City of Pinole

Pinole/Hercules WPCP Project

Technical Memorandum 18

Electrical Distribution System and Plant SCADA System Configuration Evaluation

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PRELIMINARY
FOR REVIEW ONLY

March 1, 2013

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TM 18 - Electrical Distribution System Configuration Evaluation

Pinole/Hercules WPCP Project **March 1, 2013**

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Executive Summary

The existing Pinole-Hercules Water Pollution Control Plant (WPCP) electrical system does not have the capability to serve the upgraded plant. A second 480-volt service point is needed at the proposed Headworks to serve the expanded load in that area including the headworks, influent pumps, primary clarifiers and effluent pumps. The existing 480-volt load center can remain in service in the Blower Building with some improvements.

In order to establish the second 480-volt load center at the Headworks and to minimize ongoing electrical rate costs it is recommended that the plant take electrical service at primary 12-KV voltage. This will allow the establishment of the two 480-volt load centers at the existing Blower Building and at the Headworks. The electrical rates at primary voltage are less expensive than at 480-volts.

It is recommended that the plant RTU system be improved as recommended in this TM.

Introduction

The purpose of this technical memorandum (TM) is to determine the condition and capacity of the existing electrical system and determine improvements needed for support of the proposed plant improvements.

There is an existing plant SCADA system consisting of multiple programmable logic controller (PLC) based remote terminal units (RTUs) in the field which gather plant data, provide process control and monitor process operation. There is an existing Schneider Electric Citect Supervisory Control and Data Acquisition (SCADA) system which the WPCP is planning to replace. This TM will review the existing plant RTUs and provide recommendations for RTU upgrades, replacements and improvements.

Existing Plant Electrical System

Electrical service to the Pinole-Hercules Water Pollution Control Plant (WPCP) is provided by Hercules Municipal Utility (HMU) at 12- KV primary voltage, but is billed based on the low voltage meters at the two existing switchboards. The two existing switchboards are a 1,200-ampere switchboard (SWBD-A) in the Blower Building and 600-ampere switchboard (SWBD-B) at the Effluent Pump Station. Both service switchboards are served from the 1,000-kVA service transformer. The existing WPCP electrical system is shown in single line form in Figure 18-1. The existing demand loads are within the capacity of the existing electrical system although the 600-ampere service which serves the existing effluent pumps has the capacity to run only two effluent pumps.

HMU owns the primary service pole, the primary conductors from the service pole outside the main plant entrance gate to the 1,000-kVA service transformer at the Administration Building, the 1,000-kVA service transformer, the 1,200-ampere and 600-ampere, 480-volt service conductors from the 1,000-kVA transformer to SWBD-A in the Blower Building and to SWBD-B at the Effluent Pump Station. PG&E does have primary metering on this service, but it is not used to bill the WPCP.

WPCP Expansion Loads

The electrical loads will increase considerably under the planned plant upgrades. The expected loads are shown in Appendix A. The connected load is the actual load or horsepower of each planned drive and load. The duty load reflects the loads that can run concurrently. The total expected demand load is 2,112-kVA or 2,540-amperes which are well in excess of the existing 1,000-kVA service transformer capacity and in excess of the sum of the existing 1,200-kVA and 600-kVA service feeder and switchboard capacities.

Recommended Electrical System Expansion and Improvements

The majority of the new load lies in the western section of WPCP around the Effluent Pump Station and the new Headworks. Influent pumping is incorporated into the new Headworks and is the most critical load.

An analysis of WPCP loads and locations indicates that the existing 1,000-kVA service transformer and SWBD-A are adequate for future loads if the influent pumping, primary/secondary clarification system and effluent pumping loads are removed. The most economical and practical arrangement is as follows:

1. Establish new WPCP-owned 12-KV primary service with switchgear/metering equipment. The WPCP should attempt to purchase the existing primary service conductors, the 1,000-kVA transformer, and the two sets of 480-volt secondary conductors from HMU as part of the conversion to primary metering.

