWISE
CKT	CIRCUIT
COAX	COAXIAL CABLE
COM	COMMON
COMM	COMMUNICATION
CPT	CONTROL POWER TRANSFORMER
CS	CONTROL SWITCH
CT	CURRENT TRANSFORMER
CV	CONTROL VALVE
CW	CLOCKWISE / COOL WHITE
DC	DIRECT CURRENT
DCS	DISTRIBUTED CONTROL SYSTEM
DCU - X	DISTRIBUTED CONTROL UNIT NO. X
DEMO	DEMOLITION
DISC	DISCONNECT SWITCH
DM	DEMAND METER
DPDT	DOUBLE POLE DOUBLE THROW
DPST	DOUBLE POLE SINGLE THROW
DS	DOOR SWITCH
E/G	EMERGENCY GENERATOR
EM	EMERGENCY
EMT	ELECTRICAL METALLIC TUBING
ENCL	ENCLOSURE
ENG	ENGINE
ENT	ELECTRICAL NON-METALLIC TUBING
EP	EXPLOSION PROOF
ETM	ELAPSED TIME METER
FA	FIRE ALARM
FACP	FIRE ALARM CONTROL PANEL
FDR	FEEDER
FLA	FULL LOAD AMPS
FLX	FLEXIBLE CONDUIT
FO	FIBER OPTIC
FRC	FIBERGLASS RIGID CONDUIT
FREQ	FREQUENCY
FU	FUSE
FU	SW FUSED SWITCH
FVNR	FULL VOLTAGE NON-REVERSING
FVR	FULL VOLTAGE REVERSING
FWD	FORWARD
G	GROUND / EQUIPMENT GROUND / GROUND FAULT
GEN	GENERATOR
GRC	GALVANIZED STEEL RIGID CONDUIT
GFCI	GROUND FAULT CIRCUIT INTERRUPTER (RECEPTACLE)
GFI	GROUND FAULT INTERRUPTER (BREAKER)
GFR	GROUND FAULT RELAY
H	HOT-LEG
HF	HIGH FREQUENCY
HP	HORSEPOWER
HPS	HIGH PRESSURE SODIUM
HR	HOUR
HSTAT	HUMIDISTAT
HV	HIGH VOLTAGE
HVAC	HEATING/VENTILATION/AIR CONDITIONING
HZ	HERTZ
I	INSTANTANEOUS LOAD
IC	INTERRUPTING CAPACITY
IJB	INSTRUMENT JUNCTION BOX
IMC	INTERMEDIATE METAL CONDUIT
INST	INSTANTANEOUS
INT	INTERLOCK
INTERCOM	INTERCOMMUNICATION
J	JUNCTION BOX
K	KEY INTERLOCK
KA	KILOAMP
KV	KILOVOLT
KVA	KILOVOLT AMPERE
KVAR	KILOVAR (REACTANCE)
KW	KILOWATT
KWD	KILOWATT DEMAND
KWH	KILOWATT HOUR
L	LONG-TIME
L-B	LINE-BUS
L-G	LINE-GROUND
LA	LIGHTNING ARRESTOR
LBL	LABEL
LC	LIGHTING CONTACTOR
LCP- X	LOCAL CONTROL PANEL NO. X
LP	LIGHT POLE
LR	LEAD-LAG LOAD REACTOR
LTG	LIGHTING
LV	LOW VOLTAGE
LVL	LEVEL
M-X	MOTOR CONTROLLER NO. X
MA	MILLIAMPERE
MCA	MOTOR CIRCUIT AMPS
MCC - X	MOTOR CONTROL CENTER NO. X
MCP	MOTOR CIRCUIT PROTECTOR
MH	MANHOLE / MOUNTING HEIGHT
MLO	MAIN LUGS ONLY
MOD	MOTOR OPERATED DAMPER
MOV	METAL OXIDE VARISTOR
MRP	MOTOR PROTECTION RELAY
MS-X	MOTOR STARTER NO. X
MSP	MOTOR STARTING PANEL
MTO	MANUAL THROW OVER
MTR-X	MOTOR NO. X
MTS	MANUAL TRANSFER SWITCH
MV	MEGAVOLT
MVA	MEGAVOLT-AMPERES
MVS	MEDIUM VOLTAGE SWITCH
MW	MEGAWATT
N	NEUTRAL
NC	NORMALLY CLOSED
NEC	NATIONAL ELECTRICAL CODE
NFC	NONMETALLIC FLEXIBLE CONDUIT
NL	NIGHT LIGHT
NO	NORMALLY OPEN
NP	NAMEPLATE
O	OPEN OR OPENED
OH	OVERHEAD
OL	OVERLOAD RELAY
P	POLE
PA	PUBLIC ADDRESS
PANEL-LX	LIGHTING PANEL NO.X
PANEL-PX	POWER DISTRIBUTION PANEL NO. X
PB	PUSHBUTTON / PULL BOX
PC-X	MINI POWER CENTER NO. X
PCS	PVC COATED GALVANIZED STEEL CONDUIT
PCM	PROCESS CONTROL MODULE
PE	PHOTOCELL
PF	POWER FACTOR
PFCC	POWER FACTOR CORRECTION CAPACITOR
PFR	PHASE FAILURE RELAY
PH	PHASE
PNL	PANEL
PPX	POWER PANEL NO. X
PRI	PRIMARY
PT	POTENTIAL TRANSFORMER
PVC	POLYVINYL CHLORIDE RIGID PLASTIC CONDUIT
PWR	POWER
RAC	RIGID ALUMINUM CONDUIT
RECPT	RECEPTACLE
REV	REVERSE
RF	RADIO FREQUENCY
RMS	ROOT MEAN SQUARED
RVAT	REDUCED VOLTAGE AUTO TRANSFORMER
RVNR	REDUCED VOLTAGE NON-REVERSING
RVSS	REDUCED VOLTAGE SOLID STATE
S	SHIELD / SHORT-TIME
SA	SURGE ARRESTER
SC	SHORT CIRCUIT
SDBC	SOFT DRAWN BARE COPPER
SFL	SUB FEED LUGS
SLT	SEALTIGHT LIQUIDTIGHT FLEXIBLE CONDUIT
SM	SURFACE MOUNTED
SP	SINGLE POLE
SPD	SURGE PROTECTIVE DEVICE
SPDT	SINGLE POLE DOUBLE THROW
SPST	SINGLE POLE SINGLE THROW
SPKR	SPEAKER
SS	SOLID STATE
STB	SHORTING TERMINAL BLOCK
SW	SWITCH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
SYM	SYMMECTRICAL
TACH	TACHOMETER
TB - X	TERMINAL BLOCK - UNIT X
TC	THERMOCOUPLE / TIME CLOCK / TRAY CABLE
TD	TEMPERATURE DETECTOR RELAY
TE	TOTALLY ENCLOSED
TEFC	TOTALLY ENCLOSED FAN COOLED
TENV	TOTALLY ENCLOSED NON-VENTILATED
TERM	TERMINAL
TJB	TERMINAL JUNCTION BOX
TM	THERMAL MAGNETIC
TP	TWISTED PAIR
TS	TEMPERATURE SWITCH
TS1W	TWO SPEED CONSEQUENT POLE, ONE WINDING
TS2W	TWO SPEED SEPARATE WINDING
TSTAT	THERMOSTAT
UHF	ULTRA HIGH FREQUENCY
UNG	UNGROUNDED
UPS	UNINTERRUPTABLE POWER SUPPLY
UVR	UNDER VOLTAGE RELAY
V	VOLT
VA	VOLT AMPERE
VAR	VARMETER
VCP	VENDOR CONTROL PANEL
VFD	VARIABLE FREQUENCY DRIVE
VHF	VERY HIGH FREQUENCY
VM	VOLTMETER
VP	VAPORPROOF
VR	VOLTAGE REGULATOR
VS	VOLTAGE SWITCH
VT	VOLTAGE TRANSFORMER
VTP	VOLTAGE TEST POINT
W	WATT / WEST
WT	WATER TIGHT
WP	WEATHER PROOF
XFMR	TRANSFORMER

POWER DEVICE FUNCTION NUMBERS

1	MASTER ELEMENT
2	TIME-DELAY STARTING OR CLOSING RELAY
3	CHECKING OR INTERLOCKING RELAY
4	MASTER CONTACTOR
5	STOPPING DEVICE
6	STARTING CIRCUIT BREAKER
7	ANODE CIRCUIT BREAKER
8	CONTROL POWER DISCONNECTING DEVICE
9	REVERSING DEVICE
10	UNIT SEQUENCE SWITCH
11	MULTIFUNCTION DEVICE
12	OVER-SPEED DEVICE
13	SYNCHRONOUS-SPEED DEVICE
14	UNDER-SPEED DEVICE
15	SPEED OR FREQUENCY MATCHING DEVICE
16	DATA COMMUNICATIONS DEVICE
17	SHUNTING OR DISCHARGE SWITCH
18	ACCELERATING OR DECELERATING DEVICE
19	STARTING-TO-RUNNING TRANSITION CONTACTOR
20	ELECTRICALLY OPERATED VALVE
21	DISTANCE RELAY
22	EQUALIZER CIRCUIT BREAKER
23	TEMPERATURE CONTROL DEVICE
24	VOLTS PER HERTZ RELAY
25	SYNCHRONIZING OR SYNCHRONISM-CHECK DEVICE
26	APPARATUS THERMAL DEVICE
27	UNDERVOLTAGE RELAY
27N	GROUND FAULT UNDERVOLTAGE RELAY
28	FLAME DETECTOR
29	ISOLATING CONTACTOR
30	ANNUNCIATOR RELAY
31	SEPARATE EXCITATION DEVICE
32	DIRECTIONAL POWER RELAY
33	POSITION SWITCH
34	MASTER SEQUENCE DEVICE
35	BRUSH-OPERATING OR SLIP-RING SHORT-CIRCUITING DEVICE
36	POLARITY DEVICE
37	UNDERCURRENT OR UNDERPOWER RELAY
38	BEARING PROTECTIVE DEVICE
39	MECHANICAL CONDITION MONITOR
40	FIELD RELAY
41	FIELD CIRCUIT BREAKER
42	RUNNING CIRCUIT BREAKER
43	MANUAL TRANSFER OR SELECTOR DEVICE
44	UNIT SEQUENCE STARTING RELAY
45	ABNORMAL ATMOSPHERIC CONDITION MONITOR
46	REVERSE-PHASE OR BALANCE CURRENT RELAY
47	PHASE-BALANCE OR PHASE-SEQUENCE VOLTAGE RELAY
48	INCOMPLETE SEQUENCE RELAY
49	MACHINE OR TRANSFORMER THERMAL RELAY
50	INSTANTANEOUS OVERCURRENT RELAY
51	AC TIME OVERCURRENT RELAY
52	AC CIRCUIT BREAKER
53	FIELD EXCITATION RELAY
54	TURNING GEAR ENGAGING DEVICE
55	POWER FACTOR RELAY
56	FIELD APPLICATION RELAY
57	SHORT-CIRCUITING OR GROUNDING DEVICE
58	RECTIFICATION FAILURE RELAY
59	OVERVOLTAGE RELAY
60	VOLTAGE OR CURRENT BALANCE RELAY
61	DENSITY SWITCH OR SENSOR
62	TIME-DELAY STOPPING OR OPENING RELAY
63	PRESSURE SWITCH
64	GROUND DETECTOR RELAY
65	GOVERNOR
66	NOTCHING OR JOGGING DEVICE
67	AC DIRECTIONAL OVERCURRENT RELAY
68	BLOCKING OR OUT OF STEP RELAY
69	PERMISSIVE CONTROL DEVICE
70	RHEOSTAT
71	LIQUID LEVEL SWITCH
72	DC CIRCUIT BREAKER
73	LOAD-RESISTOR CONTACTOR
74	ALARM RELAY
75	POSITION CHANGING MECHANISM
76	DC OVERCURRENT RELAY
77	TELEMETERING DEVICE
78	PHASE-ANGLE MEASURING RELAY
79	AC RECLOSING RELAY
80	FLOW SWITCH
81	FREQUENCY RELAY
82	DC LOAD MEASURING RECLOSING RELAY
83	AUTOMATIC SELECTIVE CONTROL OR TRANSFER RELAY
84	OPERATING MECHANISM
85	PILOT COMMUNICATIONS, CARRIER OR PILOT-WIRE RELAY
86	LOCKOUT RELAY
87	DIFFERENTIAL PROTECTIVE RELAY
88	AUXILIARY MOTOR OR MOTOR GENERATOR
89	LINE SWITCH
90	REGULATING DEVICE
91	VOLTAGE DIRECTIONAL RELAY
92	VOLTAGE AND POWER DIRECTIONAL RELAY
93	FIELD-CHANGING CONTACTOR
94	TRIPPING OR TRIP-FREE RELAY

