J Calton Engineering

MARIN COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

PROPOSED RELIABILITY MEMO
FOR THE COVE PUMP STATION

DATE: February 18, 2017

TO: Mr. Scott McMorrow, Assistant Engineer

FROM: Mr. John Calton, PE E14099, J Calton Engineering

This memo is to provide status and overview of the existing electrical equipment and controls at the District's Cove Pump Station, and propose modifications to improve station reliability. The memo is based on visual inspection of the electrical equipment, and discussion with Mr. Scott McMorrow, Assistant Engineer, on January 18, 2017.

1.0 EXECUTIVE SUMMARY

The motor control center was installed in 2006, with only minor improvements since original installation. The existing equipment is functional and still within the equipment manufacturer's rated lifetime, typically twenty five years. The equipment is well maintained. To increase station reliability it is proposed to remove the Power Monitor and Motor Thermostat permissive controls from the pump logic. It is also proposed to revise the back-up level controls such that the pumps pump down to a new low level stop float versus operating until the high level float clears plus a set time duration.

Modification Priority, Plant Capacity Impacts, and Work Duration

The following groups are formed by assigning a priority, as determined by increased operational reliability and ease of modification work. Also defined is the impact to plant capacity, and estimated duration of modification work.

- **Highest Priority "A" Modification:**
  - **Jumper Power Monitor and Motor Thermostat Controls:** Provide a jumper around the Power Monitor and Motor Thermostat contacts used for pump permissive operation. This is typical for Pumps 1, 2 and 4 (Power Monitor only). Confirm the PLC logic does not prohibit the PLC "auto" call of the pumps if the Power Monitor or Motor Thermostat contact to the PLC are in alarm state. Refer to revised control logic on attached drawing, "Cove PS Proposed Modifications".
  - One Pump out of service at a time. Plant shut down not required, as work can be done on a pump by pump basis. Expected duration less than half a day.
- **Medium Priority "B" Modification:**
  - **Add Low Level "Stop" Float Switch:** Procure and install new Low Level Float Switch. Modify the hardwired logic for back up float control to wire in new Low

Level Float Switch to stop the pumps at low sump level. Refer to revised control logic on attached drawing, “Cove PS Proposed Modifications”.
    - Pump 3 out of service. Plant shut down not required. Expected work duration one day.
- **Lowest Priority “C” Modification:**
    - **Pump 4 in Auto Pump Logic:** Allow Pump 4 to be part of the LEAD/LAG/LAG sequence, by putting in LEAD position. This will minimize numerous starts and short run times of other larger pumps. Allow the PLC to auto start other larger pumps (Pumps 1 and 2) to assist if Pump 4 cannot keep up with incoming flow.
    - Need to shut down auto logic while making revisions to PLC and Operator Interface Panel, but pumps can run manually. Expected duration one day.

2.0 BRIEF OVERVIEW OF EXISTING ELECTRICAL SYSTEM

The Cove Pump Station’s existing electrical system consists of the incoming PG&E service including pole mounted transformers, outdoor utility metering cabinet, a motor control center with PLC control panel, and the storm drain pumps and motors.

PG&E Service

The PG&E service is 240 VAC, three phase, four wire, 60 hertz, and is fed from pole mounted transformers located east of the station. The PG&E revenue meter (Meter No. 1009453026) is located outdoors on the east wall. The service appears to be in good order. The incoming voltage was 249 VAC per the power meter.

Motor Control Center

The existing MCC is an Eaton Freedom Series 2100, 240 VAC, three phase, four wire, 600 amp bus, with 200 amp main breaker. The MCC was manufactured in August 2006. The MCC is clean, well labeled, and represents what is shown on the as-built drawings. The MCC components, in particular the motor circuit protectors, starters, and thermal overloads, are all correctly sized based on the motor nameplate data.

PLC Control Panel

The station has a programmable logic controller (PLC) for automatic pump operation based on the storm drain sump level. The level is measured by an ultrasonic level transmitter. The pump operational setpoints and assignments (start level, stop level, lead pump number, lag pump number, etc.), are manually set at the station’s operator interface touchscreen. There is no remote monitoring of the pump station.

Pumping Systems

Pump 1 motor is a 15 horsepower, 230 VAC, three phase, 38 full load amps, Design B, Insulation Class B, 40 degree C, 1770 RPM, with a drip proof enclosure. It was noted at the site visit that Pump 1 was assigned as the LAG pump due to vibration issues. Pump 1 can be started up to 10 times per hour as long as 50 seconds of off time between running and next start.
Pump 2 motor is a 20 horsepower, 230 VAC, three phase, 51 full load amps, Design B, Insulation Class F, 40 degree C, 1770 RPM, with a drip proof enclosure. It was noted at the site visit that Pump 2 was assigned as the LEAD pump and was cycling on every few minutes, running for roughly 75 seconds. Pump 2 can be started up to 10 times per hour as long as minimum of 48 seconds of off time between running and next start.
Pump 3 is an engine driven pump.