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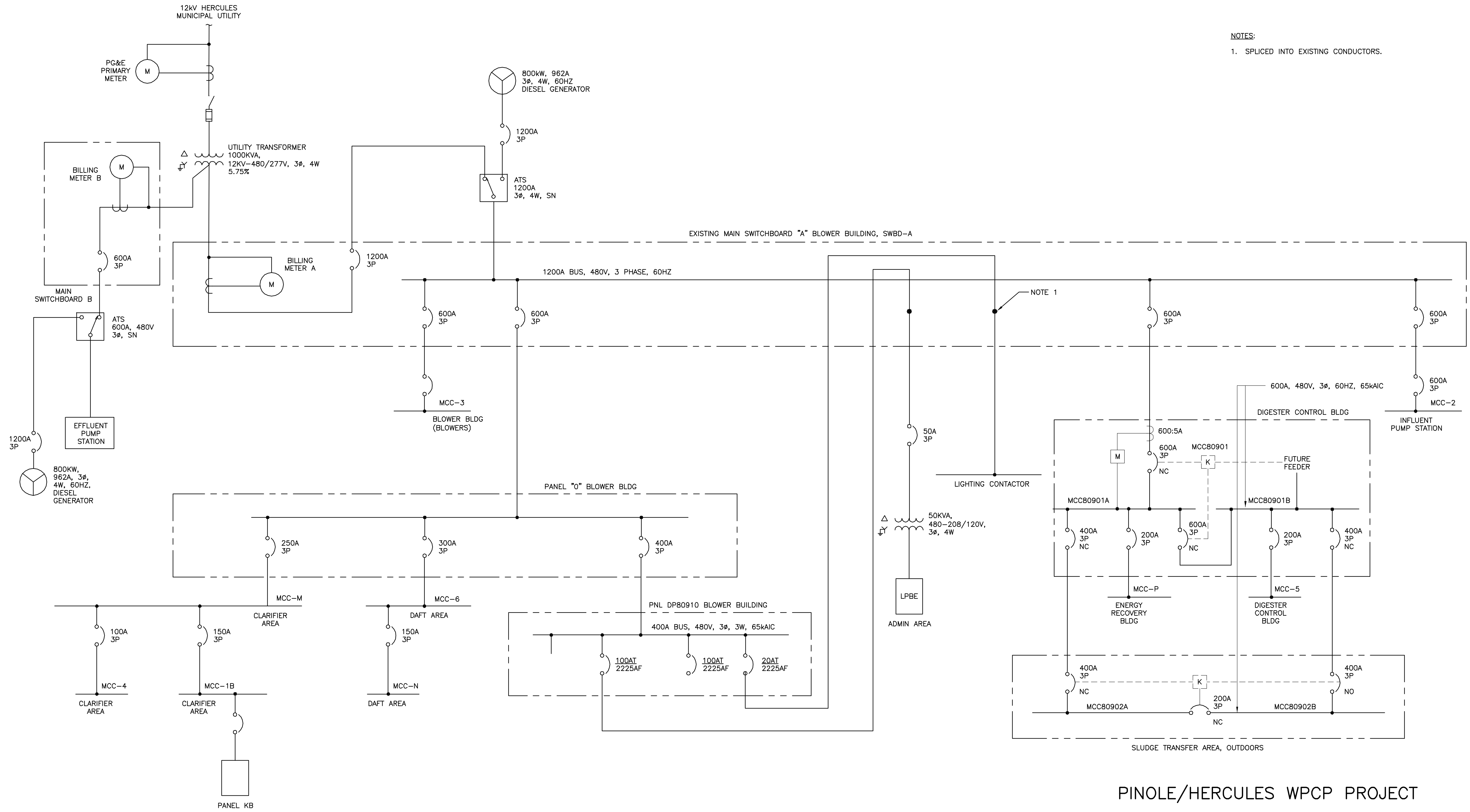