COMMONLY USED SUFFIX LETTERS APPLIED TO POWER DEVICE FUNCTION NUMBERS

A	ALARM ONLY
B	BUS PROTECTION
G	GROUND FAULT PROTECTION (RELAY CT IN A SYSTEM NEUTRAL CIRCUIT OR GENERATOR PROTECTION)
GS	GROUND FAULT PROTECTION (RELAY CT IN TOROIDAL OR GROUND SENSOR TYPE)
L	LINE PROTECTION
M	MOTOR PROTECTION
N	GROUND FAULT PROTECTION (RELAY COIL CONNECTED IN RESIDUAL CT CIRCUIT)
T	TRANSFORMER PROTECTION
V	VOLTAGE
P	PHASE PROTECTION

ABBREVIATIONS

AFD	- ARC FLASH DETECTOR
CLK	- CLOCK OR TIMING SOURCE
DDR	- DYNAMIC DISTURBANCE RECORDER
DFR	- DIGITAL FAULT RECORDER
ENV	- ENVIRONMENTAL DATA
HIZ	- HIGH IMPEDANCE FAULT DETECTOR
HMI	- HUMAN MACHINE INTERFACE
HST	- HISTORIAN
LGC	- SCHEME LOGIC
MET	- SUBSTATION METERING
PDC	- PHASOR DATA CONCENTRATOR
PMU	- PHASOR MEASUREMENT UNIT
PQM	- POWER QUALITY MONITOR
RIO	- REMOTE I/O DEVICE
RTU	- REMOTE TELEMETRY UNIT/REMOTE TERMINAL UNIT
SER	- SEQUENCE OF EVENTS RECORDER
TCM	- TRIP CIRCUIT MONITOR

NOTES:

1. REFER TO SPECIFICATIONS AND OTHER DRAWINGS FOR ADDITIONAL ABBREVIATIONS.

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DRAWN CE
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DATE MAY 2017

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ELECTRICAL
ABBREVIATIONS

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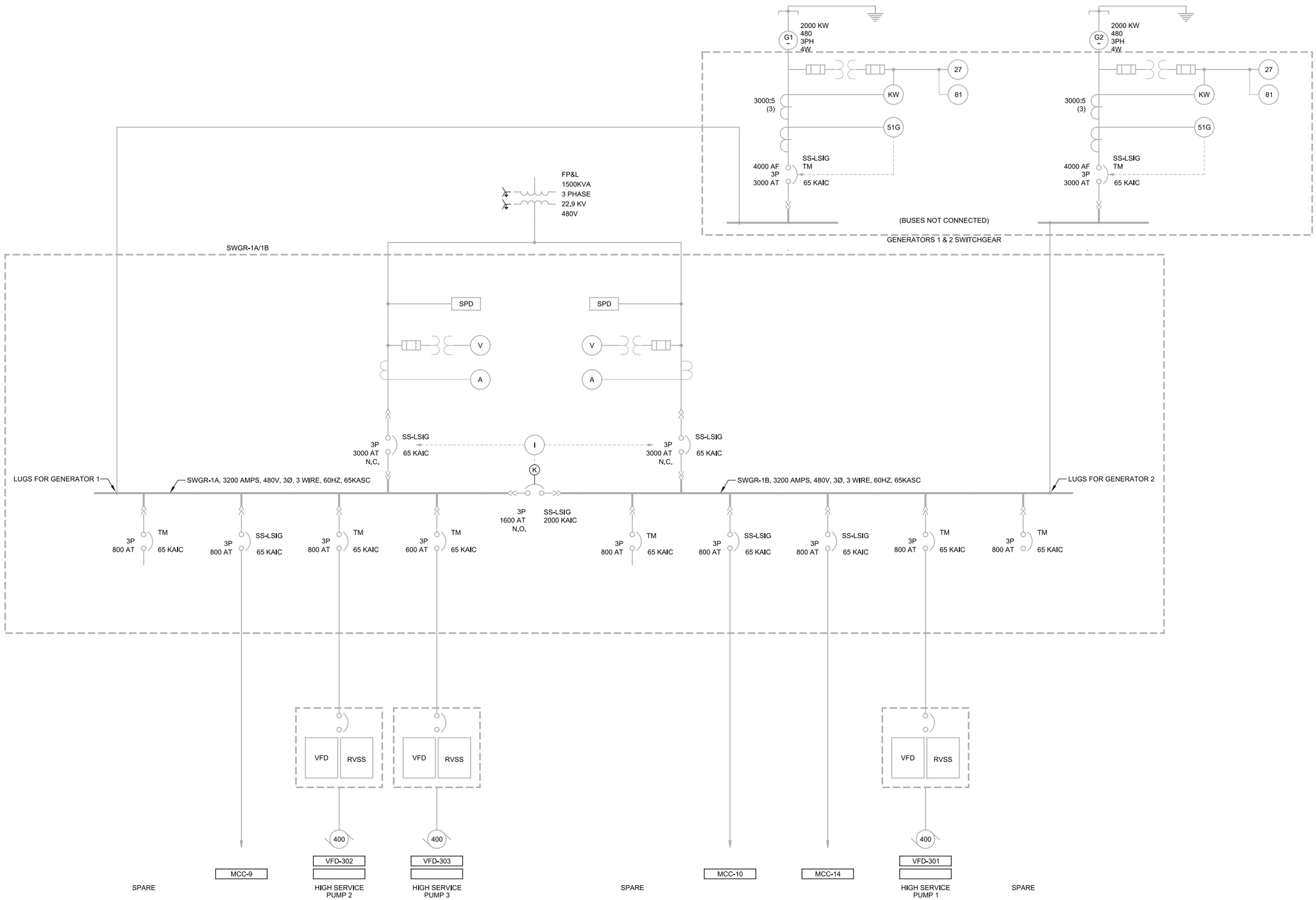

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SWGR-1A/2B
ONE-LINE DIAGRAM

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Model: Layout1 ColorTable: gshade.ctb DesignScript: Carollo_Std_Pen_v0905.pen PlotScale: 2:1
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KEY NOTES:

1. INTERCONNECTION FROM CO-GENERATION SYSTEM.
2. CO GEN GENRATOR SI 1600 KW 4.16 KV. 0.8 PF.
   CO-GEN TRANSFORMER IS 2000 KVA, 4.16 KV TO 480V, 5.75%.

FROM CO-GEN STEP-DOWN TRANSFORMER

CO-GENERATION SWITCHGEAR

480V/120V (2) PTS

TRIP/LOOKOUT

SEL 351

(N) 3200A 3P 52

86

50 51 50 51G 79

27 59 81O 81U

480V/120V (3) PTS

(3) CT'S 2500:5A

3200A, 480V, 3 PHASE, 3W, 65000 AIC

GENERATOR 2 POWER (FROM GENERATORS 1 & 2 SWITCHGEAR, SEE SHEET 03E22)

G2 2000 KW 480V, 3PH, 4W

G3 2000 KW 480V, 3PH, 4W

(2) 4:1

47N 27 81

32R KW

87G 86

4000:5 (3)

4000AF 3P 3200AT SS-LSIG 65 KAIC

TRIP

(BUSES NOT CONNECTED) GENERATORS 2 & 3 SWITCHGEAR

FP&L 1500KVA 3 PHASE 22.9 KV 480V

SWGR-2A/2B

47 27 SSM

M3 3200 AF 3P 3000 AT N.C.

M3 OCP

M4 3200 AF 3P 3000 AT N.C.

M4 OCP

SS-LSIG 65 KAIC

SPD

ST OCP

3200 AF 3P 3000 AT ST SS-LSIG 65 KAIC

LUGS FOR CO-GEN SWGR

SWGR-2A, 3200 AMPS, 480V, 3Ø, 3 WIRE, 60HZ, 65KASC

LUGS FOR GEN 2 SWGR

SWGR-2B, 3200 AMPS, 480V, 3Ø, 3 WIRE, 60HZ, 65KASC

LUGS FOR GEN 3 SWGR

800 AF 3P 600 AT TM 65 KAIC

800 AF 3P 800 AT SS-LSIG 65 KAIC

1600 AF 3P 1200 AT SS-LSIG 65 KAIC

VFD RVSS

400

VFD-304

HIGH SERVICE PUMP 4

MCC-11 SPARE SPACE MCC-7 SPARE MCC-3 MCC-1 MCC-2 MCC-4 SPARE MCC-8 MCC-12 MCC-13 SPARE SPACE

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SWGR-2A/2B ONE-LINE DIAGRAM

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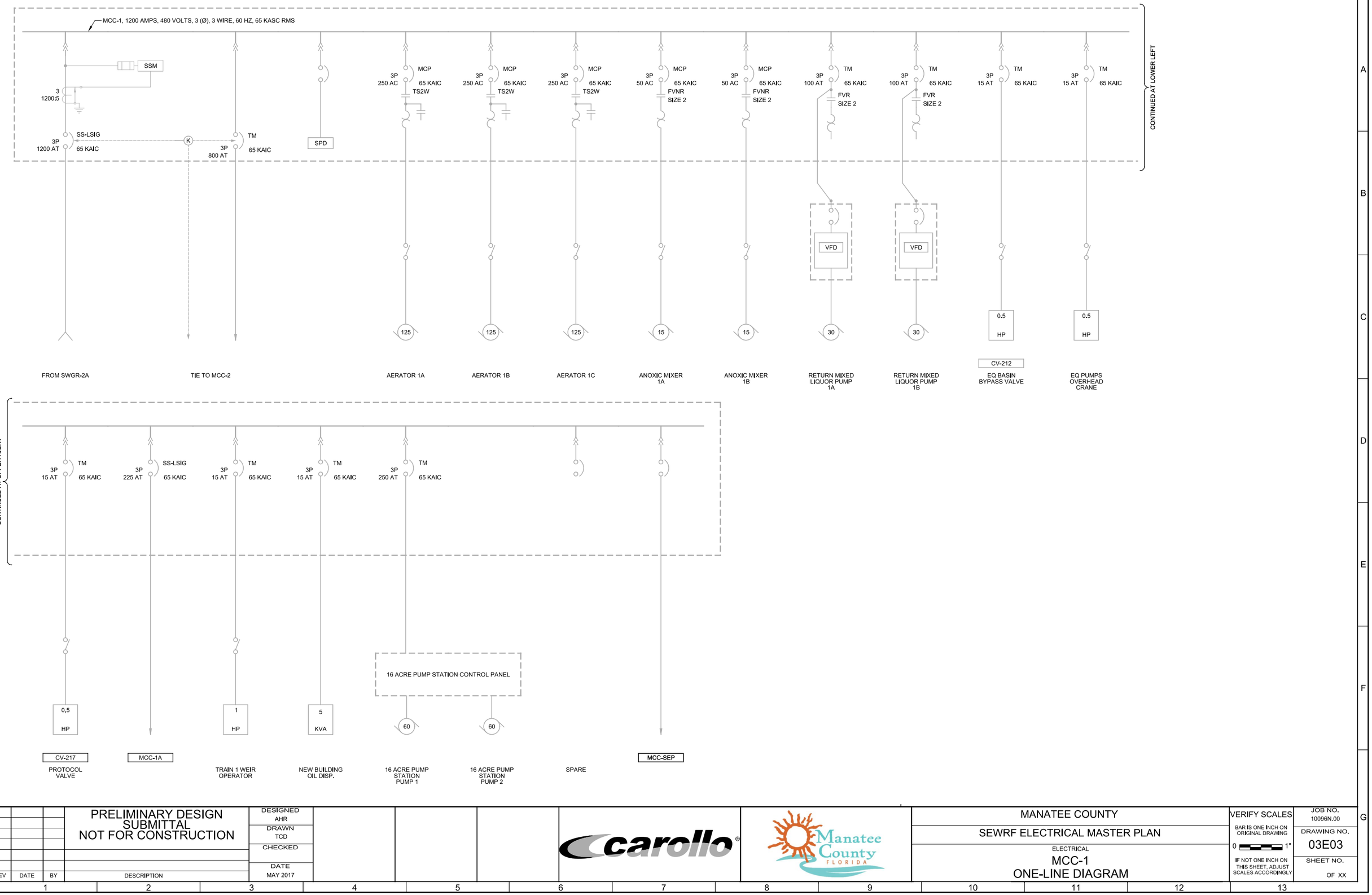

