SECTION 26 23 13
GENERATOR PARALLELING CONTROLS

SPEC WRITER NOTE: Delete between // -- // if not applicable to project. Also delete any other item or paragraph not applicable to the section and renumber the paragraphs.

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of indoor control components for medium- and low-voltage paralleling //Standby// //and// //Essential// Electrical System generators.

B. The generator paralleling controls shall be compatible and functional with the switchgear, engine generators, automatic transfer switches, remote annunciators, and all related components.

1.2 RELATED WORK

//A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of nonstructural components.//

B. Section 25 10 10, ADVANCED UTILITY METERING: Electrical metering.

C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.

E. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

F. Section 26 13 13, MEDIUM-VOLTAGE CIRCUIT BREAKER SWITCHGEAR: Medium-voltage enclosures, busing, and circuit breakers for generator paralleling switchgear.

G. Section 26 23 00, LOW-VOLTAGE SWITCHGEAR: Low-voltage enclosures, busing, and circuit breakers for generator paralleling switchgear.

H. Section 26 32 13, ENGINE GENERATORS: Engine generators.

I. Section 26 36 23, AUTOMATIC TRANSFER SWITCHES: Automatic transfer switches.

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be in accordance with Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES) in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

A. Factory Tests shall be required.

B. Factory Tests shall be in accordance with Paragraph, MANUFACTURED PRODUCTS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirement:

1. Generator paralleling controls shall be tested to assure that there are no electrical or mechanical defects. Tests shall be conducted in accordance with UL and ANSI standards.

1.5 SUBMITTALS

A. Submit in accordance with Paragraph, SUBMITTALS in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, and the following requirements:

1. Shop Drawings:

a. Per the requirements of //Section Section 26 13 13, MEDIUM-VOLTAGE CIRCUIT BREAKER SWITCHGEAR// //Section 26 23 00, LOW-VOLTAGE SWITCHGEAR//.

b. Include sequences of operation and interconnecting controls diagrams, showing connections to switchgear, generators, automatic transfer switches, and remote annunciators.

SPEC WRITER NOTE: Include the following paragraph for projects in seismic areas of moderate-high, high and very high seismicities as listed in Table 4 of VA Handbook H-18-8, Seismic Design Requirements. Coordinate with the structural engineer.

//c. Certification from the manufacturer that representative generator paralleling controls have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.//

2. Manuals:

a. When submitting the shop drawings, submit companion copies of complete maintenance and operating manuals, including technical

data sheets, wiring diagrams, and information for ordering replacement parts.

1) The terminals of wiring diagrams shall be identified to facilitate installation, maintenance, and operation.
2) Wiring diagrams shall indicate internal wiring for each piece of equipment and the interconnection between the pieces of equipment, including related equipment specified in other sections.
3) Provide a clear and concise description of operation, including detailed information required to properly operate the equipment.
4) Approvals shall be based on complete submissions of manuals together with shop drawings.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Test Reports:
   a. Two weeks prior to the final inspection, submit certified field test reports and data sheets.
4. Certifications: Two weeks prior to the final inspection, submit the following.
   a. Certification by the manufacturer that the generator paralleling controls conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the generator paralleling controls have been properly installed, connected, and tested.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. International Code Council (ICC):
   IBC-15.....International Building Code

C. National Fire Protection Association (NFPA):
   70-17.....National Electrical Code (NEC)
   99-15.....Health Care Facilities
   110-16.....Emergency and Standby Power Systems

D. National Electrical Manufacturers Association (NEMA):

250-14.....Enclosures for Electrical Equipment (1000 Volts Maximum)

ICS 6-11.....Enclosures

E. Underwriters Laboratories Inc. (UL):

50-15.....Enclosures for Electrical Equipment

508A-13.....Industrial Control Panels

SPEC WRITER NOTE: A/E shall show on the drawings the arrangement and priority of all Essential, Standby, and Normal Electrical System loads, so that the system vendor can provide proper configuration and programming of the generator paralleling controls.

PART 2 – PRODUCTS

2.1 GENERATOR PARALLELING CONTROLS

A. Generator paralleling controls shall be integral to the switchgear, or housed in a separate cubicle, or be integrated into the controls on each paralleled engine generator. The functional requirements are identical for all system topologies.

B. The generator paralleling controls shall perform automatic and manual operation, synchronization, load management, monitoring, and alarm annunciation functions of the paralleled engine generator system.

