

PREPARED FOR: Western Wake Partners

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SUBJECT: Western Wake Regional Wastewater Management Facilities
Western Wake Water Reclamation Facility
PER Technical Memorandum No. 23 – Standby Power Facilities and
Electric Utility Service

INTRODUCTION

This Technical Memorandum (TM) is one in a series of TMs being prepared for the Preliminary Engineering Report for the Western Wake Regional Wastewater Management Facilities project. The purpose of this TM is to present the preliminary engineering information and data for the standby power and electrical service facilities at the Western Wake Water Reclamation Facility (WWWRF).

ELECTRIC UTILITY SERVICE

There are two possible electrical utility providers for primary electrical service to the plant: Progress Energy and the Town of Apex. Both providers have the electric utility infrastructure capable of serving the plant.

Initial indications are that the serving electric utility will not charge an initial or continual facilities charge for providing electric power to the plant and the Beaver Creek Pumping Station due to the large amount of load to be served. The plant could be served from one of two substations in the vicinity. These substations are located as follows:

- ❖ Green Level 115kV Sub - Wimberly Rd. (SR 1603) and Jenks Rd. (SR 1601)
- ❖ New Hill 230kV Sub - US1 and Shearon Harris Rd. (SR 1134)

Permanent electrical service is not anticipated to be required until the year 2011.

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The electrical service to the plant will consist of one utility-owned, 10MVA, 23kV-4.16kV substation transformer located on the plant site as indicated on the site plan in TM 30, Figure 30-2. State regulatory reliability requirements require the plant to be served with both primary and standby electrical services. The plant primary electric service will be the main electric utility service and the plant standby electric service will be from a standby generation facility as discussed below.

An alternative to the single electric utility service described above would be to have the serving electric utility install multiple electric services at the plant site. The multiple service scenario would involve the serving electric utility owning and maintaining the in-plant primary distribution system and distribution transformers. This type of electric service would result in additional facility charges to the owner. In addition, the owner could not benefit from the advantages of having a single standby power facility described in the standby power Alternative 1 below. The power distribution systems described in this technical memorandum are based on the plant taking a single utility service.

IN-PLANT POWER DISTRIBUTION SYSTEM

Electric power will be distributed throughout the plant at 4160VAC from a line up of 5kV class drawout circuit breaker switchgear located inside a dedicated electrical building as shown in TM 30, Figure 30-2. A single line diagram of the standby power and distribution system is shown on Figure 23-1. The in-plant 4160VAC distribution voltage will be stepped down to the equipment utilization voltage by pad mounted transformers located near the facility to be served. All low and medium voltage distribution equipment (i.e. motor control centers, switchgear, etc.) served by the 5kV main switchgear will be a main-tie-main arrangement to maximize reliability and flexibility.

STANDBY POWER

In order to meet reliability requirements, a standby power source must be installed to maintain plant operations in the event the primary electric utility service fails. The standby power source can be an on-site power generation facility or a second electric utility service. In order for the second utility service to qualify as a standby source, it must be served from a different substation than the primary electric utility service. It is highly recommended that the WWRF install an on-site power generation facility in lieu of a second utility service to serve as the standby power source for the following reasons:

- ❖ An extreme weather event (i.e. hurricane) will most likely cause both utility services to fail.
- ❖ An on-site standby power generation facility can be used to reduce demand charges during peak demand periods.

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An on-site standby power generation facility would be installed as a part of the WWRWF power distribution system. Electric power will be generated from diesel fueled engine-generator sets installed on the plant site. Two on site standby power system alternatives were evaluated:

Alternative 1: Engine-generator sets connected in parallel at the electrical service entrance to the facility.

Alternative 2: Multiple standby engine-generator sets dedicated to specific process areas (i.e. blowers, return activated sludge pumping, biosolids handling, administration and effluent pumping).