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MCC-1 ONE-LINE DIAGRAM

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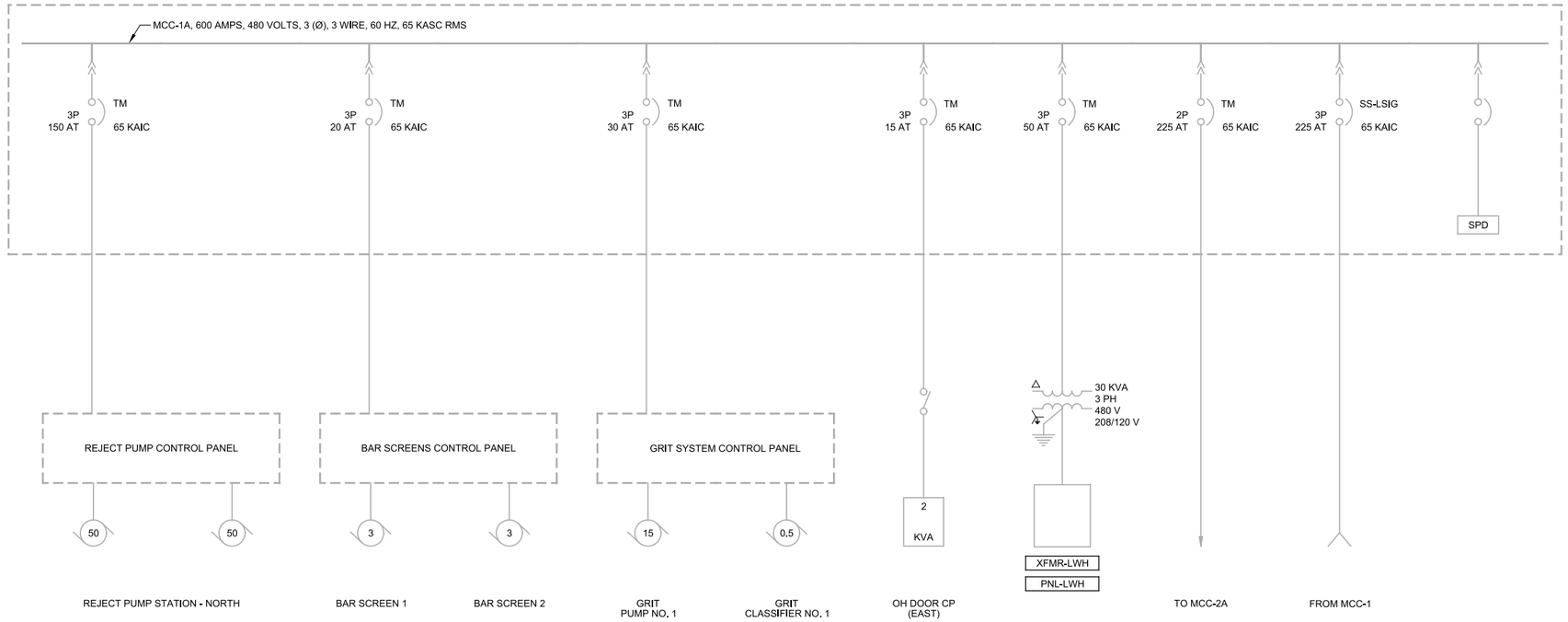
DRAWING NO. 03E03
SHEET NO. OF XX



REV	DATE	BY	DESCRIPTION
			PRELIMINARY DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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DRAWN TCD
CHECKED
DATE MAY 2017

MANATEE COUNTY

SEWRF ELECTRICAL MASTER PLAN

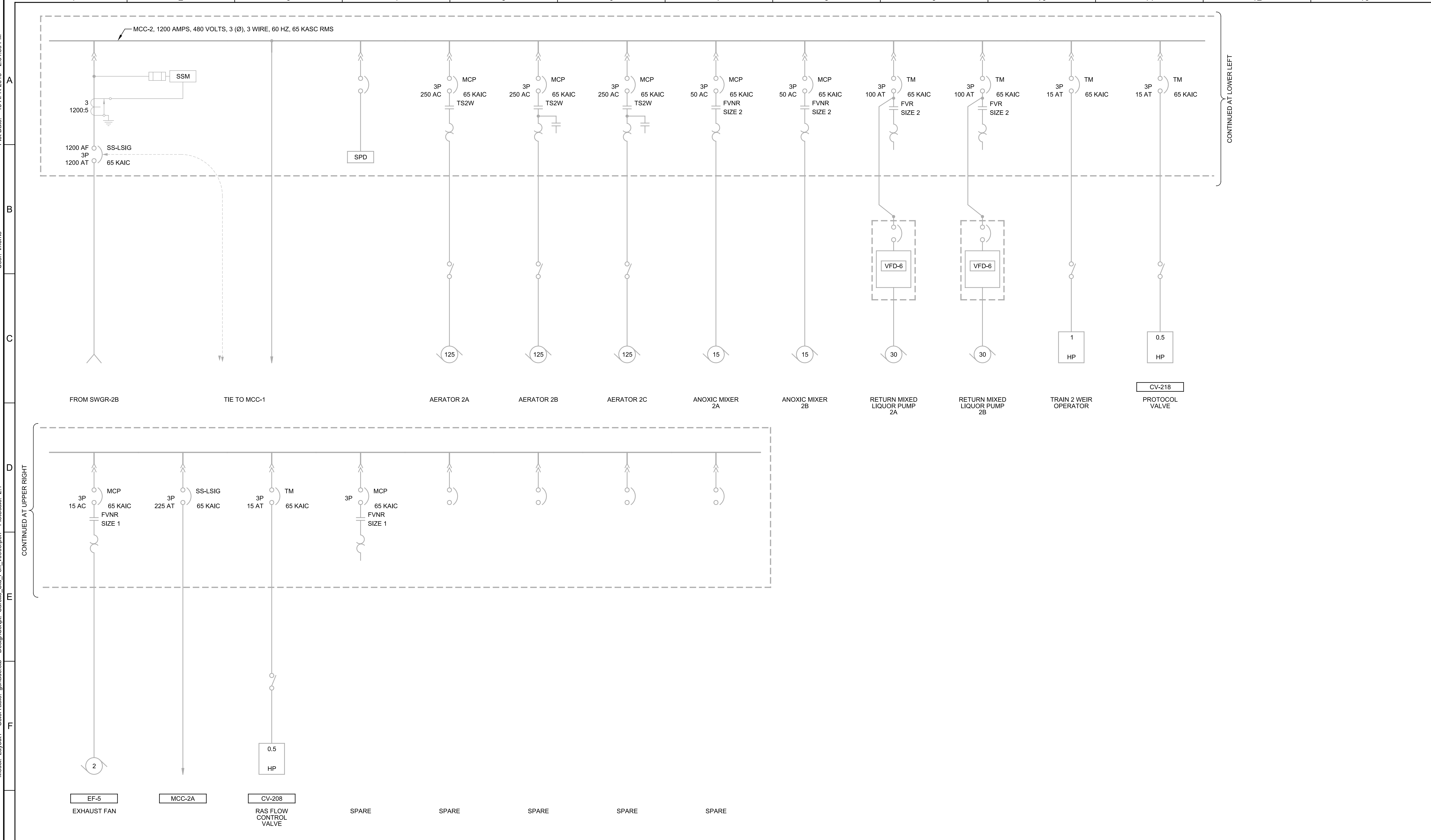
ELECTRICAL

MCC-1A
ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E04
SHEET NO. OF XX

Plot Date: 27-DEC-2017 11:53:01 AM
User: bshepard
PlotScale: 2:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: bshepard
PROJECT NO. 10096N.00
FILE NAME: 10096N0003E004.dgn



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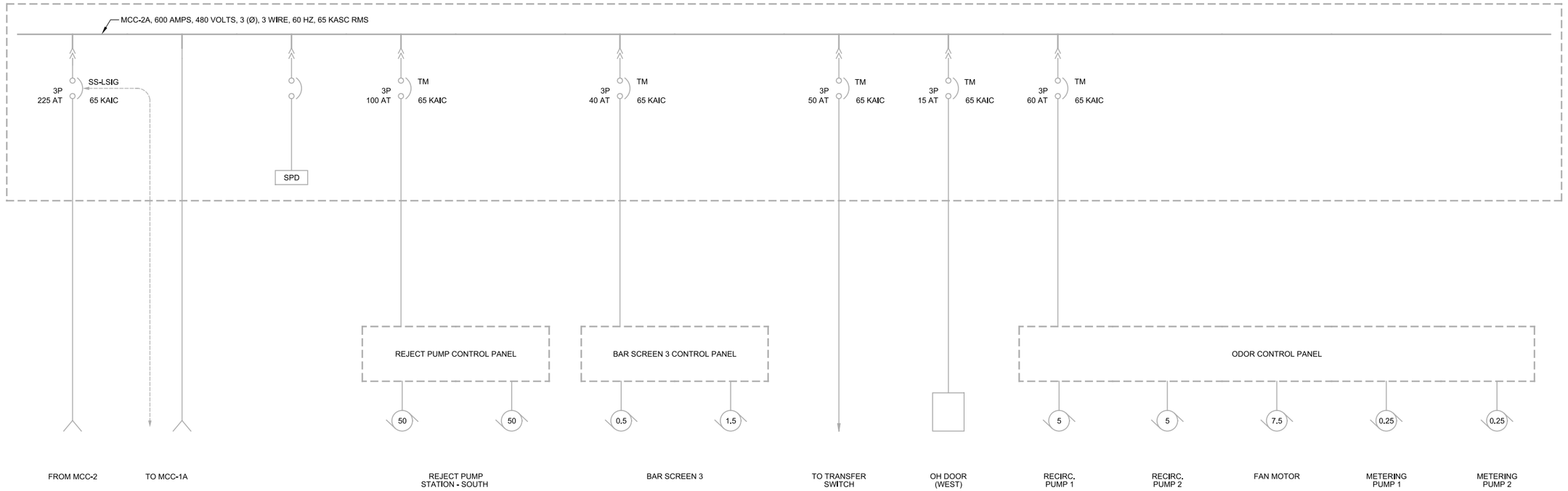
MANATEE COUNTY
SEWRF ELECTRICAL MASTER PLAN
ELECTRICAL
MCC-2
ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E05
SHEET NO. OF XX