C. The control logic shall be distributed between the generator paralleling controls and each engine generator such that each engine generator is capable of starting and paralleling to the bus, in the event of failure of the generator paralleling controls and receipt of a start signal from any automatic transfer switch.

D. The master control and display panel shall be a touchscreen panel, or a combination of digital and analog control, monitoring, and alarm devices. The generator paralleling control logic and master control and display panel shall be such that the master controls will continue to function in the event of a master control and display panel failure.

1. The master control and display panel shall indicate the following status information:
   a. Status of utility-source and generator-source buses.
   b. Status of each utility- and generator-source circuit breaker, including protective relays if applicable.
   c. Status of each engine generator, including start, run, stop, off, automatic operation, manual operation, speed in rotations per

minute (RPM), oil pressure, coolant temperature, hours of operation.

d. Status of each automatic transfer switch.

2. The master control and display panel shall indicate and trend the following metering information on a per-phase, line-to-line, line-to-neutral, and summary basis as applicable.
   a. Instantaneous and average volts, amperes, kilowatts, kilovars, kilovolt-amperes, frequency, and power factor for each utility and generator bus, and for each utility and generator source.
   b. Demand amperes, kilowatts, and kilovolt-amperes for each utility and generator bus, and for each utility and generator source.
3. The master control and display panel shall provide the following control functions for each generator.
   a. Automatic, manual, start, stop.
4. The master control and display panel shall provide the following system control functions.
   a. Automatic, manual, exercise, test with load, and test without load operation.
   b. Load management functions that monitor bus loads and automatically or manually control generators to meet system requirements, including prioritization of Essential and Normal Electrical System loads and groups of loads as shown on the drawings, and operation under failure conditions of one or more engine generators.
   c. Password-protected means to alter the system programming.
5. The master control and display panel shall provide the following alarm functions.
   a. All alarms annunciated by each engine generator.
   b. All system alarms.

E. The master control and display panel shall be powered by at least two sources, which may be from engine generator start batteries and/or switchgear station batteries.

SPEC WRITER NOTE: Coordinate with Sections 26 32 13, ENGINE GENERATORS and 26 36 23, AUTOMATIC TRANSFER SWITCHES. Edit the paragraph below to conform to project requirements.

F. Interconnecting Communications Protocol and Media: The generator paralleling controls shall be interconnected to the switchgear, engine

generators, automatic transfer switches// and the remote annunciator(s)// by a dedicated //fiber optic network// //dedicated CAT5E network//. The network shall be per the requirements of Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING. Provide all necessary fiber optic and copper media, raceways, hardware, software, and programming necessary to establish interconnection between all components//. All equipment shall share a non-proprietary and open topology and communications protocol.

2.2 REMOTE ANNUNCIATOR PANEL

A. A remote annunciator panel shall be installed at //the Engineering Control Center// //location as shown on the drawings//.

B. The annunciator shall indicate alarm conditions as required by NFPA 99 and 110.

C. Include control wiring between the remote annunciator panel and the engine generator. Wiring shall be as required by the manufacturer.

2.3 PARALLELING OPERATION

A. Emergency Mode:

1. Upon initiation of the automatic start sequence, all engine generators shall start. The first engine generator to achieve 90% of nominal voltage and frequency shall be connected to the bus. All first priority loads shall be transferred to the bus upon sensing availability of power on the bus. As the remaining engine generators start, their respective synchronizers shall initiate control of voltage and frequency of the oncoming set with the bus. Upon synchronizing with the bus, the oncoming engine generator shall be paralleled on the bus. Each time an additional engine generator is added to the bus, the remaining loads shall be transferred in priority sequence, until all loads are connected to the bus. The generator paralleling controls shall prevent the automatic transfer of loads to the bus until there is sufficient capacity to carry these loads. Provision shall be made to manually override the load addition circuits for supervised operation.

2. Load management sensing shall be furnished to ensure that sufficient generating capacity is connected to the bus to carry the load. The load management sensing shall also ensure that not more than the required capacity plus a limited reserve is connected to the bus at any time. The system in conjunction with the load management shall

ensure maximum efficiency in the utilization of engine generators to ensure maximum fuel economy.

