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Subject: Electrical Service Strategy for Murray CSO Facility
Subtask 1000.05 Electrical Service and Generator System

1.0 Introduction

A new 1.0 million gallon Murray Combined Sewer Overflow (CSO) Storage Tank will be constructed adjacent to the existing Murray Pump Station. A new standby generator will be installed that provides power to both the existing Murray Pump Station and the new Murray CSO Facility. There will be a Service Entrance Switchboard that contains an automatic throw-over scheme to automatically start the generator and transfer power from utility power to standby generator upon loss of utility power. This switchboard will distribute power to the existing Murray Pump Station and the new Murray CSO Facility.

1.1 National Electric Code (NEC)

The design of the generator and electrical systems for the Murray CSO Facility will conform to Article 702 (Optional Standby Systems) of the National Electric Code.

2.0 Electrical Service

2.1 Existing Conditions

The existing Murray Pump Station is served from a three-phase Seattle City Light (SCL) overhead distribution feeder to a Seattle City Light 1000 kilovolt-ampere (kVA) transformer located in an underground vault adjacent to the pump station. This transformer supplies power to a utility metering section in the existing Murray Pump Station Service Entrance Switchboard, which is located underground in the existing pump station. There is visible water intrusion under the existing switchboard though the source has not been identified.

2.2 Proposed Configuration

2.2.1 Seattle City Light Electric Service

The existing 1000 kVA Seattle City Light transformer is adequate to accommodate the new loads for the CSO Facility and the loads of the existing Murray Pump Station, therefore no upgrade to the Seattle City Light transformer is anticipated. A new CSO Facility Service Entrance Switchboard will be installed in an above-ground Electrical Room in the CSO Facility and will supply power to the CSO Facility and the existing Murray Pump Station. The existing feed from the SCL transformer to the Murray Pump Station Switchboard will be disconnected

and a new feed from the SCL transformer to the new CSO Facility Service Entrance Switchboard will be established. The Murray Pump Station will remain in operation throughout the change-over; proposed construction sequencing will be developed during final design.

2.2.2 CSO Facility Service Entrance Switchboard

The CSO Facility Service Entrance Switchboard will be double-ended with a tie breaker between the two busses. Transfer between utility and standby power sources will be accomplished through the use of an Automatic Throw-over System in conjunction with electrically operated breakers in lieu of an automatic transfer switch. Due to the large ampacity of the switchboard and the importance of the Murray Pump Station to the conveyance system, double-ended switchgear is being provided to maximize flexibility and redundancy. See Drawing No. E600 in Appendix A for the proposed Service Entrance Switchboard configuration.

It will be determined in final design whether the new CSO Facility Service Entrance Switchboard will feed the Pump Station MCC through the existing Murray Pump Station Switchboard or whether the Murray Pump Station Switchboard will be demolished and the new feed terminated directly on the Murray Pump Station MCC.

2.3 Electrical Room

A separate above-ground room will be provided to house the CSO Facility Service Entrance Switchboard, CSO Facility Motor Control Center, and other required electrical equipment and control panels. Water intrusion in the current underground Murray Pump Station electrical room is a known issue; designing the new electrical room as an above-ground facility reduces the risk of flooding and water intrusion. See Drawing No. E601 in Appendix B for a preliminary layout of the Electrical Room.

2.4 Control System Interface

The interface between the Automatic Throw-over System and the Switchboard to the County control system will be via hard-wiring. The proposed programmable logic controller (PLC) input/output (I/O) points for the Automatic Throw-over System are:

- On Utility.
- On Standby.

The proposed I/O points for the new CSO Facility Service Entrance Switchboard are:

- Instantaneous Power (4-20 mA signal).

3.0 Generator Equipment

3.1 Generator

In order to accommodate the loads from the existing Murray Pump Station and the Murray CSO Facility, a 1000 kilowatt (kW) standby generator will be provided. The 1000 kW generator will be able to start and run all loads at both facilities and has approximately 30% spare capacity to accommodate future additional loads. No load shedding is required. A load summary for both facilities is provided below in Table 1. The sizing of the generator has been confirmed with Pacific Power Products, King County's pre-selected provider for standby generators. See Appendix C for the output from Pacific Power Products' generator sizing software.

The Murray Standby Generator will be Model 1000RXC6DT2 with Alternator 575RSL4044 with 130C temperature rise.

King County's Technical Specification 11083 – Low Emission Diesel Engine Standby Generator Set 150 KW and Larger will be used as the basis to specify the generator.

Table 1: Approximate Pump Station and CSO Facility Loads

Load Description	Power (kVA)	Location
Pump Station Pump 1 (VFD)	100	Pump Station
Pump Station Pump 2	300	Pump Station
Pump Station Pump 3	300	Pump Station
Pump Station Pump 4 (VFD)	100	Pump Station
Pump Station Small Misc. Facility Loads	30	Pump Station
CSO Odor Control Fan 1	5	CSO Facility
CSO Odor Control Fan 2	20	CSO Facility
CSO Storage Tank Drain Pump 1	25	CSO Facility
CSO Storage Tank Drain Pump 2	25	CSO Facility
CSO Storage Tank Drain Pump 3	25	CSO Facility
CSO Small Misc. Facility Loads	30	CSO Facility
TOTAL	**960**	CSO Facility and Pump Station

3.2 Generator Room

A separate room will be provided to house the generator and its associated equipment. See Drawing No. E601 in Appendix B for a preliminary layout of the Generator Room.

3.3 Generator Control Panel

The standby generator will be provided with the pre-selected manufacturer's control panel that regulates and controls the generator and provides information to the operators through the facility control system.