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DATE MAY 2017

MANATEE COUNTY

SEWRF ELECTRICAL MASTER PLAN

ELECTRICAL

MCC-2A
ONE-LINE DIAGRAM

VERIFY SCALES
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0 1"
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JOB NO. 10096N.00
DRAWING NO. 03E06
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E006.dgn

Plot Date: 27-DEC-2017 11:53:07 AM
User: bshepard
Model: Layout1 ColorTable: gshade.ctb DesignScript: Carollo_Std_Pen_v0905.pen PlotScale: 2:1
LAST SAVED BY: bshepard

MCC-3, 1200 AMPS, 480 VOLTS, 3 (Ø), 3 WIRE, 60 HZ, 65 KASC RMS

CONTINUED AT LOWER LEFT

CONTINUED AT UPPER RIGHT

FROM SWGR-2A	TIE TO MCC-4		AERATOR 3A	AERATOR 3B	AERATOR 3C	ANOXIC MIXER 3A	ANOXIC MIXER 3B	EQUALIZATION PUMP NO.1	EQUALIZATION PUMP NO.3	EQUALIZATION PUMP NO.5	EQUALIZATION BLOWER NO. 1
1200 AF 3P 1200 AT	SS-LSIG 65 KAIC	800 AF 3P 800 AT	TM 65 KAIC								
SSM											
3 1200:5											
		SPD									
			3P 250 AC	3P 250 AC	3P 250 AC	3P 30 AC	3P 30 AC	3P 50 AC	3P 30 AC	3P 30 AC	3P 250 AC
			MCP 65 KAIC FVR	MCP 65 KAIC FVR	MCP 65 KAIC FVR	MCP 65 KAIC FVNR SIZE 2	MCP 65 KAIC FVNR SIZE 2	MCP 65 KAIC FVNR SIZE 3	MCP 65 KAIC FVNR SIZE 2	MCP 65 KAIC FVNR SIZE 2	MCP 65 KAIC RVAT
			125	125	125	15	15	30	15	15	125

3P 90 AT	TM 65 KAIC			
		3P 50 AC	MCP 65 KAIC FVNR SIZE 2	FVNR SIZE 2

30 KVA
3 PH
480 V
208/120 V

XFMR - L2
PANEL-L2

PANEL PC/TC-2

SPARE SPARE SPARE

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MANATEE COUNTY

SEWRF ELECTRICAL MASTER PLAN

ELECTRICAL

MCC-3
ONE-LINE DIAGRAM

VERIFY SCALES
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0 1"
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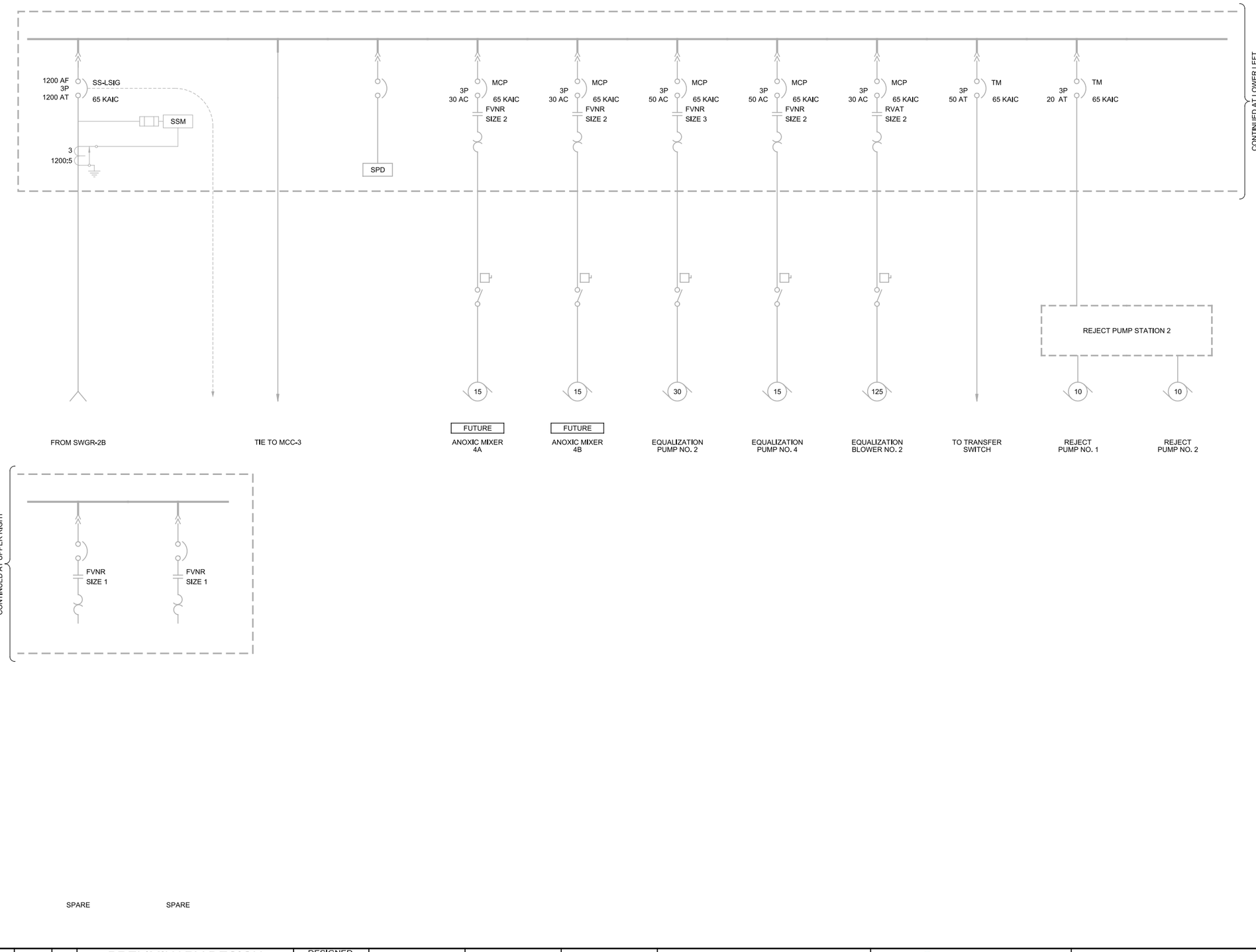
JOB NO. 10096N.00
DRAWING NO. 03E07
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E007.dgn



REV	DATE	BY	DESCRIPTION
			PRELIMINARY DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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DATE MAY 2017

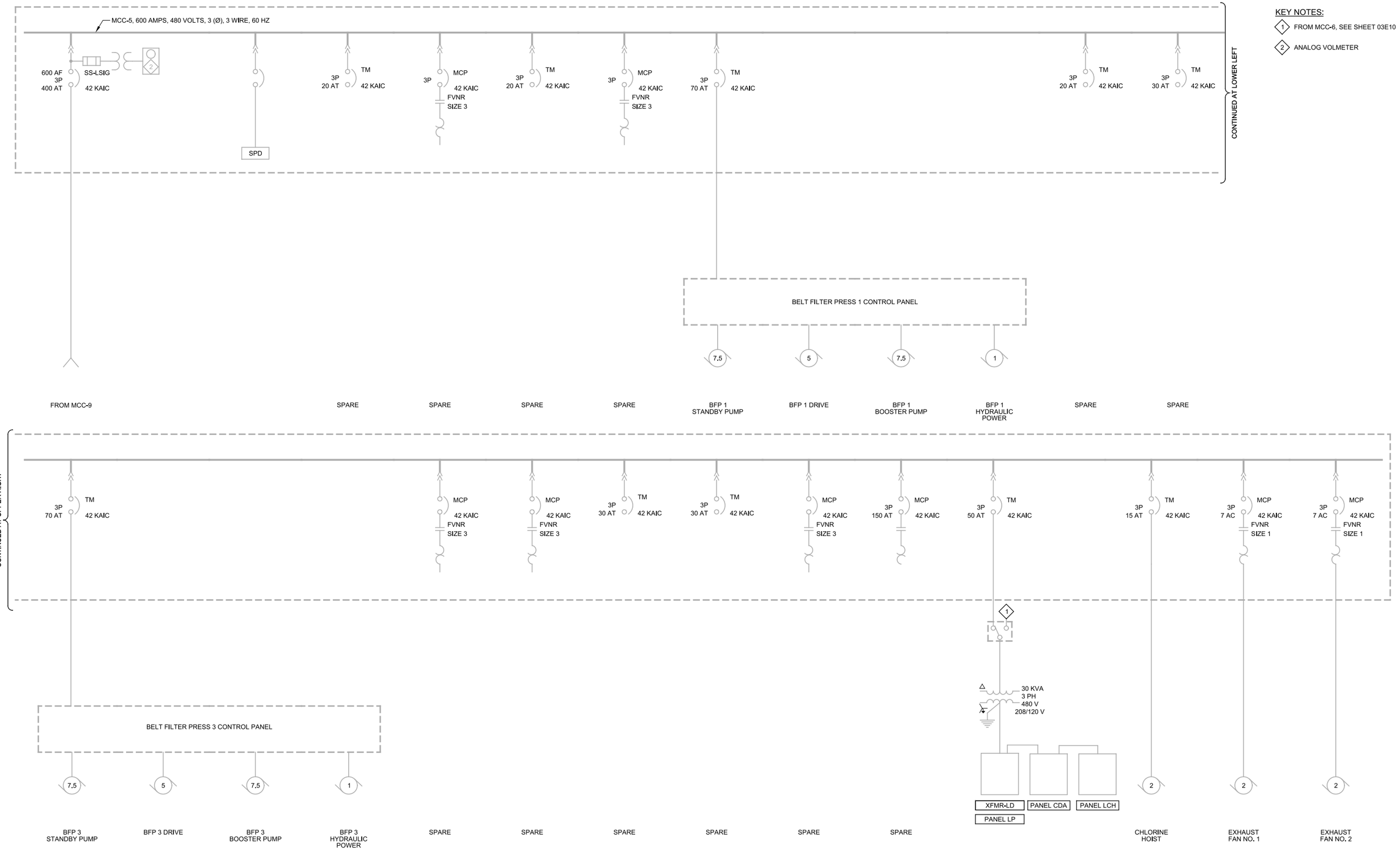
MANATEE COUNTY
SEWRF ELECTRICAL MASTER PLAN
ELECTRICAL
MCC-4
ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E08
SHEET NO. OF XX

Plot Date: 27-DEC-2017 1:27:13 PM
User: bshepard
Model: Layout1 ColorTable: gshade.ctb DesignScript: Carollo_Std_Pen_v0905.pen PlotScale: 2:1
LAST SAVED BY: bshepard

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E008.dgn



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DATE MAY 2017

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SEWRF ELECTRICAL MASTER PLAN
ELECTRICAL
MCC-5
ONE-LINE DIAGRAM - I

VERIFY SCALES
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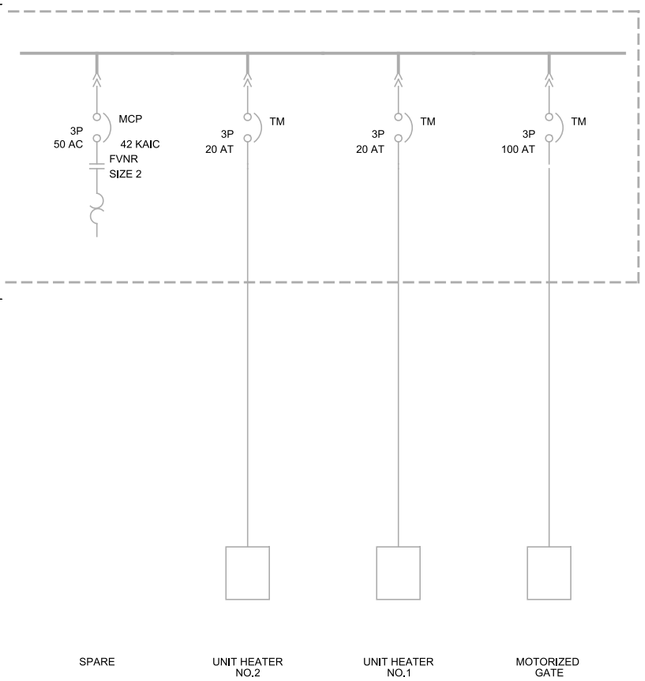
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E09
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E009.dgn