PINOLE/HERCULES WPCP PROJECT

EXISTING SINGLE LINE DIAGRAM

Figure 18–1

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2. Establish 12-KV feeds from the primary service to the existing 1,000-kVA transformer and a second primary feed to a new 2,000-kVA service transformer and 2,500-ampere, 480-volt service switchboard, SWBD-B, in the vicinity of the Effluent Pump Station/Headworks to serve the effluent pumps, headworks, influent pumps, and the primary and secondary clarification systems.
3. Coordinate with PG&E because the existing primary service does not meet PG&E requirements for protection. PG&E requires a re-closer or primary circuit breaker in the primary line between the customer and its system. As the primary is expanded to provide two feeders for the two substations, the primary service should be upgraded to meet PG&E protection requirements as shown in Figure 18-2 as it is likely that, in the future, PG&E will be the electrical supplier to the WPCP.
4. Add a second 800-kW standby diesel generator to operate in parallel with the existing 800-kW generator at the Effluent Pump Station. This addition provides adequate standby power for the service point and dual generator backup for the critical influent pumps.

The new 480-volt substation relieves enough load from the existing 1,000-kVA service transformer, 1,200-ampere switchboard, SWBD-A, and existing 800-kW generator in the Blower Building to serve the balance of the upgraded plant load including the new blowers.

The following changes to the existing 1,200-ampere service switchboard are recommended:

5. Remove the existing 600-ampere feeder from the 1,000-kVA service transformer that now runs to the effluent pumping.
6. Place the new centrifuge on the same feeder from motor control center (MCC) 5 in the Digester Building that now serves the existing main centrifuge. Install a manual transfer switch on this feeder so only one centrifuge can be selected to run at a time.
7. Consolidate existing MCC-6 and MCC-N into a single new MCC-N located on the north-east wall of the former Dissolved Air Flotation Tank (DAFT) Building, (now the Polymer Storage Building). This MCC will serve miscellaneous drives associated with the centrifuges and dewatered sludge equipment as well as the mixers and recirculation pumps associated with the aeration nutrient removal process.
8. Consolidate the feeder breakers in Panel O, PNL DP80910 and the four existing feeders in the existing main switchboard into two new 480-volt distribution sections. The new distribution sections should be added to the existing main switchboard adjacent to the existing 1,200-ampere main breaker section and extended out to take the space now used by Panel O. This will simplify the switchboard distribution arrangement, eliminate wiring and panels, and increase reliability.
9. Run the power and control conductors from the standby generator in the Blower Building directly to the automatic transfer switch (ATS) in the generator room rather than through SWBD-A.

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10. Consolidate MCC-M, MCC-1B, and MCC-4 in the secondary clarification area and consolidate the variable frequency drives (VFD) and RTU7 in an air conditioned VFD cabinet.

11. Replace Panel LPBE in the Administration Building.

The proposed electrical system is shown in single line form in Figure 18-2. This arrangement places a maximum demand load on SWBD-A of 786-kVA (945-amperes) and on SWBD-B of 1,326-kVA (1,595-amperes). Minor future load can be added to SWBD-A and additional load to SWBD-B. A summary of the demand loads on each MCC and switchboard is shown in Table 18-1.

If, in the future, a major load is added, a third 480-volt substation and switchboard can be established by running a third primary feeder from the proposed primary service.

Table 18-1. Plant Electrical Load Summary

Item	Load		Capacity, Amps
	kVA	Amps	
Service Switchboard A	786	945	960
MCCN	71	85	120
MCC80901A	278	333	480
MCC5	83	99	160
MCCP	41	49	160
Panel LPBE	30	36	40
Service Switchboard B	1,326	1,595	2,000
MCCM	104	125	250

Construction Sequencing

Construction sequencing will be critical to keeping the plant in operation. The following general sequence will be required.

1. Upgrade the existing primary service to meet PG&E requirements. This upgrade should be an early step in construction and the changeover carried out while the plant operates on standby generation.

2. Construct the new substation, switchboard SWBD-B, new standby generator and electrical building. Connect the Headworks and primary and secondary clarification system to SWBD-B. The primary feeder for SWBD-B should be routed around the southwest perimeter of the plant.

