

## SECTION 26 32 13.13 – DIESEL-ENGINE DRIVEN GENERATOR SETS

### 1.01 <sup>A7</sup>SUMMARY:<sup>A7</sup>

- A. <sup>A16</sup>**Basic Function:** At each locks complex the Contractor shall provide a complete system design of a diesel-engine driven generator group to provide electrical power to the locks electrical system in the event of a power failure from the normal source incoming feeders. Under this condition, the generator carries all normal locks operations electrical loads and in addition may start in sequence, the two fire fighting pump motors. The normal locks operations includes the operation of all lighting and electric equipment and systems described in Section 01 81 29 (*Electrical and Lighting Systems*), electrical power for mechanical equipment as described in Section 01 86 13 (*Plant – Mechanical Systems and Equipment*), and all lighting and power loads in rooms, buildings and other locations at each locks complex. The rooms and buildings and other locations are described in Section 01 81 36 (*O & M Buildings and Facilities Program*) and Section 01 81 36.13 (*O & M Buildings and Facilities Space Programming*). **As part of his desing responsibilities the Contractor shall develop a testing program for the transfer arrangement of the system.**
- B. **Scope:** This Section contains the technical specifications for furnishing a complete design for future installation by the Employer of the generator set group at each locks complex. The generator will be installed in a separate building and will feed the electrical distribution system through the incoming switchgear. The generator power transfer will be done with programming to be retrofitted by the Employer in the incoming switchgear, in accordance to the transfer scheme to be supplied by the Contractor as indicated in Section 26 13 00 (*Medium Voltage Switchgear*)., and with the provisions provided by the Contractor in the switchgear for later retrofitting by the Employer of such transfer scheme. <sup>A16</sup> <sup>A17</sup>The generator room will be designed and constructed by the Employer. <sup>A17</sup>

### 1.02 <sup>A16</sup>REFERENCES:<sup>A16</sup>

- A. **The Institute of Electrical and Electronics Engineers (IEEE) Standards:**  
141-1998                      Electric Power Distribution for Industrial Plants  
446-1995                      Emergency and Standby Power Systems for Industrial and Commercial Applications
- B. **National Electrical Manufacturers Association (NEMA) Standards:**  
MG 1-2007                      Motors and Generators
- C. **National Fire Protection Association (NFPA) Publication:**  
<sup>A16</sup>70-2008                      National Electrical Code <sup>A16</sup>  
110-2005                      Emergency and Standby Power Systems
- D. **Military Standard:**  
MIL-STD-461E                      Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
- E. **Underwriters' Laboratories Inc. (UL) Standards:**

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| 142-2006  | Above Ground Tanks for Flammable and Combustible Liquids  |
| 508-2005  | Industrial Control Equipment  |
| <b>E. International Organization for Standardization:</b> |   |
| 8178-1 - 2006   | Reciprocating Internal Combustion Engines - Exhaust Emissions Measurement – Part 1: Test-bed Measurement of Gaseous and Particulate Exhaust Emissions |

### 1.03 <sup>A7</sup>REQUIREMENTS:<sup>A7</sup>

- A. <sup>A5A7</sup>**General:**<sup>A7</sup> <sup>A11</sup>Each lock complex shall be provided with emergency electric back up power generation. <sup>A16</sup>A maximum of four generator sets will be acceptable as the back up power generator arrangement, at each lock complex. The power generation shall have the capacity for continued operation of the locks during a power outage and shall in addition be able to start and run the fire protection pump motors. <sup>A16</sup>Generator voltage shall be selected taking into account the calculated generator load requirements, standard generator sizes, and maintenance and reliability requirements. See Section 01 81 29 (*Electrical and Lighting Systems*) and Section 01 86 13 (*Plant – Mechanical Systems and Equipment*).<sup>A5</sup>
- B. <sup>A7</sup>**Transfer Requirements:**<sup>A7</sup> The transfer from normal source to emergency generator source shall be automatic, but the transfer from emergency generator source to normal source shall be dispatch operator controlled. The software shall issue all indications and effect synchronization and all other remote control instructions.
- C. **Durability Performance.** Generator sets, components and accessories shall be designed with durable materials, for use in a tropical, coastal marine environment. Ferrous metal shall be protected against corrosion with heavy duty coatings, resistant to water, and splash or spillage of diesel, oil and other petroleum products, in accordance with Section 09 96 00 (*Corrosion Control Coatings*).
- D. <sup>A7</sup>**Thermal Performance:**<sup>A7</sup>
1. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 125° C.
  2. Each generator shall be rated for full load operation in 50 °C ambient as measured at the generator air inlet.
- E. <sup>A7</sup>**Vibration Performance:**<sup>A7</sup> Each generator set shall have vibration isolators to minimize transmission to the building structure, with seismic restraints.
- F. <sup>A7</sup>**Airborne Noise Requirements:**<sup>A7</sup> Each generator set engine shall have a residential grade, exhaust silencer, installed according to the generator set manufacturer's recommendations.
- G. <sup>A7</sup>**Safety Requirements:**<sup>A7</sup>
1. **Grounding and Bonding:** The generator, generator covers, base, and other non-current carrying metal shall be bonded to the building grounding system in accordance with Section 26 05 26 (*Grounding and Bonding for Electrical Systems*).