CONTINUED ON PREVIOUS SHEET



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SEWRF ELECTRICAL MASTER PLAN

ELECTRICAL

MCC-5
ONE-LINE DIAGRAM - II

VERIFY SCALES
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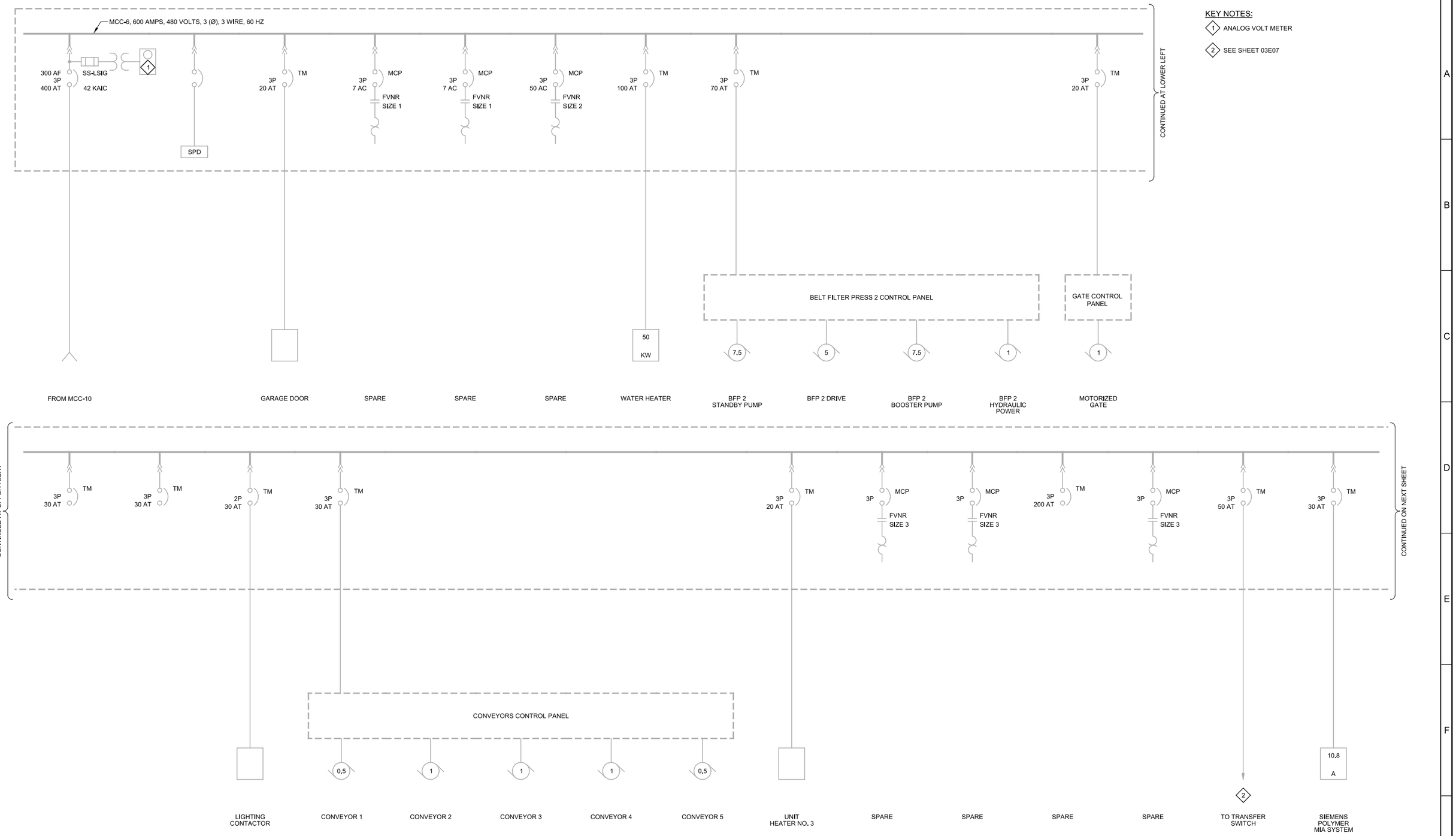
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E10
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E010.dgn



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MANATEE COUNTY
SEWRF ELECTRICAL MASTER PLAN
ELECTRICAL
MCC-6
ONE-LINE DIAGRAM - I

VERIFY SCALES
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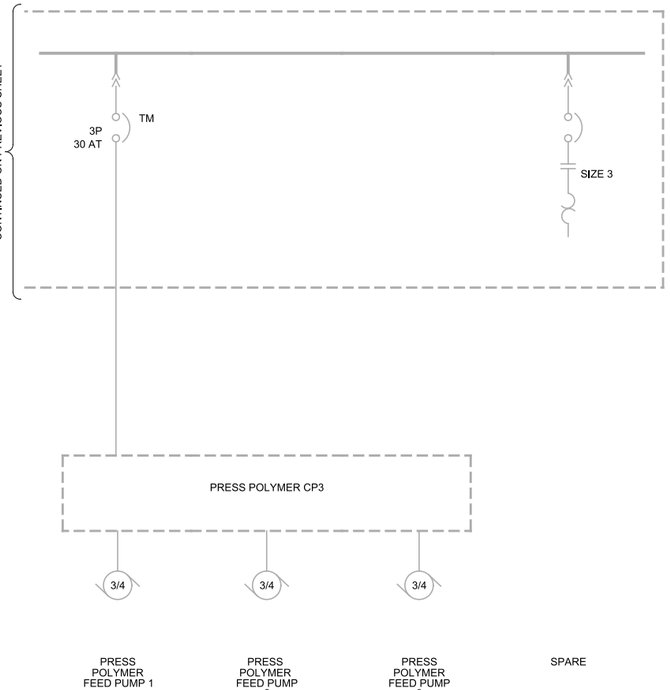
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E11
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E011.dgn

Plot Date: 27-DEC-2017 11:53:23 AM
User: bshepard
PlotScale: 2:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: bshepard



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MANATEE COUNTY

SEWRF ELECTRICAL MASTER PLAN

ELECTRICAL

MCC-6
ONE-LINE DIAGRAM - II

VERIFY SCALES
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0 1"
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JOB NO. 10096N.00
DRAWING NO. 03E12
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E012.dgn

Plot Date: 27-DEC-2017 11:53:26 AM
User: bshepard
PlotScale: 2:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: bshepard

MCC-7, 1200 AMPS, 480 VOLTS, 3 (Ø), 3 WIRE, 60 HZ, 65 KASC RMS

1200 AF 3P 1200 AT — SS-LSIG 65 KAIC — SSM — 3 1200:5

800 AF 3P 800 AT — TM 65 KAIC

SPD

3P 600 AC — MCP 65 KAIC RVAT — 250

3P 600 AC — MCP 65 KAIC RVAT — 250

3P 30 AT — TM 65 KAIC — LL VFD-6 — 3 — 10 — VFD-301

3P 30 AT — TM 65 KAIC — LL VFD-6 — 3 — 10 — VFD-303

3P 30 AT — TM 65 KAIC — LL VFD-6 — 3 — 2 — 10 — VFD-305

3P 30 AT — TM 65 KAIC — GRAVITY BELT SLUDGE THICKENER 2 CONTROL PANEL — 2 — 1 — 2

0 AF 3P 30 AT — TM 65 KAIC — LL VFD-6 LR — 3 — 2 — 10 — VFD-307

CONTINUED AT LOWER LEFT

FROM SWGR-2A

TIE TO MCC-8

SLUDGE BLOWER NO. 1

SLUDGE BLOWER NO. 3

SLUDGE FEED PUMP NO. 1

SLUDGE FEED PUMP NO. 3

SLUDGE FEED PUMP NO. 5

WASHWATER BOOSTER PUMP 2

HYDRAULIC SYSTEM PUMP 2

BELT DRIVE 2

GRAVITY BELT DISCHARGE PUMP 1

CONTINUED AT UPPER RIGHT

3P 50 AT — TM 65 KAIC — 1 — 30 KVA 3 PH 480 V 208/120 V — XFMR L3 — PANEL PC/TC — PANEL 63

3P 3 AC — MCP 65 KAIC FVNR SIZE 1 — 2 — EF-3

EXHAUST FAN

3P 15 AT — TM 65 KAIC

SPARE

3P 15 AT — TM 65 KAIC

MOV-100

FVNR SIZE 2

SPARE

KEY NOTES:

1. SUPPLY CIRCUIT FROM FEEDER BREAKER IN MCC-8, SEE 03E12.
2. WITH DV/DT FILTER.
3. INCLUDES BYPASS.

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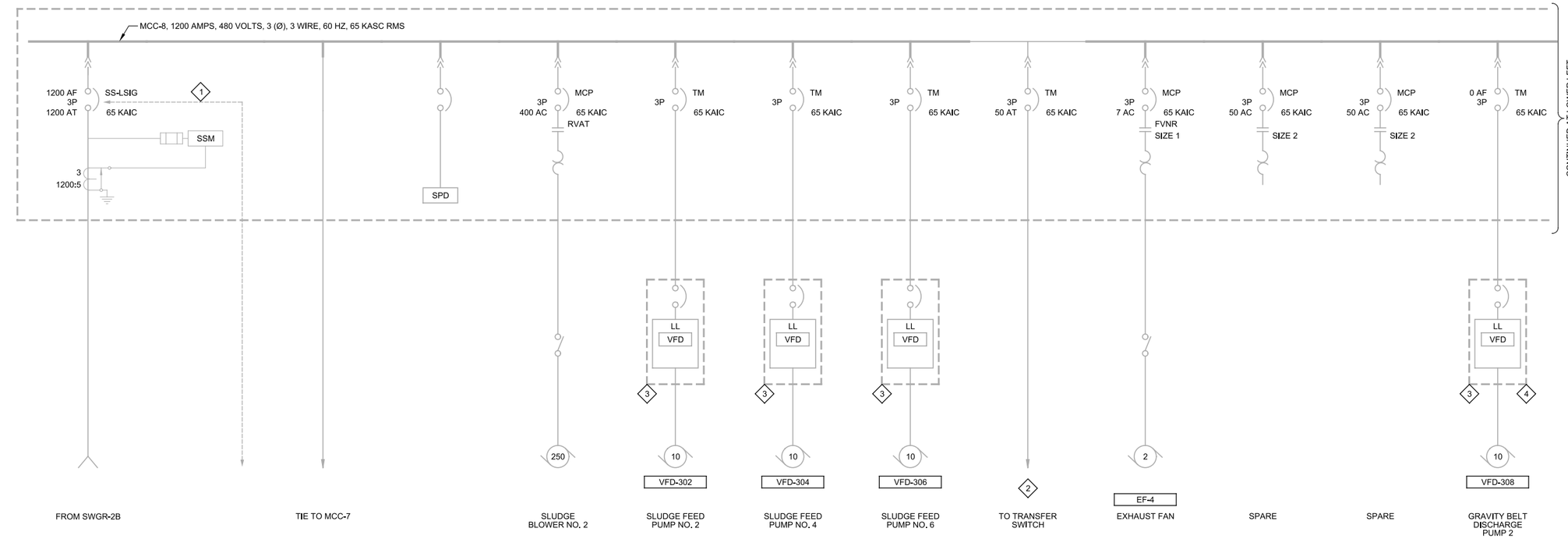
MCC-7
ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