3. Remove 600-ampere SWBD-B feeder (effluent pumps) from 1,000-kVA transformer.

4. Add distribution section to switchboard, SWBD-A, and remove Panel O and PNL DP80910.

5. Install new MCC-N and remove existing MCC-6 and MCC-N.

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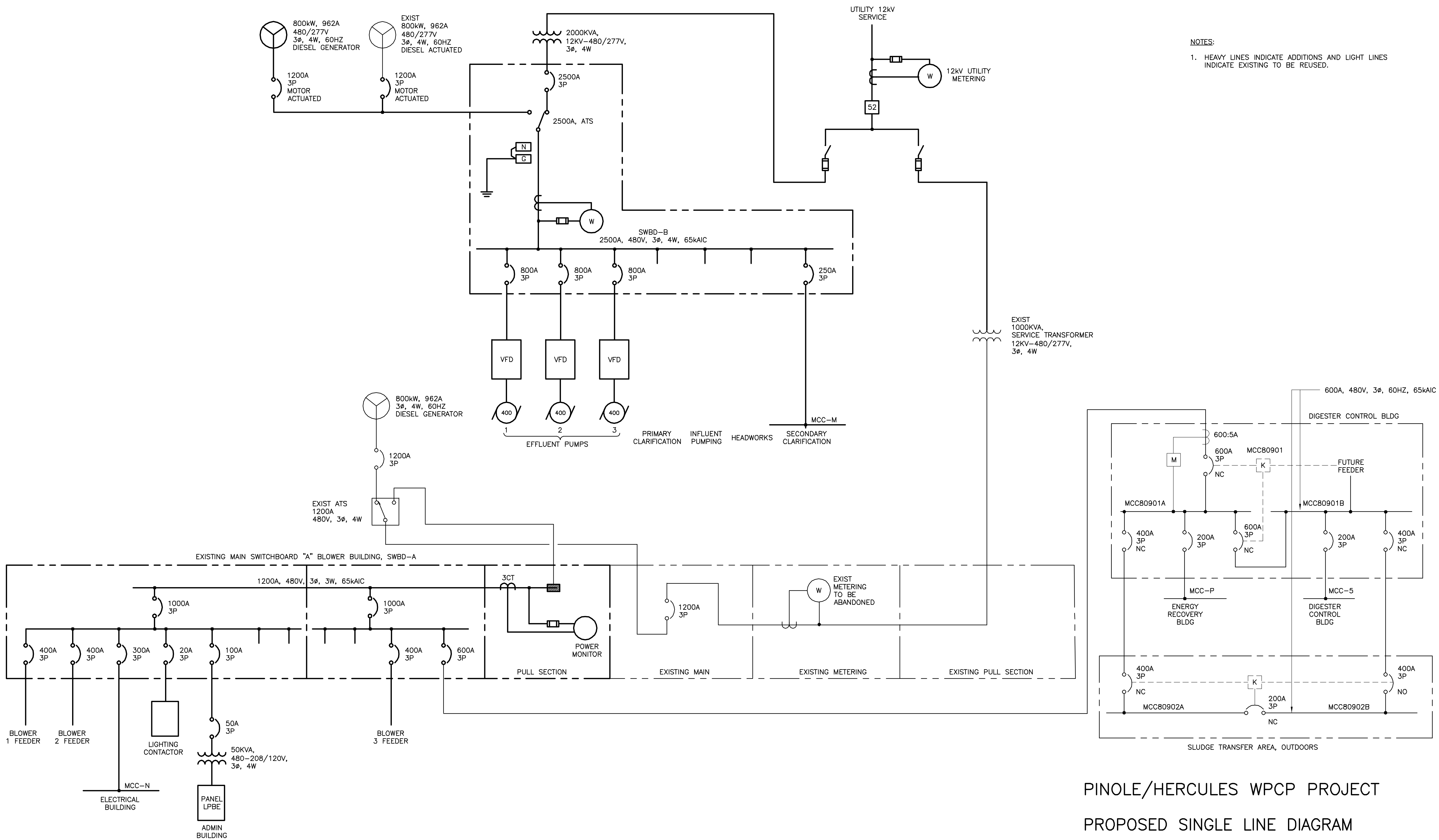

PINOLE/HERCULES WPCP PROJECT

PROPOSED SINGLE LINE DIAGRAM

Figure 18–2

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6. Relocate existing underground duct banks and conduits outside the construction area in the primary and secondary clarifiers, solids handling facility, and the extended aeration basins. This work to be done early in construction.