3. Load management sensing shall ensure that the on-line reserve capacity does not fall to less than 10% or exceed more than 110% of a single engine generator. Upon sensing if the connected load exceeds the present limit for an established period of time, the next engine generator will be started and paralleled. If upon sensing, the connected load is determined to be less than the preset limit for an established period of time, the last engine generator to be paralleled will be disconnected and shut down. Its controls will be automatically reset so that the engine generator will be ready for next operation.
4. While one engine generator is connected to the bus, and if the connected load exceeds the capacity of the bus, resulting in a decrease in system frequency to 58 Hz or less, load dumping will be initiated to reduce the connected load within the capacity of the bus. Similarly, with increased loading, the remaining engine generator will be signaled to start and be paralleled to the engine generator already connected to the bus, and the load dump signal will be automatically cancelled. Upon restoration of the normal source of power supply, as defined in the generator paralleling controls for an adjustable period of 0 to 30 minutes, the loads shall be transferred back to the normal power source. Subsequently, the engine generator shall be disconnected from the bus, run for an adjustable period of time up to 15 minutes maximum for cool down, and then shut down. All controls associated with operation of the engine generator shall automatically reset for the next automatic operation.

B. Manual Mode: The engine generators and automatic transfer switch(es) can be operated manually.

C. Exercising Mode: Incorporate controls so as to allow automatic and manual testing of each engine generator and remotely located transfer switch.

SPEC WRITER NOTE: The A/E shall coordinate with the electrical utility company when standby engine generators are to be used to curtail peak utility demand.

//D. Utility Peak Demand Reduction Mode:

The system shall include //control equipment// //provisions for future addition of control equipment// which will operate the standby power system to reduce utility peak demand in the following way:

1. Upon initiation of an automatic sequence for utility peak demand reduction operation, all engine generators shall be started. The first engine generator to achieve 90% of nominal voltage and frequency shall be connected to the bus. The first peak reduction transfer switch shall then be signaled to transfer its load to the bus. As the remaining engine generators start and achieve 90% of nominal voltage and frequency, their individual automatic synchronizers shall initiate control of voltage and frequency to bring the oncoming engine generators into synchronism with the bus. Upon achieving synchronism, the oncoming engine generators shall be paralleled. As these oncoming engine generators are paralleled, the system shall signal additional peak reduction transfer switches to connect their loads to the bus.
2. The system shall prevent load transfer to the bus until there is sufficient capacity to carry the additional loads. Provisions shall be included to manually override the load addition circuits for supervised operation.
3. Upon termination of the utility peak demand reduction operation, the loads shall be retransferred to the normal power source. The engine generators shall be disconnected from the bus, run for a cool down period, and shut down.
4. If while operating in the utility peak demand reduction mode, a normal source of failure occurs at any Essential Electrical System automatic transfer switch, then the peak demand reduction operation shall be terminated. Upon receipt of signal that the normal source has failed, all peak loads shall be shed and the system shall return to Emergency Mode.//

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be as shown on the drawings, manufacturer’s instructions, and per //Section 26 13 13, MEDIUM-VOLTAGE CIRCUIT BREAKER SWITCHGEAR// //Section 26 23 00, LOW-VOLTAGE SWITCHGEAR//.

//B. In seismic areas, generator paralleling controls shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.//

SPEC WRITER NOTE: Mounting slab connections may have to be given in detail depending on the requirements for the seismic zone in which the equipment is located. Include construction requirements for concrete slab only if slab is not detailed in drawings.

C. Mount generator paralleling controls on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 12.5 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 100 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

3.2 ACCEPTANCE CHECKS AND TESTS

A. An authorized representative of the generator paralleling controls manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the //Resident Engineer// //COR//. The manufacturer’s representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer’s recommendations.

B. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Inspect physical, electrical, and mechanical condition.
   c. Vacuum-clean enclosure interior. Clean enclosure exterior.
   d. Verify appropriate equipment grounding.
   e. Verify appropriate anchorage and required area clearances.
2. Systems Tests:
   a. Verify proper operation of all control, monitoring, trending, and alarm functions.
   b. Verify undisrupted operation of the system under conditions of loss of the generator paralleling controls.

c. Test and verify continuity of all interconnecting copper and fiber optic control media.

C. Perform all acceptance checks and tests specified in //Section 26 13 13, MEDIUM-VOLTAGE CIRCUIT BREAKER SWITCHGEAR,// //Section 26 23 00, LOW-VOLTAGE SWITCHGEAR,// Section 26 32 13, ENGINE GENERATORS,// and Section 26 36 23, AUTOMATIC TRANSFER SWITCHES.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the generator paralleling controls are in good operating condition and properly performing the intended function.

3.4 INSTRUCTION

A. Furnish the services of a factory-trained technician for two 4-hour periods to instruct personnel in the operation and maintenance of the generator paralleling controls and related equipment on the date requested by the //Resident Engineer// //COR//.

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