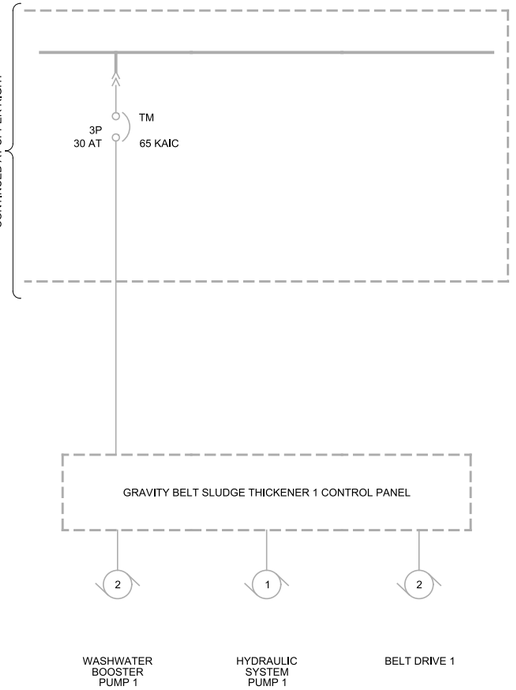
JOB NO. 10096N.00
DRAWING NO. 03E13
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E013.dgn



KEY NOTES:

1. KIRK-KEY INTERLOCK TO MCC-7.
2. SEE SHEET 03E11.
3. INCLUDES BYPASS.
4. UNIT DV/DT FILTER.



REV	DATE	BY	DESCRIPTION
			PRELIMINARY DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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DATE MAY 2017

MANATEE COUNTY

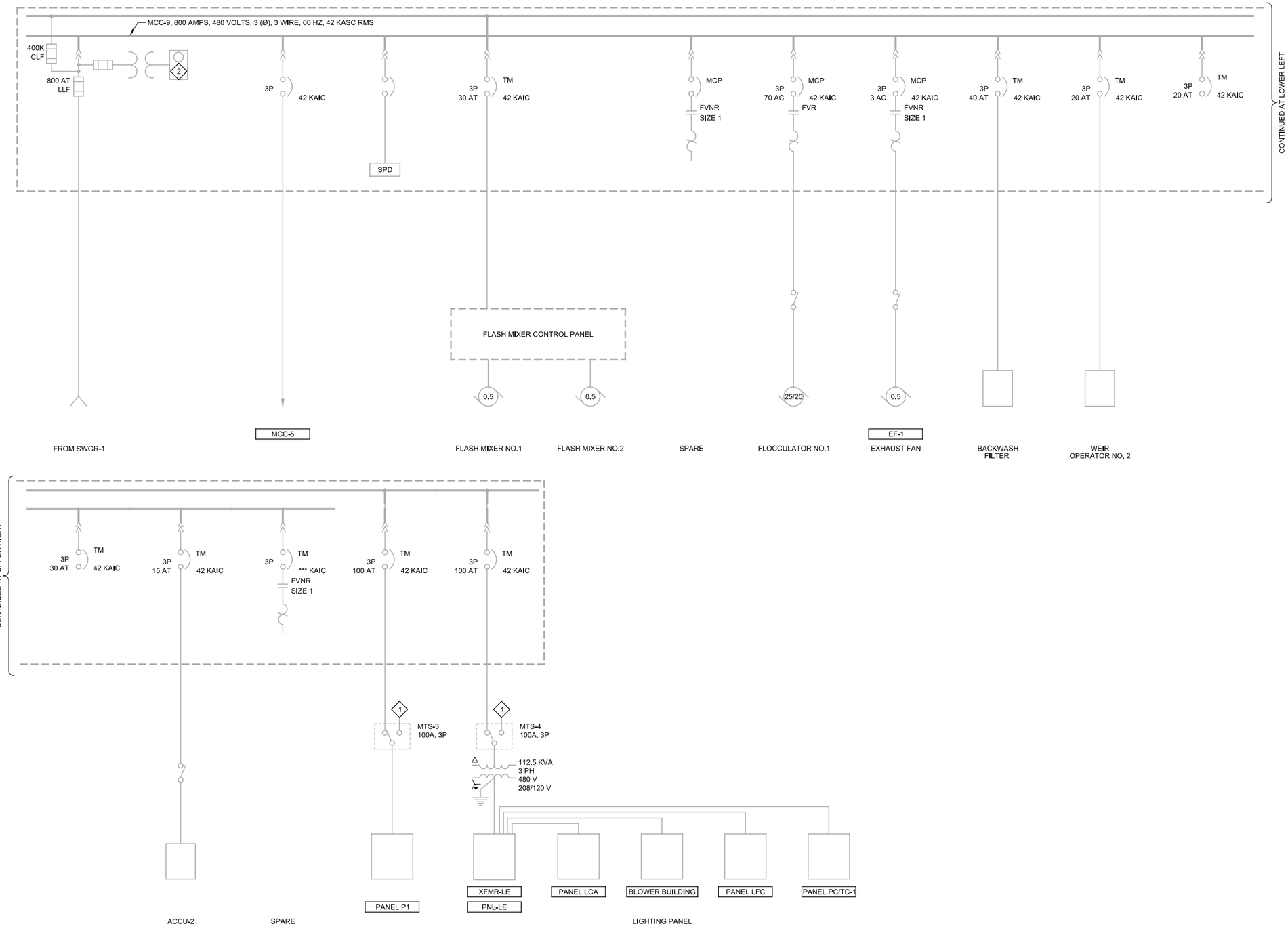
SEWRF ELECTRICAL MASTER PLAN

ELECTRICAL

MCC-8
ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E14
SHEET NO. OF XX



KEY NOTES:

1. SUPPLY CURCUT FROM FEEDER BREAKER IN MCC-10, SEE 03E14.
2. ANALOG VOLT METER.

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DATE MAY 2017

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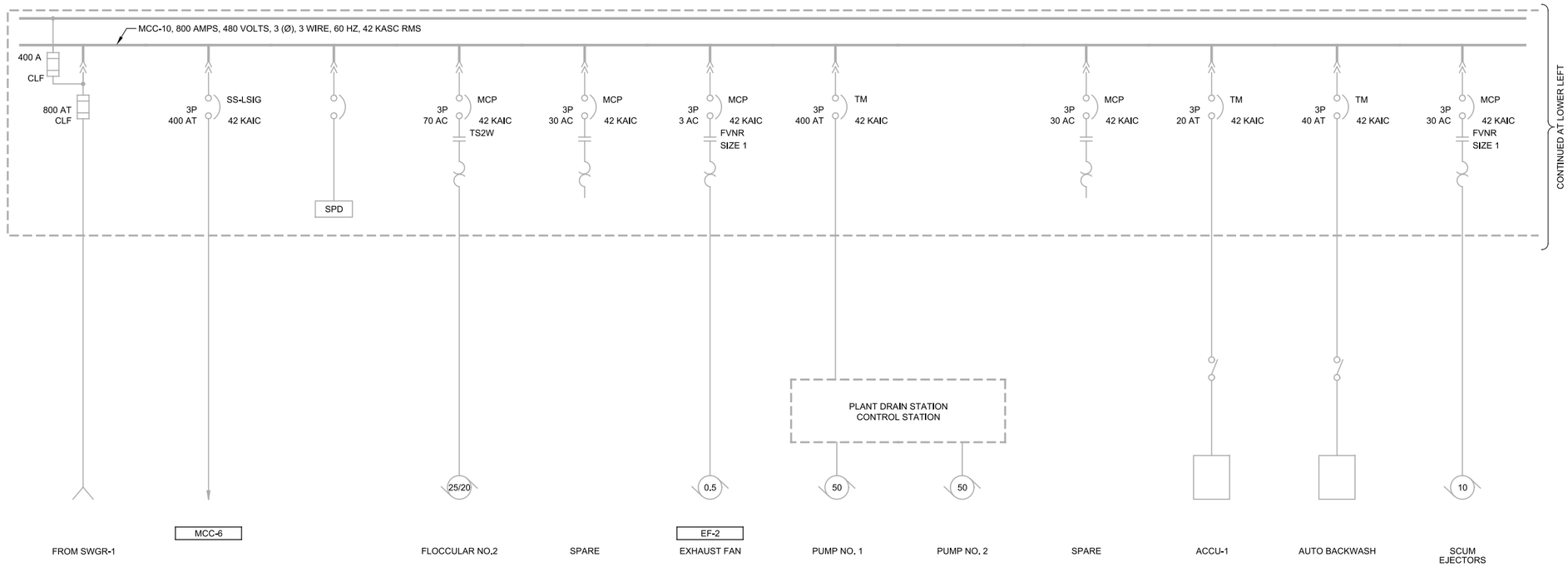
SEWRF ELECTRICAL MASTER PLAN
ELECTRICAL
MCC-9
ONE-LINE DIAGRAM

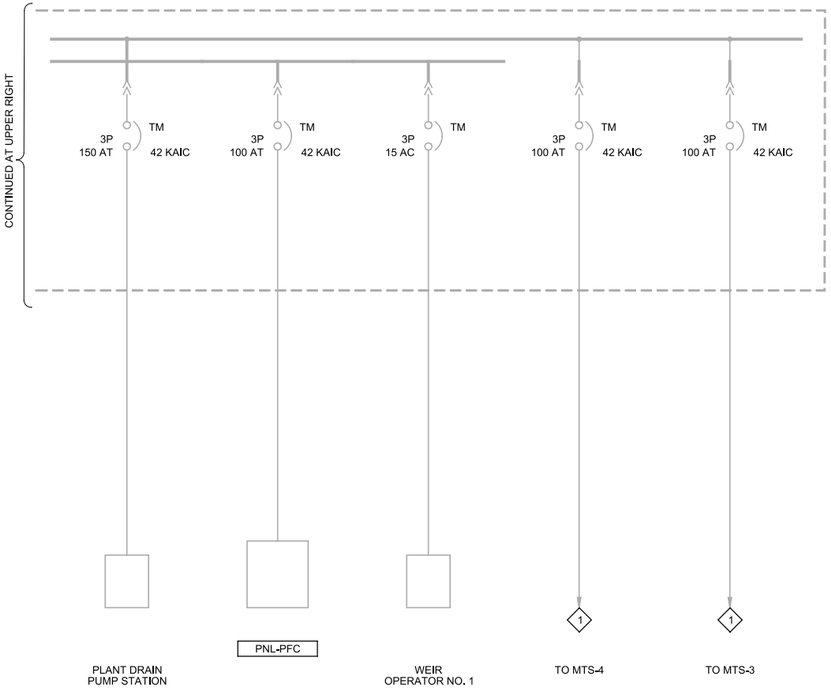
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E15
SHEET NO. OF XX



KEY NOTES:

1. TO MANUAL TRANSFER SWITCH, SEE SHEET 03E13.



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MCC-10
ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E16
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E016.dgn

Plot Date: 12-APR-2018 2:11:20 PM
User: lmorris
Model: Layout1 ColorTable: gshade.ctb DesignScript: Carollo_Std_Pen_v0905.pen PlotScale: 2:1
LAST SAVED BY: lshepard

MCC-11, 800 AMPS, 480 VOLTS, 3 (Ø), 3 WIRE, 60 HZ, 65 KASC RMS

CONTINUED AT LOWER LEFT

FROM SWGR-2	TIE TO MCC-12		GENERATOR WATER JACKET HEATER	CLARIFIER NO. 1	CLARIFIER NO. 3	RAS PUMP NO. 1	RAS PUMP NO. 3	WAS PUMP NO. 1	WAS PUMP NO. 3	AIR COMPRESSOR NO. 1	
800 AF 3P 800 AT	3P 600 AT		3P 30 AT	3P 7 AC	3P 7 AC	3P 150 AT	3P 150 AT	3P 30 AT	3P 30 AT	3P 30 AT	3P 50 AT
SS-LSIG 65 KAIC	TM 65 KAIC		TM 65 KAIC	MCP 65 KAIC FVNR SIZE 1	MCP 65 KAIC FVNR SIZE 1	TM 65 KAIC	TM 65 KAIC	TM 65 KAIC	TM 65 KAIC	TM 65 KAIC	TM 65 KAIC
SSM		SPD				LL VFD-6 (2)	LL VFD-6 (2)	LL VFD-6	LL VFD-6		MTS-L1 (1) 30 KVA 3 PH 480 V 208/120 V
				1	1	75	75	7.5	7.5	10 HP	XFMR-L1 PNL-L1
						VFD-101	VFD-103	VFD-104	VFD-105		