Existing SCADA System

The existing WPCP SCADA system consists of seven Direct Logic 405 based remote terminal units (RTUs) and central SCADA terminals using Schneider Electric Citect SCADA software. The WPCP's control integrator is Calcon Systems, Inc., of San Ramon, California.

It is likely, according to the WPCP, that the Citect SCADA will be phased out and replaced. This work will be done by Calcon under contract to the WPCP and will not be a part of construction upgrades.

The existing RTUs are distributed around the plant as follows and are connected to SCADA using Ethernet data cabling:

- RTU1: Not Used
- RTU2: Influent Pump Station
- RTU3: Blower Building
- RTU4: DAFT Building (900 MHz radio)
- RTU5: Co-Generation
- RTU6: Digester Control building
- RTU7: Secondary Clarification (900 MHz radio)
- RTU8: Effluent Pump Station (900 MHZ radio)
- RTU9: Chlorine Contact/Effluent (900 MHz radio)

Planned SCADA System

It is planned that the following RTU's will be in service for the expanded treatment plant:

- RTU1: Not Used
- RTU2: Headworks/Influent Pumping
- RTU3: Blower Building
- RTU4: MCC-N
- RTU5: Co-Generation
- RTU6: Digester Control Building
- RTU7: Primary/Secondary Clarification

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- RTU8: Effluent Pump Station
- RTU9: Chlorine Contact/Effluent

RTU 3, RTU5 and RTU6 will remain essentially as existing except the existing blowers will be removed from RTU3 and the new blowers added.

RTU4 will be moved within the existing building and will serve all of the drives in MCC-N including the miscellaneous dewatering drives and the aeration basin drives.

RTU2 will be replaced with a new RTU located to serve the Headworks, Influent Pumping and Primary Clarification.

RTU7 will serve Secondary Clarification.

RTU8 will remain in place to continue to serve loads in the Effluent Pump Station.

RTU9 will serve disinfection and effluent monitoring.

Some of the existing RTUs are on 900 MHz unlicensed radio for convenience in communications where conduits are not available for fiber optic or hard wired cable. Where practical, consideration will be given to installing fiber optic cable for communications.

The existing RTUs will be expanded as needed for new loads and replacement RTUs will be installed where needed.

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Appendix A. Load Study

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Switchboard A Loads

*Table 18 A-1. Switchboard, SWBDA, 1,200 A. Main
Biological Treatment, Sludge Digestion, Dewatering, Administration*

Load	kVA	
	Connected	Demand
Blower 1, 200 HP	200	200
Blower 2, 200 HP	200	200
Blower 3, 200 HP	200	--
Lighting Contactor, 8 kVA	8	8
Administration Panel LPBE, 50 kVA	50	30
MCC-N	100.5	70.5
MCC-80901A	337.5	277.5
kVA	1,096	786
Amperes at 480V	1,319	945

*Table 18 A-2. MCCN, 150A. Main
Electrical Building, Dewatering, Biological Treatment*

Load	kVA	
	Connected	Demand
Exhaust Fan, 0.5 HP	0.5	0.5
Lighting	20	10
Mixer AB 1A, 10 HP	10	10
Mixer AB 1B, 10 HP	10	10
Mixer AB 2A, 10 HP	10	10
Mixer AB 2B, 10 HP	10	10
Recirculation Pump 1, 10 HP	10	10
Recirculation Pump 2, 10 HP	10	--
Recirculation Pump 3, 10 HP	10	10
Recirculation Pump 4, 10 HP	10	--
kVA	100.5	70.5
Amperes at 480V	121	85

Table 18 A-3. MCC80901A, 600 A. Main Sludge Digestion, Energy Recovery, Sludge Dewatering

Load	kVA	
	Connected	Demand
MCC-80901 A	49	39
MCC-80901B	27	27
MCC-80902A	73	58
MCC-80902B	55	30
MCC-P	46	41
MCC-5	87.5	82.5
kVA	337.5	277.5
Amperes at 480V	407	333