ALTERNATIVE 1

Alternative 1 consists of installing engine-generator sets that serve the entire plant from a single standby power generation facility. The standby engine-generator sets, as well as the electric utility, would be connected to the plant's 5kV main distribution switchgear, such that all plant loads have the capability of being connected to the standby source. Under either alternative, 5kV switchgear will be required to serve the plant load. The generator and main distribution switchgear will contain controls to synchronize the operating generators to the utility source so that the two sources may be connected simultaneously to the plant to facilitate ease of testing the standby generators and provide the capability for peak shaving. This configuration allows non-interrupted transfer between the utility and the standby power system. This is commonly referred to as closed transition switching. A single line diagram of the standby power and distribution system for Alternative 1 is shown on Figure 23-1. The standby power system would operate as follows during a utility power outage:

- ❖ The utility fails and the plant is de-energized.
- ❖ After an adjustable time delay, the standby engine-generator sets will automatically start and parallel together.
- ❖ The switchgear controls will connect the plant to the standby engine-generator sets once they are operating at the proper voltage and frequency.
- ❖ The plant will resume operations under standby power.
- ❖ Once the utility returns and is stable, the standby generator controls will synchronize the standby source with the utility source and operate the plant from both sources while the control system transfers the load from the generator system to the electric utility. Power transfer would be completed in less than 10 seconds.
- ❖ The generator controls will transfer the plant load back to the utility source with no interruption in service.

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The operators would have the ability to select through the SCADA system which loads are to operate on standby power. The generator controls will be networked into the SCADA system so that the real-time generator load will be displayed at the operator workstations. This approach will allow the operator to start plant loads without overloading the generators.

Each engine-generator set will consist of a 1,800-RPM diesel-fueled engine coupled to a synchronous 4-pole, 4160VAC, three phase alternator. It is estimated that four 2250kW standby engine-generator sets will be required to operate the plant during peak flow conditions for the initial phase of the plant construction (18-mgd design capacity). It is estimated that the addition of a fifth 2250kW unit will be required to operate the plant during peak flow conditions for the 30-mgd (Phase 2) plant expansion. Provisions for a fifth 2250kW standby engine-generator set would be incorporated in the standby power generation facility design so that the standby power system can be easily expanded.

The standby engine-generator sets would be installed on the plant site near the plant's main 5kV distribution switchgear. The main 5kV distribution switchgear and generator paralleling switchgear are anticipated to be located inside the dedicated electrical building shown in TM 30, Figure 30-2. The standby engine-generator sets may be installed in one of the two configurations listed as follows:

- ❖ Outdoors inside weather-protected, sound-attenuated enclosures. All engine generator set components (i.e., radiator, alternator, engine, silencer, etc.) will be installed by the manufacturer inside or as a part of the weatherproof enclosure. The generator enclosures would be sized so that there is a minimum of 3 ft of working clearance around the engine-generator sets to perform maintenance and repairs. The enclosures would be furnished with sound-attenuating materials that will reduce the generator noise to 78dB(A) at a distance of seven meters from the outside of the generator enclosure
- ❖ In a new building that would house the engine-generator sets and associated electrical equipment

A cost analysis for the Alternative 1 standby generator system is included in Appendix 23A.

ALTERNATIVE 2

Alternative 2 consists of installing multiple engine-generator sets dedicated to individual plant loads (i.e. blower building, RAS/WAS pumping stations, UV disinfection facilities, effluent pumping etc). Each generator would be furnished with an automatic transfer system to transfer power from the normal source to the generator source in the event the normal source fails.

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It is estimated that up to 8 separate standby engine-generator sets would be required to supply the major points of power distribution on the plant site (i.e. blower building, RAS/WAS pumping stations, UV disinfection facilities, effluent pumping etc).

Each generator would be housed inside a weather-protected, sound-attenuated enclosure. All generator set components (i.e., radiator, alternator, engine, silencer, etc.) would be installed by the manufacturer inside or as a part of the weatherproof enclosure. The generator enclosures would be sized so that there is a minimum of 3 ft. of working clearance around the engine-generator set to perform maintenance and repairs. The enclosures would be furnished with sound-attenuating materials that will reduce the generator noise to 78dB(A) at a distance of seven meters from the outside of the generator enclosure.