KEY NOTES:

1. FROM MCC-12. SEE SHEET 03E16.
2. INCLUDES BYPASS.

CONTINUED AT UPPER RIGHT

CONTINUED ONTO DWG. 03E18

FILTER NO. 3 DRAIN VALVE	FILTER NO. 3 AIR SCOUR VALVE	SPARE	SUPPLY FAN	PUMP NO. 1-1	PUMP NO. 1-2	PUMP NO. 1-3	AIR COMPRESSOR NO. 2	LAKE GRAVITY DISK FILTER NO. 2			LAKE GRAVITY DISK FILTER NO. 3		
3P 15 AT	3P 15 AT	3P 30 AT	3P 30 AC	3P 200 AT			3P 40 AT	3P 35 AT			3P 35 AT		
TM 65 KAIC	TM 65 KAIC	TM 65 KAIC	MCP 65 KAIC FVNR SIZE 1	TM 65 KAIC			TM 65 KAIC	TM 65 KAIC			TM 65 KAIC		
1 HP	1 HP		10	OLD PLANT DRAIN PUMP STATION CONTROL PANEL (NORTH)			10 HP	DFCP-2			DFCP-3		
			SF-1	25	25	25		7.5	3	3	7.5	3	3

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MANATEE COUNTY

SEWRF ELECTRICAL MASTER PLAN

ELECTRICAL

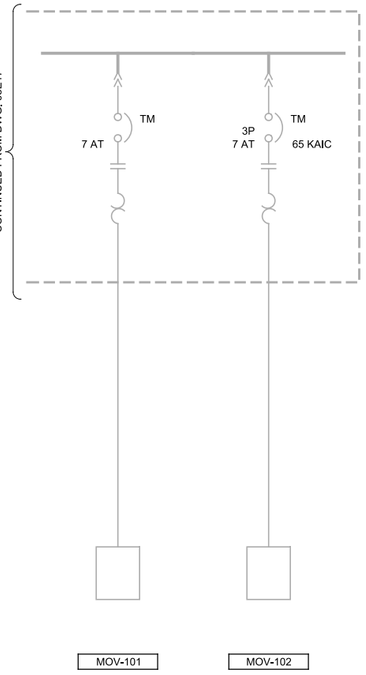
MCC-11
ONE-LINE DIAGRAM - I

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E17
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E017.dgn

Plot Date: 27-DEC-2017 11:53:41 AM
User: bshepard
Model: Layout1 ColorTable: gshade.ctb DesignScript: Carollo_Std_Pen_v0905.pen PlotScale: 2:1
LAST SAVED BY: bshepard



KEY NOTES:

1. FROM MCC-12. SEE SHEET 03E16.
2. INCLUDES BYPASS.

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SEWRF ELECTRICAL MASTER PLAN

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MCC-11A
ONE-LINE DIAGRAM - II

VERIFY SCALES
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0 1"
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JOB NO. 10096N.00
DRAWING NO. 03E18
SHEET NO. OF XX

MCC-12, 800 AMPS, 480 VOLTS, 3 (Ø), 3 WIRE, 60 HZ, 65 KASC RMS

CONTINUED AT LOWER LEFT

FROM SWGR-2	TIE TO MCC-11	SPD	CLARIFIER NO. 2	CLARIFIER NO. 4	RAS PUMP NO. 2	SPARE	WAS PUMP NO. 2	WAS PUMP NO. 4	SPARE
800 AF 3P 800 AT			3P 7 AC	3P 3 AC	150 AF 3P 150 AT	3P 30 AC	3P 30 AT	3P 30 AC	3P
SS-LSIG			MCP	MCP	TM	MCP	TM	MCP	TM
65 KAIC			65 KAIC	65 KAIC	65 KAIC	65 KAIC	65 KAIC	65 KAIC	65 KAIC
SSM			FVNR SIZE 1	FVNR SIZE 1		FVNR SIZE 2			
3 800:5									
			1	1	LL VFD-6 (2) 75		LL VFD-6 7.5 VFD-105	LL VFD-6 7.5 VFD-107	

KEY NOTES:

1. TO MTS-C1, SEE SHEET 03E18.
2. INCLUDES BYPASS.

CONTINUED AT UPPER RIGHT

CONTINUED ONTO 03E20

FILTER NO. 3	FILTER NO. 4	AIR SCOUR BLOWER (FILTERS)	PUMP NO. 2-1	PUMP NO. 2-2	PUMP NO. 2-3	FILTER NO. 4 DRAIN VALVE	FILTER NO. 4 AIR SCOUR VALVE	SUPPLY FAN	EXHAUST FAN	BACKWASH PUMP STATION	LAKE GRAVITY DISK FILTER NO. 1
3P 60 AT		3P 150 AC	3P 150 AT			3P 15 AT	3P 15 AT	3P 30 AC	3P 7 AC	3P 35 AC	3P 35 AT
TM		MCP	TM			TM	TM	MCP	MCP	TM	TM
65 KAIC		65 KAIC	65 KAIC			65 KAIC	65 KAIC	65 KAIC	65 KAIC		65 KAIC
		RVAT/B						FVNR SIZE 1	FVNR SIZE 1		
FILTER CONTROL PANEL 3&4 (AUTO BACK WASH)			NEW PLANT DRAIN PUMP STATION CONTROL PANEL (SOUTH)							BPCP	DFCP-1
7.5	7.5	100	25	25	25	1 HP	1 HP	10	2	5 5	7.5 3 3
								SF-2	EF-2		

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ELECTRICAL
MCC-12
ONE-LINE DIAGRAM

VERIFY SCALES
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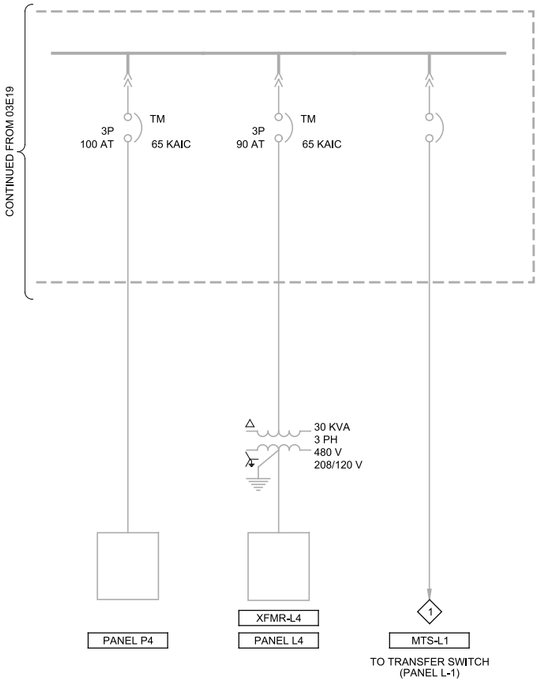
JOB NO. 10096N.00
DRAWING NO. 03E19
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E019.dgn



KEY NOTES:

1. TO MTS-C1, SEE SHEET 03E18.
2. INCLUDES BYPASS.

REV	DATE	BY	DESCRIPTION
			PRELIMINARY DESIGN SUBMITTAL NOT FOR CONSTRUCTION

DESIGNED AHR
DRAWN SMB
CHECKED
DATE MAY 2017

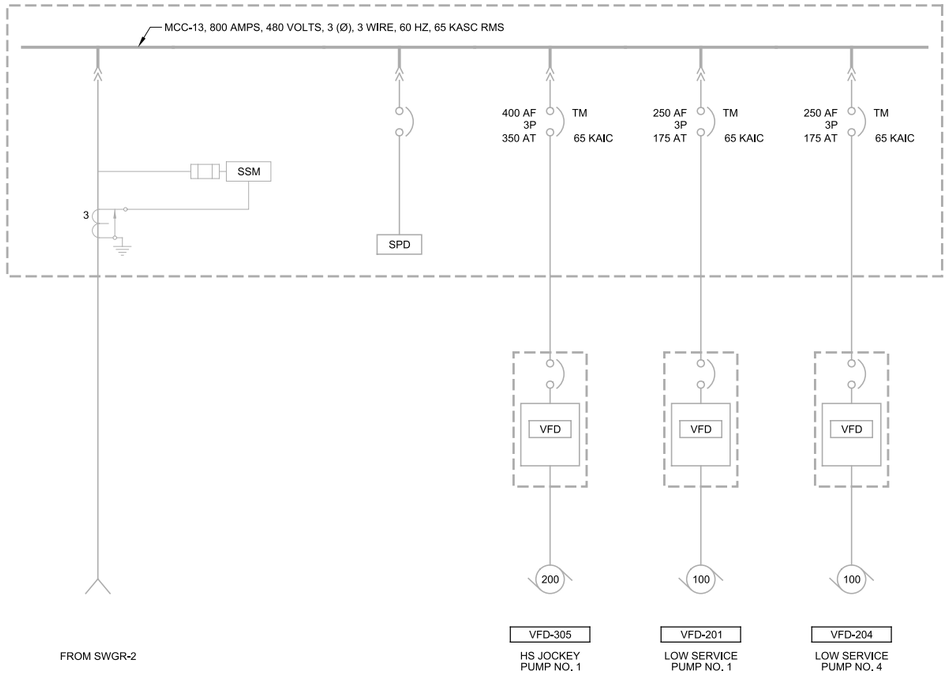
MANATEE COUNTY
SEWRF ELECTRICAL MASTER PLAN
ELECTRICAL
MCC-12
ONE-LINE DIAGRAM - II

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E20
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E020.dgn

Plot Date: 27-DEC-2017 11:53:51 AM
User: bshepard
Model: Layout1 ColorTable: gshade.ctb DesignScript: Carollo_Std_Pen_v0905.pen PlotScale: 2:1
LAST SAVED BY: bshepard



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			PRELIMINARY DESIGN SUBMITTAL NOT FOR CONSTRUCTION

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DATE MAY 2017

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SEWRF ELECTRICAL MASTER PLAN

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MCC-13
ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E21
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E021.dgn

Plot Date: 27-DEC-2017 11:53:54 AM
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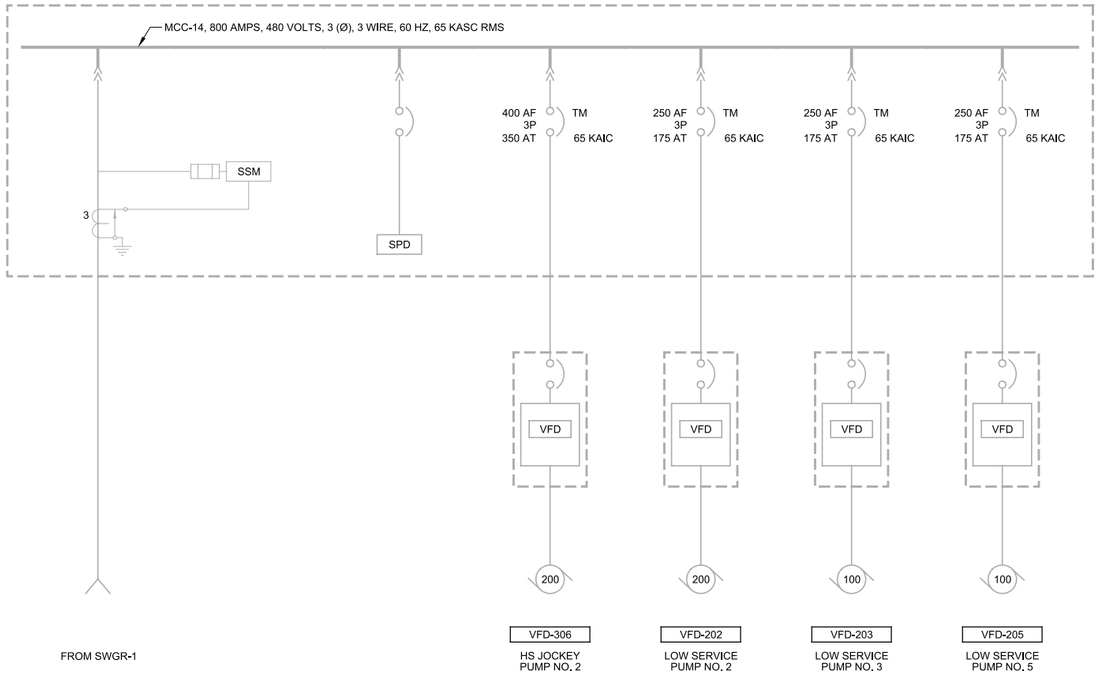