Table 18 A-4. MCC5, 200 A. Main Digestion, Centrifuge

Load	kVA	
	Connected	Demand
Sludge Transfer Pump No. 1, 5 HP	5	5
Sludge Transfer Pump No. 2, 5 HP	5	--
Digested Sludge Pump, 7.5 HP	7.5	7.5
Thickened Sludge Pump, 7.5 HP	7.5	7.5
Thickener, 1.5 HP	1.5	1.5
Grit Conveyor, 1 HP	1	1
Centrifuge, 60 HP	60	60
kVA	87.5	82.5
Amperes at 480V	105	99

Table 18 A-5. MCCP, 200 A. Main Energy Recovery

Load	kVA	
	Connected	Demand
Grinder No. 4, 3 HP	3	3
Grinder No. 5, 3 HP	3	3
Sludge Recirc Pump No. 3, 20 HP	20	20
Sludge Recirc Pump No. 4, 5 HP	5	--
Exhaust Fan, 5 HP	5	5
Digested Sludge Pump No. 2, 10 HP	10	10
kVA	46	41
Amperes at 480V	55	49

Switchboard B Loads

*Table 18 A-6. Switchboard, SWBDB, 2,500-ampere Main
Headworks, Influent Pumping, Primary, Secondary and Effluent Pumping*

Load	kVA	
	Connected	Demand
Effluent Pump 1, 400 HP	400	400
Effluent Pump 2, 400 HP	400	400
Effluent Pump 3, 400 HP	400	--
Influent Pump 1, 60 HP	60	60
Influent Pump 2, 60 HP	60	60
Influent Pump 3, 60 HP	60	60
Influent Pump 4, 60 HP	60	60
Barscreen 1, 1 HP	1	1
Barscreen 2, 1 HP	1	1
Washer/Compactor, 5 HP	5	5
Screw Conveyor, 3 HP	3	3
Grit Chamber Drive, 1.5 HP	1.5	1.5
Grit Pump 1, 10 HP	10	10
Grit Pump 2, 10 HP	10	--
Grit Classifier, 5 HP	5	5
Primary Clarifier 1, 2 HP	2	2
Primary Clarifier 2, 2 HP	2	2
Primary Clarifier 3, 2 HP	2	2
Primary Sludge Pump 1, 20 HP	20	20
Primary Sludge Pump 2, 20 HP	20	20
Primary Sludge Pump 1/2, 20 HP	20	--
Primary Sludge Pump 3, 20 HP	20	20
Primary Sludge Pump 3, 20 HP	20	--
Primary Scum Pump 1/2, 10 HP	10	10
Primary Scum Pump 3, 10 HP	10	10
Lighting, etc.	50	30
Generator 1 Block Heater	5	5
Generator 2 Block Heater	5	5
HVAC	30	30
MCC-M	198.5	103.5
kVA	1,891	1,326
Amperes at 480V	2,275	1,595

*Table 18 A-7. MCCM, 250 A Main
Secondary Clarification*

Load	kVA	
	Connected	Demand
Secondary Clarifier 1, 2 HP	2	2
Secondary Clarifier 2, 2 HP	2	2
Secondary Clarifier 3, 1.5 HP	1.5	1.5
Secondary Clarifier 4, 1.5 HP	1.5	1.5
Secondary Clarifier 5, 1.5 HP	1.5	1.5
Scum Pump 1, 7.5 HP	7.5	7.5
Scum Pump 2, 7.5 HP	7.5	--
Scum Pump 3, 5 HP	5	5
Scum Pump 4, 5 HP	5	--
Lighting, 20 kVA	20	10
RAS Pump 1, 7.5 HP	7.5	7.5
RAS Pump 2, 7.5 HP	7.5	--
RAS Pump 3, 7.5 HP	7.5	7.5
RAS Pump 4, 7.5 HP	7.5	--
RAS Pump 5, 7.5 HP	7.5	7.5
RAS Pump 6, 7.5 HP	7.5	--
RAS Pump 7, 15 HP	15	15
RAS Pump 8, 15 HP	15	--
RAS Pump 9, 15 HP	15	15
RAS Pump 10, 15 HP	15	--
WAS Pump 1	10	10
WAS Pump 2	10	--
WAS Pump 3	10	10
WAS Pump 4	10	--
kVA	198.5	103.5
Amperes at 480V	239	125