A cost analysis for the Alternative 2 standby generator system is also included in Appendix 23A.

RECOMMENDATIONS

Alternative 1 is recommended for the WWWRf standby generator system for the following reasons:

- ❖ The standby power system under Alternative 1 is the most cost effective method of providing standby power to the plant site (See Appendix 23A).
- ❖ The standby power system under Alternative 1 would have the advantage of serving all plant loads from a single facility, simplifying operation and maintenance of the standby generator facilities
- ❖ The standby power system under Alternative 1 could easily be used for peak shaving since the standby generators controls would have the ability to synchronize and operate in parallel with the utility. Peak shaving is less feasible for Alternative 2 because of the multiple generators throughout the plant site.
- ❖ The standby power system under Alternative 1 would be more reliable and more flexible than under Alternative 2. Under Alternative 2, if a single generator serving critical process loads (i.e. RAS pumping, aeration, effluent pumping, UV disinfection, etc.) fails, the treatment process could not continue until that generator is repaired or the utility source is re-energized. If a single generator fails under Alternative 1, the remaining generator could keep the plant energized so the treatment process could continue on standby power at a limited rate.
- ❖ The larger generators will be needed to provide the inrush demand associated with starting the large motor loads such as the blowers and effluent pumps.

APPENDIX 23A

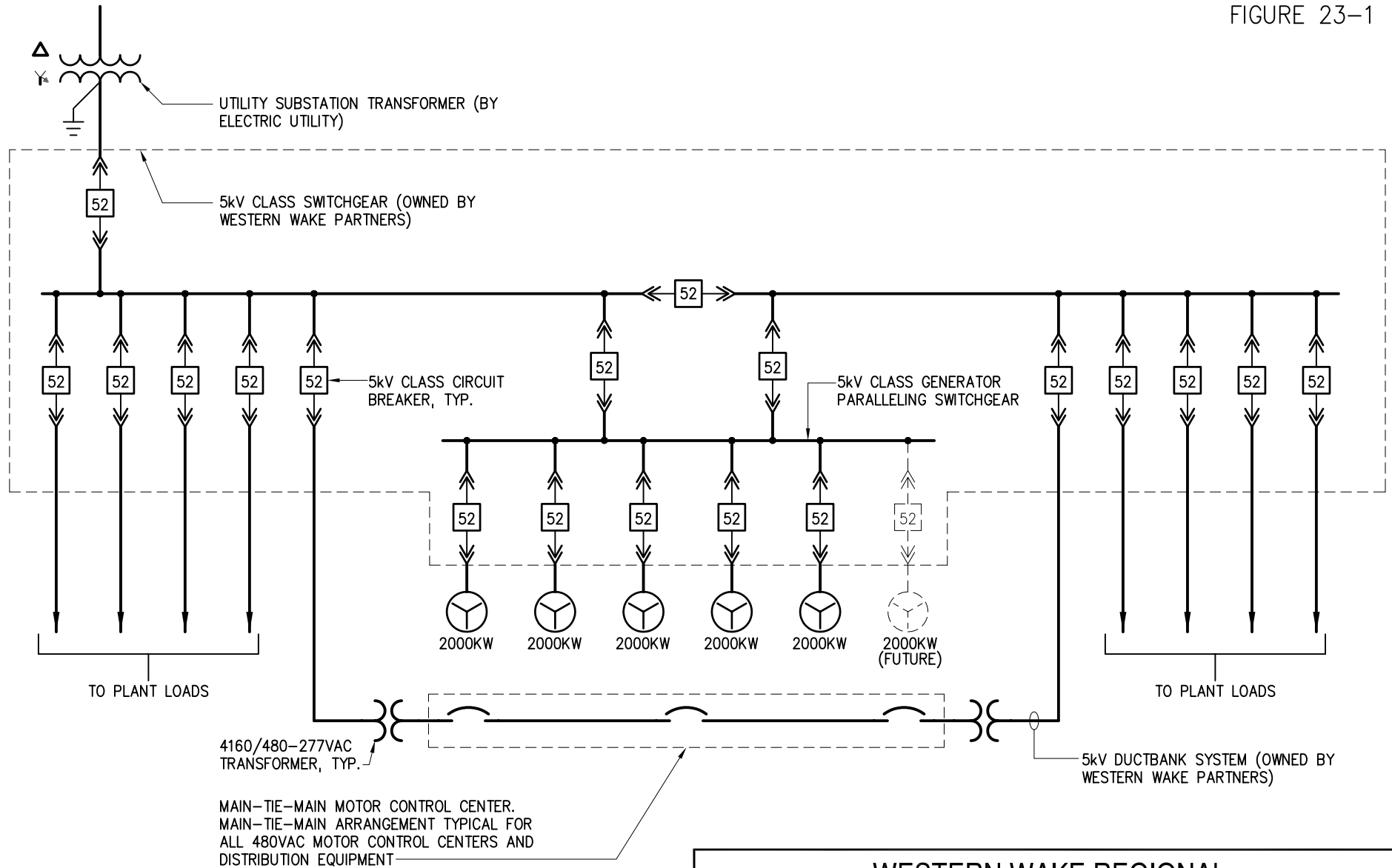
STANDBY GENERATOR ALTERNATIVE COST COMPARISON

Appendix 23A - Standby Generator Alternative Cost Comparison

Alternative 1	
Single Standby Power Generation Facility	
