20.0 ELECTRICAL POWER SUPPLY AND PROTECTION SYSTEMS

20.1 Power Supply

20.1.1 Primary Power Supply

In general, where electrical power is required to operate the structure facilities (i.e. gates and control systems), the primary power supply should consist of the most reliable and cost effective service that can be provided, taking added equipment and utility costs into account.

Selection of the utility service or power supply source should include the following considerations:

- In general, 3-phase power is normally preferred over 1-phase, even if a solid-state phase converter is required.

- Where 1-phase service is the closest available, can supply the project loads, and 1-phase actuators can be used, then consider using a 1-phase service. Single-phase service should be kept under 250 volts and 200 amps. The extra cost of 1-phase actuators may be offset by the reduced cost for single-phase service and distribution equipment.

- Where 3-phase actuators are required or where aggregate project loads make 1-phase service uneconomical, then 3-phase service should be provided as follows:

    - If economically available, provide 3-phase service from the utility.

    - If 3-phase service cannot be economically provided from the utility, use a 1-phase service with a solid-state phase converter, as discussed below, to supply 3-phase power to the gates and other equipment as required. However, power for the control system including the gate operator controls should be provided from the utility's 1-phase power supply rather than from converted 3-phase power.

- Where the site is remote, the facilities are operated infrequently by operations personnel from the site (i.e. not remotely operated), and providing utility service is uneconomical, consider the use of a stand-alone generator as an alternate to the utility service. Alternatively, depending on power requirements and costs, the use of solar power with battery storage systems may be considered.

Where a solid-state phase converter will be used:

- Consider using the PLC to limit the number of gate actuators that can run simultaneously without affecting the operational requirements of the facility.

- Size the converter for the kVA rating for the aggregate load of those actuators and other equipment that may run simultaneously, plus a starting allowance of 5 times the largest

actuator kVA rating.

- Specify that the solid state converter have the following features and performance characteristics:
    - Line and load disconnect.
    - Overcurrent and over and under voltage protection.
    - Pulse width modulated output with carrier frequency filter and adjustable settings for output frequency and start and stop ramp.
    - Harmonic distortion limits of less than 15% total current harmonic distortion at the line terminals.
    - 3% line reactors on the input and 5% load reactors on the output.
    - Rotating restart and anti-regeneration protection where the converter serves a single motor.

For the utility service, buried power lines rather than overhead lines are preferred near structures or in areas where the use of cranes may be required for future operation or maintenance activities. Examples of such areas include screened intakes, access and operating decks, gatewells, and terminal structures

20.1.2 Backup Power Supply

For gated water control structures, the need to provide a backup power supply system to permit operation of the key elements of the facility in the event of a failure in the primary power supply system should be considered whenever the following conditions exist:

- The inability to operate the gates within a prescribed period of time would create a hazardous situation that could lead to potential loss of life and an appreciable amount of damage to property and the environment.
- The primary utility service supplying power to the site is not robust, and utility service and site maintenance staff and equipment are not located nearby (i.e. further than 1 hour away from the site). A robust utility service would include the following characteristics:
    - A short transmission line to the site from a nearby substation or a utility service that has alternate routes with automatic routing.
    - Overhead portions of the power supply are subject to low lightning incidence.

- The site service is underground.

Where required, the backup power supply system should consist of:

- A diesel fuelled engine generator sized to handle all simultaneously running loads plus the starting load of the largest gate operator.

- Automatic load transfer system that can monitor the primary utility service, initiate generator start-up, shut down, and load transfer.

- On-site fuel storage for at least 8 hours operation at full load.

- Controls for automatic exercising of the generator once per month.

- Generator status monitoring outputs for input to the control system.

- A weatherproof enclosure, heated if the generator will be operated in cold weather, for housing the generator. Where a control building is required, a separate generator room is typically added to the building.

Where temporary inability to operate the gates would not create a hazardous situation and the utility service is robust, a backup power supply would not normally be required.

For smaller projects, the electrical system should be designed to facilitate the use of a portable generator to supply backup power to enable operation of the key components.

20.1.3 Uninterruptible Power Supply

A backup UPS with an alarm system should be provided where the control system includes a PLC or a computer. The UPS should be an on-line type with a static bypass and manual bypass isolation switch, and include sufficient battery capacity to permit operation for at least 4 hours under full load.

20.2 Lightning Protection and Grounding Systems

Lightning protection and grounding systems are normally required wherever electrically operated equipment is installed.

Sites serviced by utility circuits with overhead lines should have lightning protection on the incoming service. In addition, other metal work (handrails, fencing, etc.) located adjacent to such equipment is usually also grounded. Normally, the grounding system should be tied into the concrete reinforcement mats of the structure footings or set well below finished grade.

Site services should be fitted with surge suppression equipment. Suppression devices should be UL 1499 and UL 1283 listed, and be capable of handling 3500 ANSI/IEEE C62.41 Category 3 surges. Surge protection devices may also be required to protect equipment that is susceptible to damage due to power surges.