Pump 4 is a sump pump. Pump 4 motor is a 1.5 horsepower, 220 VAC, three phase, 4.6 full load amps. Pump 4 was turned off (breaker opened) during site visit. Pump 4 can be started up to 29 times per hour as long as 34 seconds of off time between running and next start.

3.0 DETAILED MODIFICATIONS FOR INCREASED RELIABILITY

The following provides further details and justification to proposed modifications for increased reliability of station.

Removal of Power Monitor from Pump Logic

The existing pump controls for Pumps 1, 2 and 4, include a permissive contact from the Power Monitor (Diversified Electronics Model No. PBC-230-ALE) relay. The Power Monitor examines the incoming electrical service for low and/or high voltage. The as-found setpoints for permissive pump operation voltage was above 200 VAC and below 265 VAC. While this range is sufficiently wide enough to eliminate most nuisance alarms, it is still recommended to jumper out the “PM” contact from the pump logic (Pumps 1, 2, and 4) to simplify the pump control logic and reduce a single point of pump failure (the Power Monitor relay). For a storm drain pump station where pump reliability is priority, and with “smaller” horsepower pumps as installed at the Cove Pump Station, the use of voltage monitoring is not necessary. The Power Monitor relay shall still be connected to the PLC for monitoring, although shall not prohibit the PLC from automatic operation of the pumps.

Removal of Motor Thermostat from Pump Logic

The existing pump controls for Pumps 1 and 2, include a permissive contact from the respective motor winding thermostat. The motor thermostat is embedded in the motor windings and opens on high heat. It is recommended to jumper out the motor thermostat contact to simplify the pump control logic and reduce a single point of pump failure. For a storm drain pump station where pump reliability is priority, and with “smaller” horsepower pumps as installed in the Cove Pump Station, the use of motor thermostat monitoring is not necessary. The motor thermostats shall still be connected to the PLC for monitoring, although shall not prohibit the PLC from automatic operation of the pumps. The motor thermostats are not required for motor protection per the National Electrical Code. The pump motors are sufficiently protected from short circuit, ground fault, and overload from the installed motor circuit protector and thermal overloads.

Modifications of Emergency Level Controls - Add Low Level Stop Float Switch

The Cove Pump Station added a sump high level float circuit to the pump logic in late 2016. The logic is sourced from Pump 3’s 12 VDC battery, and acts as a back up to the sump ultrasonic level transmitter for hardwired pump control. The logic is designed to start Pumps 1, 2 and 3 if the high level float switch trips. Pump 3 would start right away, and Pumps 1 and 2 would start after set time delay. Pump 3 would stop after the high level switch trip went away and an expiration of a time delay (currently set at 1 minute). Pumps 1 and 2 would stop immediately after the high level switch trip went away.

The suggested modifications include:

1. Furnish and install a new low level “stop” float switch to the sump. Rather than using a single float switch and timers to start and stop the pumps, install a second float switch to stop the pumps at a low sump level.
2. Revise the stop control logic for Pumps 1, 2 and 3 to shut down once the low level float switch permissive goes away.

3. Refer to revised control logic on attached drawing, “Cove PS Proposed Modifications”.

Pump 4 Allowed in Auto Pump Logic
Allow Pump 4 to operate as LEAD pump to handle the small influent flows. This will reduce the number of starts, and the short runs of the larger Pumps 1 and 2. Currently Pump 4 acts only as a sump pump and is not utilized for normal operations. Revise PLC and Operator Interface logic so Pump 4 can be assigned as LEAD pump. Also revise the logic to LEAD/LAG/LAG configuration; therefore with rising sump levels additional pumps are called. PLC can stop Pump 4 while either Pump 1 or Pump 2 are running.

4.0 MODIFICATIONS SUMMARY AND COSTS

The priority of modifications is assigned based on ease of work, and increased reliability. Priority “A” being the highest, “B” is medium, and C” the lowest priority. The table below provides a summary of the modifications with assigned priority, equipment procurement lead time, impacts to plant capacity, and impacted pumps.

No. Item	Equipment	Priority	Procurement Lead time	Impacts to Plant Capacity	Pumps Impacted
1	Jumper out Power Monitor and Motor Thermostat contact. Confirm PLC program Auto start does not inhibit based on Power Monitor or Motor Thermostat status.	A	None	Shut off one pump at a time to allow for modifications. Make PLC modifications on line to reduce impacts.	Pump 1, Pump 2, Pump 4
2	Add Low Level Stop Float Switch.	B	2 weeks	Install new float switch. Modify hardwired control logic, loss of Pump 3. Make PLC modifications on line to reduce impacts.	Pump 1, Pump 2, Pump 3
3	Add Pump 4 in modified LEAD/LAG/LAG logic for low flow condition.	C	None	Make PLC modifications on-line to reduce impacts.	Pump 4

The estimated construction costs per Priority are: Priority A is $1,500, Priority B is $3,500, and Priority C is $2,000. Estimates above assumes PLC programmer can complete assigned work in less than one day for each Priority. Further savings can be achieved if Priorities are grouped together to minimum PLC Programmer site visits.