Plot Date: 27-DEC-2017 11:53:57 AM
User: bshepard
Model: Layout1 ColorTable: gshade.ctb DesignScript: Carollo_Std_Pen_v0905.pen PlotScale: 2:1
LAST SAVED BY: bshepard

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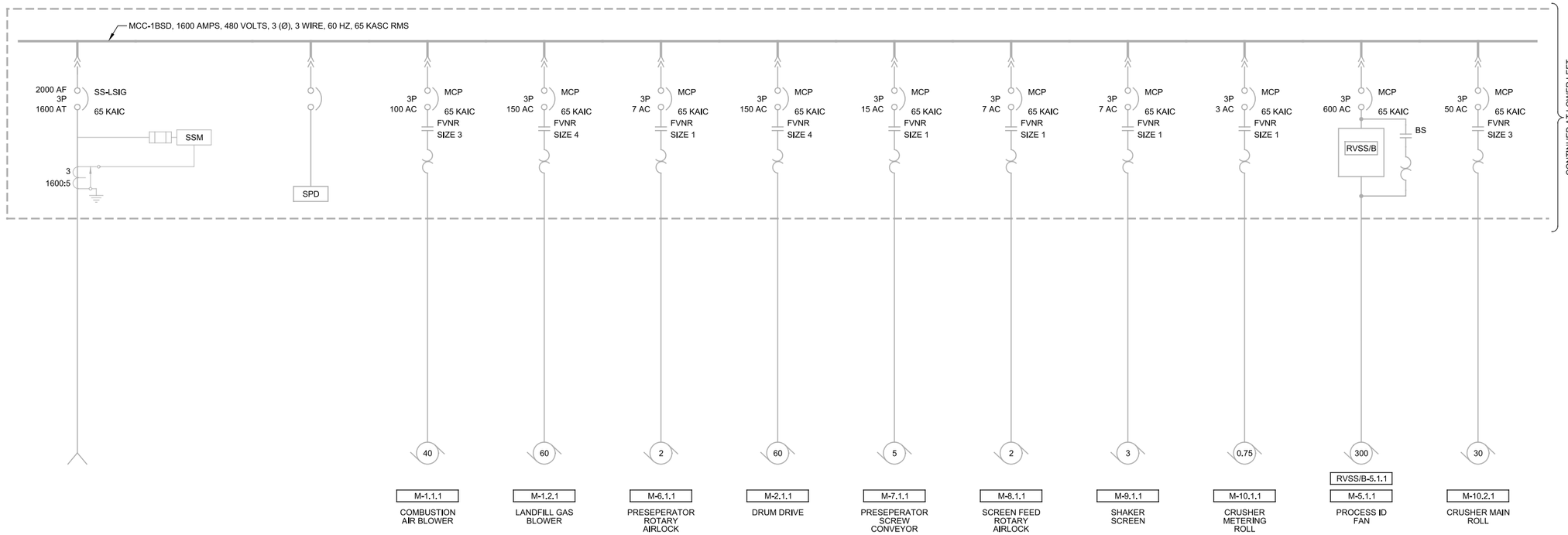
MCC-14
ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E22
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E022.dgn



REV	DATE	BY	DESCRIPTION

PRELIMINARY DESIGN SUBMITTAL
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SEWRF ELECTRICAL MASTER PLAN
ELECTRICAL
MCC-1BSD
ONE-LINE DIAGRAM - I

VERIFY SCALES
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0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 10096N.00
DRAWING NO. 03E23
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E023.dgn

LAST SAVED BY: bshepard Model: Layout1 ColorTable: gshade.ctb DesignScript: Carollo_Std_Pen_v0905.pen PlotScale: 2:1 Plot Date: 12-APR-2018 2:12:32 PM User: lmorris

CONTINUED ON PREVIOUS SHEET

3P 30 AC MCP 65 KAIC FVNR SIZE 1	3P 3 AC MCP 65 KAIC FVNR SIZE 1	3P 7 AC MCP 65 KAIC FVR SIZE 1	3P 3 AC MCP 65 KAIC FVR SIZE 1	3P 35 AT TM 65 KAIC	3P 150 AC MCP 65 KAIC LL VFD-6 LR	3P 3 AC MCP 65 KAIC FVR SIZE 1	3P 3 AC MCP 65 KAIC FVNR SIZE 1	3P 70 AT TM 65 KAIC	3P 7 AC MCP 65 KAIC FVNR SIZE 1	3P 7 AC MCP 65 KAIC FVNR SIZE 1	3P 7 AC MCP 65 KAIC FVNR SIZE 1	3P 7 AC MCP 65 KAIC FVNR SIZE 1
				7.5 KVA 1 PH 480 V 240/120 V				45 KVA 3 PH 480 V 208/120 V				
10	0.5	1.5	1		60	1	0.5		3	3	3	3
M-31.1.1	M-31.2.1	M-60.1.1	M-99.1.1	XFMR-UPS	VFD-520.1.1	M-99.1.2	M-22.1.2	XFMR-LIGHT	M-810.1.1	M-810.2.1	M-810.3.1	M-810.4.1
SILO AREA BAGHOUSE FAN	SILO BAGHOUSE ROTARY AIRLOCK	PELLET COOLER BIN ACTIVATORS	SILO #1 TRUCK LOADOUT CHUTE	PANEL-UPS	M-520.1.1 VENTURI EXHAUST FAN	SILO #2 TRUCK LOADOUT CHUTE	SILO #2 BIN ACTIVATOR	PANEL-LP-1	ROOF VENTILATION FAN 1	ROOF VENTILATION FAN 2	ROOF VENTILATION FAN 3	ROOF VENTILATION FAN 4

CONTINUED AT LOWER LEFT

CONTINUED AT UPPER RIGHT

3P 7 AC MCP 65 KAIC FVNR SIZE 1	3P 15 AC MCP 65 KAIC FVNR SIZE 1	3P 15 AC MCP 65 KAIC FVNR SIZE 1	3P 15 AC MCP 65 KAIC FVNR SIZE 1	3P 15 AC MCP 65 KAIC FVNR SIZE 1	3P 50 AC MCP 65 KAIC FVNR SIZE 3	3P 40 AT TM 65 KAIC	3P 50 AC MCP 65 KAIC FVNR SIZE 3
2	5	5	5	5	30	32 AMP	30
M-620.1.1	M-461.1.1	M-461.2.1	M-461.1.2	M-461.2.2	M-465.1.1	CB-620.1.1	M-465.1.2
PELLET OILING PUMP	SLUDGE PIT 1 LIVE BOTTOM SCREW 1	SLUDGE PIT 1 LIVE BOTTOM SCREW 2	SLUDGE PIT 2 LIVE BOTTOM SCREW 1	SLUDGE PIT 2 LIVE BOTTOM SCREW 2	CAKE TRANSFER PUMP #1	PELLET OILING FEEDER	CAKE TRANSFER PUMP #2

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MANATEE COUNTY
SEWRF ELECTRICAL MASTER PLAN
ELECTRICAL
MCC-1BSD
ONE-LINE DIAGRAM - II

VERIFY SCALES
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0 1"
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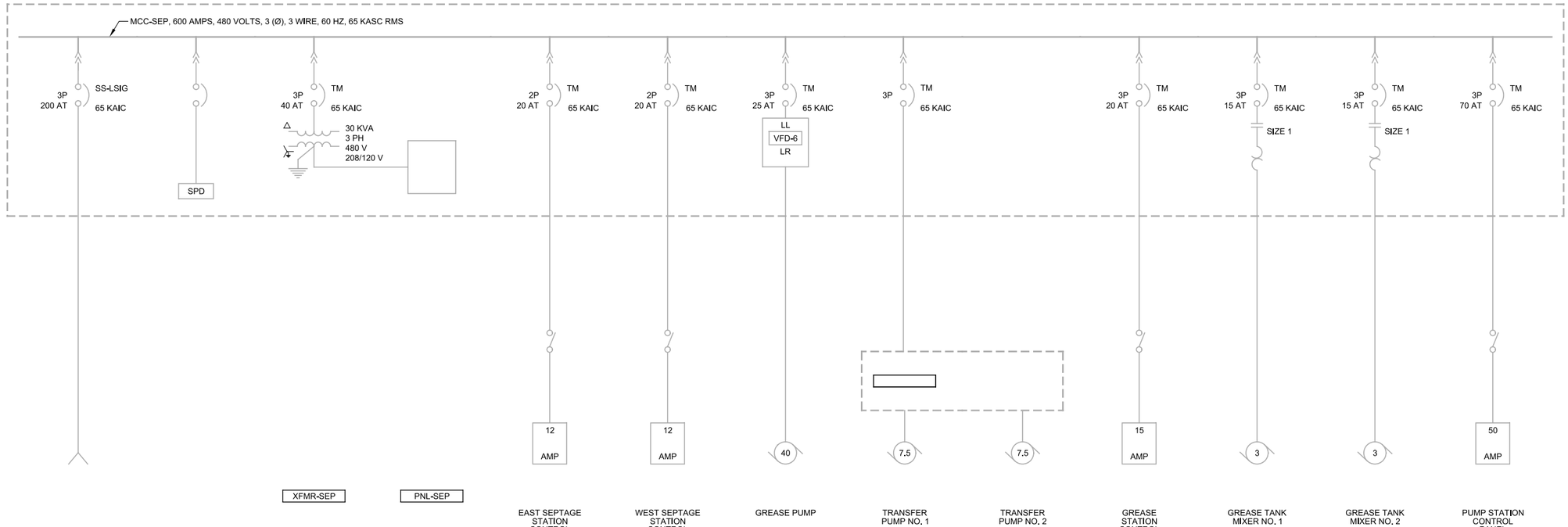
JOB NO. 10096N.00
DRAWING NO. 03E24
SHEET NO. OF XX

LAST SAVED BY: lmorris Model: Layout1 ColorTable: gshade.ctb DesignScript: Carollo_Std_Pen_v0905.pen PlotScale: 2:1 Plot Date: 16-JUL-2018 15:33:33 PM User: lmorris



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REV	DATE	BY	DESCRIPTION

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DATE MAY 2017

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Manatee County FLORIDA

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SEWRF ELECTRICAL MASTER PLAN

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MCC-SEP
ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
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JOB NO. 10096N.00
DRAWING NO. 03E25
SHEET NO. OF XX

PROJECT NO. 10096N.00 FILE NAME: 10096N0003E024.dgn

Plot Date: 12-APR-2018 2:23:17 PM
User: lmorris
Model: Layout1 ColorTable: gshade.ctb DesignScript: Carollo_Std_Pen_v0905.pen PlotScale: 2:1
LAST SAVED BY: bshepard