4-2250kW, Diesel Genset with Batteries/Control Panel/Enclosure/Fuel Tank	\$2,160,000
5kV Paralleling Switchgear with Generator Controls	\$958,400
Electrical Building (2400 square feet)	\$288,000
Misc Equipment - 10% of Total Equipment Cost	\$340,640
Total	\$3,747,040

Alternative 2	
Blower Building Standby Generators	
2-1250kW, Diesel Genset with Batteries/Control Panel/Enclosure/Fuel Tank	\$720,000
5kV Paralleling Switchgear with Generator Controls	\$474,200
Misc Equipment - 10% of Total Equipment Cost	\$179,100
Effluent Pump Station Standby Generators	
2-2250kW, Diesel Genset with Batteries/Control Panel/Enclosure/Fuel Tank	\$1,080,000
5kV Paralleling Switchgear with Generator Controls	\$587,400
Misc Equipment - 10% of Total Equipment Cost	\$250,100
Effluent Filters & RAS/WAS Pump Stations Standby Generator	
1-750kW, Diesel Genset with Batteries/Control Panel/Enclosure/Fuel Tank	\$180,000
1200A Automatic Transfer Switch	\$42,000
Misc Equipment - 10% of Total Equipment Cost	\$33,300
Sludge Thickening, Dewatering, and Digestion Standby Generator	
1-750kW, Diesel Genset with Batteries/Control Panel/Enclosure/Fuel Tank	\$180,000
1200A Automatic Transfer Switch	\$42,000
Misc Equipment - 10% of Total Equipment Cost	\$33,300
Operations Building Standby Generator	
1-300kW, Diesel Genset with Batteries/Control Panel/Enclosure/Fuel Tank	\$90,000
800A Automatic Transfer Switch	\$33,600
Misc Equipment - 10% of Total Equipment Cost	\$18,500
Preliminary Treatment Standby Generator	
1-300kW, Diesel Genset with Batteries/Control Panel/Enclosure/Fuel Tank	\$90,000
800A Automatic Transfer Switch	\$33,600
Misc Equipment - 10% of Total Equipment Cost	\$18,500
Total	\$4,085,600

FIGURE 23-1



WESTERN WAKE REGIONAL
WASTEWATER MANAGEMENT FACILITIES

POWER DISTRIBUTION SINGLE LINE DIAGRAM
WESTERN WAKE WRF