3.4 Fuel and Fuel Tanks

A 1000 kW standby generator uses fuel at the rate of approximately 70 gallons/hr at full load. It is standard King County practice to have 24 hours of on-site fuel storage. To meet these requirements, a minimum of 1,680 gallons of fuel storage must be provided on site.

The fuel for the generator will be stored in an above-ground fuel tank. The fuel tank will be located above-ground to prevent water intrusion into the tank due to the high water table. The above-ground configuration also eliminates concerns that the Seattle Department of Transportation will not permit a buried fuel tank in their right of way. A standard tank size is 2,000 gallons, which is adequate to meet King County's storage requirements. See Fuel Monitoring section for information about how operators monitor the fuel tank.

Double-containment fuel piping will be provided between the large fuel tank and the day tank adjacent to the generator. The day tank stores a small amount of fuel directly adjacent to the generator and draws fuel from the large tank as required.

Access to the tank will need to be provided for refueling; a clear path will need to be provided from the street to the fuel port on the tank.

A vent to atmosphere will be required for the large fuel tank. The day tank will require two vents to atmosphere by code.

3.5 Fuel Monitoring

A Fuel Control Panel will be provided that monitors fuel level in the tank. King County has standardized on the Veeder-Root line of monitoring products, typically using model TLS-300C to monitor the large fuel tank.

Safeguards such as automatically closing the fuel tank fill port will reduce the risk of fuel spills.

A Leak Detection Panel will monitor for leaks in the double-containment piping between the day tank and the large fuel tank.

3.6 Generator Cooling

A radiator will be required for generator cooling. The radiator is often mounted directly on the generator so that a generator-mounted fan blows across the radiator. Direct mount fans are not possible in all applications, and the radiator sometimes needs to be mounted remote from the generator. In that case, a remote-mounted fan co-located with the radiator would be required for cooling. In a remote radiator application, piping is required between the generator and radiator for circulating the coolant. It will be determined in final design whether a direct-mount radiator and fan or a remotely mounted radiator and fan will be required for the new Murray CSO Facility standby generator.

Motorized supply and exhaust dampers will also need to be provided and interlocked with the fans as part of the cooling system.

3.7 Provision for Connection to Load Bank

Generators should be regularly exercised per the manufacturer's recommendations. Exercising typically involves running the generator weekly for a short duration (usually 15 minutes plus cool down) with no load. In addition to the regular exercise, regular periodic maintenance and testing is required and uses a load bank. A load bank is a device that consists of high power resistors and cooling fans that allows load to be added to a generator in a controlled fashion for testing, and it also allows the generator to be tested at full load. A load bank can be permanently installed on site or provided by the tester. Rather than providing a permanently installed on-site load bank which would add to the facility footprint, provision will be made for connecting to a portable load bank. Making such provision simplifies load bank testing. Two breakers will be provided on the generator; one to supply the new CSO Facility Service Entrance Switchboard and a separate breaker for connecting to a load bank.

3.8 Sound Mitigation

A silencer is a device located in the generator exhaust piping that mitigates engine noise produced by the standby generator; its function is analogous to a car muffler. It is typically located directly above the standby generator. Additional sound attenuation is accomplished through sound attenuating baffles that will be located on both the inlet and exhaust louvers/dampers to reduce noise exiting the generator room to a defined noise level.

The design will mitigate noise to a maximum of 55 dBA at the property line per Seattle Municipal Code requirements.

3.9 Exhaust

The generator engine exhaust needs to be vented to the outside. It should be vented to the outside as close as possible to the generator in order to reduce pressure drop. If the pipe run is too long, a larger pipe or additional equipment such as a fan may be required for the exhaust.

An air quality permit is required for the project. The air quality permit will need to include the standby generator. It is not anticipated that the regional air quality board will require mitigation beyond the standard Environmental Protection Agency (EPA) guidelines. For the purposes of defining EPA emission requirements, the application duty of the standby generator at Murray CSO Facility will be categorized as Stationary Emergency (per EPA nomenclature, not NEC nomenclature).

3.10 Fire Code

Provisions within the local fire code apply to the installation of standby generators and their accompanying fuel systems. The design will conform to applicable codes.

3.11 King County Pre-Selected Equipment Scope

Per King County Specification 11083, the scope of supply for Pacific Power Products is as follows: "As part of Contract 222872, PPP is obligated to provide engine-generator sets consisting of, but not limited to, diesel engine; generator; electric starter, starting and control batteries; cooling system equipment; day tank system with duplex transfer pumps and level controls; critical grade exhaust silencing system; operating and safety shutdown controls; engine generator control panel; intake air cleaner; lubrication system; engine jacket water heater; and vibration isolation base and connectors. In addition to the provision of equipment, the work includes manufacturer's services for inspection and certification of installation, functional testing, start-up, and training of County personnel."

3.12 Control System Interface

The interface between the Generator Control Panel and the Fuel Control Panel to the County control system PLC will be via hard-wiring. The proposed I/O points for the Generator Control Panel are:

- Generator Fail.
- Generator Ready.
- Generator Running.
- Generator Trouble.

The proposed I/O points for the Fuel Control Panel are:

- Fuel Level.
- Fuel Trouble.

The proposed I/O points for the Leak Detection Panel are:

- Pipe Leak.
- Tank Leak.

4.0 Summary

A new standby generator will be installed at the Murray CSO Facility that provides power to both the existing Murray Pump Station and the new Murray CSO Facility. There will be a Service Entrance Switchboard that transfers power from utility power to standby generator upon loss of utility power; this switchboard will distribute power to the existing Murray Pump Station and the new Murray CSO Facility. Two new above-ground rooms will be required: Standby Generator Room and Electrical Room. The large fuel tank for the standby generator will also need to be accommodated on the site in an above-ground enclosure.