2. <sup>A7</sup>**Controls:**<sup>A7</sup> The control shall be UL508 listed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts. The controls shall meet or exceed the requirements of MIL-STD-461 for susceptibility, conducted, and radiated electromagnetic emissions.
  3. Rotating parts shall be guarded against accidental contact.
- H. <sup>A5</sup>**Fire Protection Requirements:** The generator, fuel system, and controls shall be inherently designed so as to prevent the occurrence of fire. An external fire suppression system is not required. The generator sets engines shall use No. 2 Diesel Oil. <sup>A5</sup>
- I. **Environmental Protection Requirements.**
1. <sup>A7</sup>**Solenoid Valve:**<sup>A7</sup> The fuel line shall have an electrical solenoid valve with automatic shut off control.
  2. **Catch Basin:** A catch basin shall be constructed around the generator set, to collect and retain the fuel in case of accidental leakage or spill. The volume of the catch basin shall be 25% greater than the volume of the fuel day tank.
  3. **Air Pollution:** Generator set emissions shall have low emissions, consistent with current industrial standards and practices and the Environmental Management System <sup>A17</sup>plan. <sup>A17</sup> Refer to Section 01 57 19.13 (*Environmental Management System*). Measurements shall conform to ISO 8178-1 under steady-state, full load conditions, using number 2 diesel fuel.
- J. <sup>A16</sup>**Operational and Maintenance Requirements:**
1. **Reserved.** <sup>A16</sup>
  2. <sup>A7</sup>**Starting:**<sup>A7</sup> Each generator set shall automatically start when normal power source fails. The starter shall be capable of performing three complete cranking cycles without overheating. The generator starting controls shall allow for automatic periodic starting without load transfer, and as required by the generator equipment manufacturer. Batteries and battery chargers shall be the standard package supplied by the generator set manufacturer, and shall be in accordance with Section 26 33 00 (*Direct Current Equipment*)
  3. <sup>A7</sup>**Controls:**<sup>A7</sup>
    - a. Controls shall detect the existence of abnormal conditions, including as a minimum: low oil pressure, high coolant temperature, low coolant level, low or high battery voltage, low fuel, overcurrent, overload, and other, and shall indicate the alarm condition on a digital display panel:
    - b. Controls shall shutdown the generator set upon abnormal conditions, as a minimum: low oil pressure, high coolant temperature, overcrank, overspeed, high or low AC voltage, under frequency, overcurrent, short circuit, and emergency stop, and shall indicate the existence of the shutdown conditions on the digital display panel:
    - c. <sup>A16</sup>Digital status panel on the generator set control shall provide measurements of parameters required for troubleshooting and maintenance, as a minimum: engine coolant temperature, oil temperature, engine speed, battery voltage, hours of operation, and engine oil pressure.

K. **Reserved.**<sup>A16</sup>

L. <sup>A17</sup>**Ventilation:** The generator room shall be provided with forced air ventilation.<sup>A17</sup>

#### 1.04 <sup>A7</sup>**DESIGN CRITERIA/SYSTEM DESCRIPTION AND PERFORMANCE:**<sup>A7</sup>

##### A. <sup>A7</sup>**Generators:**<sup>A7</sup>

1. <sup>A17</sup>**General:** The emergency generators design shall be in accordance with IEEE 446, IEEE 141 and NFPA 70. Each generator shall be complete with all necessary components and accessories, including generator main disconnect, overcurrent protection, and transformers. Each generator will follow the generator manufacturer installation instructions, inside a generator room [GR] constructed at each locks complex for the generator.<sup>A17</sup> See Section 01 81 36.13 (*O&M Buildings and Facilities – Space Programming*).
2. **Nominal Capacity:** <sup>A11</sup>The generator, or generator group, at each Locks complex shall be continuous duty, emergency generator(s).<sup>A11</sup> The nominal capacity of the <sup>A11</sup>generation<sup>A11</sup> shall be adequate to allow continuous locks operations during a power outage and shall have adequate motor starting capability, including the sequenced starting of fire protection pump motors.
3. Low voltage electrical work shall conform to Section 26 20 00 (*Electrical Low Voltage Distribution Work*). Transformers shall conform to Section 26 12 19 (*Pad Mounted Liquid Filled Medium Voltage Transformers*).
4. <sup>A7</sup>**Fuel Day Tank:**<sup>A7</sup> The generator fuel transfer day tank shall be double wall, UL 142 listed. The fueling operation shall be automatic from an exterior, aboveground fuel tank. See Section 01 86 13 (*Plant – Mechanical Systems and Equipment*).

##### B. <sup>A7</sup>**Control Panels:**<sup>A7</sup>

1. <sup>A7</sup>**Control System:**<sup>A7</sup> Each generator set shall be provided with a microprocessor-based control system designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall allow local and remote monitoring and control of the generator set.
2. **Remote Annunciation:** A remote alarm annunciator with visual and audible indication shall be provided and installed at a location which can be conveniently monitored by facility personnel inside the <sup>A17</sup>electrical room (ELR) where generator feeders connect to the locks electrical distribution system. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110.<sup>A17</sup>
3. <sup>A17</sup>**Provisions for Software:** The control scheme shall consider that a future Windows-based software<sup>A17</sup> package will be provided by the Employer to supervise and control the emergency power generator system from three remote computers — one in the main control room [MCR], one at the Balboa power dispatcher, and the other at the supervisor's office in the maintenance building [MB]. The software will be capable of supervision and control of up to 4 generator sets and will have at least two levels of authorization with security password with control levels that will limit function access to approved personnel (observe; observe and control).

<sup>A16</sup>C. **Reserved.** <sup>A16</sup>

**1.05** <sup>A7</sup>**SUBMITTALS:** <sup>A7</sup> Shall be in accordance with Section 01 33 00 (*Submittal Procedures*).

<sup>A16</sup>A. **With the intermediate design :**

1. **Design Drawings:** Submit complete sets of <sup>A17</sup>design drawings <sup>A17</sup> for review. Design drawings shall include installation details, outline and dimensional data, and one-line, schematic, elementary diagrams to indicate functions of equipment components, equipment plan layout, point to point wiring diagrams, and riser diagrams. The drawings shall show the exact number of devices per circuit, control equipment components, operation sequences, control unit configuration, and any other details required to demonstrate that the system has been coordinated and will properly function as a whole. Diagrams for wiring external to panels shall include the corresponding cable markings, color coding, and identifiers.
2. **Equipment Descriptive Data:** Submit technical data of the proposed generator sets, control panel, remote annunciator, software and accessories, exhaust silencer, cooling system, vibration isolators, fuel day tank system, battery, battery charger and protective devices,
3. **Calculations:** Submit <sup>A17</sup>emergency power generator set(s) size calculation, cable size calculations, voltage drop calculations. <sup>A17</sup> Submit protection coordination data.

B. **Final Design:**

1. **Design Drawings:** Submit complete sets of <sup>A17</sup>design drawings <sup>A17</sup> for review. Design drawings shall include installation details, outline and dimensional data, and one-line, schematic, elementary diagrams to indicate functions of equipment components, equipment plan layout, point to point wiring diagrams, and riser diagrams. The drawings shall show the exact number of devices per circuit, control equipment components, operation sequences, control unit configuration, and any other details required to demonstrate that the system has been coordinated and will properly function as a whole. Diagrams for wiring external to panels shall include the corresponding cable markings, color coding, and identifiers.
2. **Equipment Descriptive Data:** Submit technical data of the proposed generator sets, control panel, remote annunciator, software and accessories, exhaust silencer, cooling system, vibration isolators, fuel day tank system, battery, battery charger and protective devices,
3. <sup>A17</sup>**Calculations:** Submit emergency power generator set(s) size calculation, cable size calculations, voltage drop calculations. <sup>A17</sup> Submit protection coordination data.

C. **Reserved.**

**1.06** **Reserved.** <sup>A16</sup>

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