

SECTION 26 36 23 AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of open-transition automatic transfer switches with bypass isolation, indicated as automatic transfer switches or ATS in this section.
- B. This Section include remote monitoring and control requirements at the generators low-voltage paralleling switchgear and requirements for load shed capability.

1.2 RELATED WORK

- A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirement for seismic restraint for nonstructural components.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personal safety and to provide a low impedance path for possible ground fault currents.
- F. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- G. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.
- H. Section 26 23 10, NORMAL POWER LOW VOLTAGE SWITCHGEAR
- I. Section 26 23 15, GENERATOR LOW VOLTAGE SWITCHGEAR PARALLELING CONTROLS: Paralleling controls for multiple engine-generators and ATS
- J. Section 26 32 13, ENGINE-GENERATORS: Requirements for normal and emergency power generation.
- K. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS: General communications requirements that are common to more than one section in Division 27.
- L. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATION SYSTEMS: Raceways for communications cabling.

- M. SECTION 27 15 00, COMMUNICATIONS HORIZONTAL CABLING:
Communications media for interconnecting automatic transfer switches and remote control and annunciation components.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. A factory-authorized representative shall be capable of providing emergency maintenance and repairs at the project site within 4 hours maximum of notification.
- C. Automatic transfer switch, bypass/isolation switch, and annunciation control panels shall be products of the same manufacturer.
- D. The Emergency Power Systems Supplier must be capable of servicing the Generator sets, the Generator Paralleling Switchgear and the Automatic Transfer Switches, and be able to supply replacement parts for each factory supplied equipment. Proof for factory qualified dual ticketed service technicians within the EPSS organization is required.

1.4 FACTORY TESTS

- A. Automatic transfer switches shall be thoroughly tested at the factory to ensure that there are no electrical or mechanical defects. Tests shall be conducted per UL standards. Factory tests shall be certified, and shall include the following tests:
 - 1. Visual inspection to verify that each ATS is as specified.
 - 2. Mechanical test to verify that ATS sections are free of mechanical hindrances.
 - 3. Insulation resistance test to ensure electrical integrity and continuity of entire system.
 - 4. Main switch contact resistance test.
 - 5. Electrical tests to verify complete system electrical operation.
- B. Furnish four (4) copies of certified manufacturer's factory test reports to the COR prior to shipment of the ATS to ensure that the ATS has been successfully tested as specified.

1.5 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.

- b. Include voltage rating, continuous current rating, number of phases, withstand and closing rating, dimensions, weights, mounting details, conduit entry provisions, front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, factory relay settings, and accessories.
 - c. For automatic transfer switches that are networked together to a common means of annunciation and/or control, submit interconnection diagrams as well as site and building plans, showing connections for normal and emergency sources of power, load, control and annunciation components, and interconnecting communications paths. Equipment locations on the diagrams and plans shall match the site, building, and room designations on the drawings.
 - d. Complete nameplate data, including manufacturer's name and catalog number.
 - e. A copy of the markings that are to appear on the automatic transfer switches when installed.
 - f. Certification from the manufacturer that representative ATS 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. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - 1.) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the automatic transfer switches.
 - 2.) Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
 - 3.) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
 - 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.

- 1.) Include complete "As Installed" diagrams that indicate all pieces of equipment and their interconnecting wiring.
 - 2.) Include complete diagrams of the internal wiring for each piece of equipment, including "As Installed" revisions of the diagrams.
 - 3.) The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.
3. Certifications:
- a. When submitting the shop drawings, submit a certified test report from a recognized independent testing laboratory that a representative sample has passed UL 1008 prototype testing.
 - b. Two weeks prior to final inspection, submit the following.
 - 1.) Certification by the manufacturer that the ATS conform to the requirements of the drawings and specifications.
 - 2.) Certification by the Contractor that transfer switches have been properly installed, adjusted, 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 designation only.
- B. Institute of Electrical and Electronic Engineers (IEEE):
 - 446-95.....Emergency and Standby Power Systems for Industrial and Commercial Applications
 - C37.90.1-02 Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
 - C62.41.1-02Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
 - C62.41.2-02Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
- C. International Code Council (ICC):
 - IBC-12.....International Building Code
- D. National Electrical Manufacturers Association (NEMA):
 - 250-08.....Enclosures for Electrical Equipment (1000 Volts Maximum)
 - ICS 6-06.....Enclosures

- ICS 4-10.....Application Guideline for Terminal Blocks
- MG 1-11.....Motors and Generators
- E. National Fire Protection Association (NFPA):
 - 70-17.....National Electrical Code (NEC)
 - 99-15.....Health Care Facilities
 - 110-16.....Emergency and Standby Power Systems
- F. Underwriters Laboratories, Inc. (UL):
 - 50-95.....Enclosures for Electrical Equipment
 - 508-99.....Industrial Control Equipment
 - 891-07.....Switchboards
 - 1008-07.....Transfer Switch Equipment

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Automatic transfer switches shall comply with UL, NEMA, NEC, ANSI, IEEE, and NFPA, and have the following features:
 - 1. Automatic transfer switches shall be open transition switches, 4-pole, draw-out construction, electrically operated, mechanically held open contact type, without integral overcurrent protection. Automatic transfer switches utilizing automatic or non-automatic molded case circuit breakers, insulated case circuit breakers, or power circuit breakers as switching mechanisms are not acceptable.
 - 2. Automatic transfer switches shall be completely factory-assembled and wired such that only external circuit connections are required in the field.
 - 3. Each automatic transfer switch shall be equipped with an integral bypass/isolation switch.
 - 4. Ratings:
 - a. Phases, voltage, continuous current, poles, and withstand and closing ratings shall be as shown on the drawings.
 - b. Transfer switches are to be rated for continuous duty at specified continuous current rating on 60Hz systems.
 - c. Maximum automatic transfer switch rating: 800 A.
 - 5. Markings:
 - a. Markings shall be in accordance with UL 1008.

6. Tests:
 - a. Automatic transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstand and closing tests when used with the upstream overcurrent device and available fault current specified.
7. Surge Withstand Test:
 - a. Automatic transfer switches utilizing solid-state devices in sensing, relaying, operating, or communication equipment or circuits shall comply with IEEE C37.90.1.
8. Housing:
 - a. Enclose automatic transfer switches in wall- or floor-mounted steel cabinets, with metal gauge not less than No. 14, in accordance with UL 508, or in a switchboard assembly in accordance with UL 891, as shown on the drawings.
 - b. Enclosure shall be constructed so that personnel are protected from energized bypass-isolation components during automatic transfer switch maintenance.
 - c. Automatic transfer switch components shall be removable without disconnecting external source or load power conductors.
 - d. Finish: Cabinets shall be given a phosphate treatment, painted with rust-inhibiting primer, and finish-painted with the manufacturer's standard enamel or lacquer finish.
 - e. Viewing Ports: Provide viewing ports so that contacts may be inspected without disassembly.
9. Operating Mechanism:
 - a. Actuated by an electrical operator.
 - b. Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in either normal and emergency position.
 - c. Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of transfer. Release of the locking mechanism shall be possible only by normal operating action.
 - d. Contact transfer time shall not exceed six cycles.
 - e. Operating mechanism components and mechanical interlocks shall be insulated or grounded.
10. Contacts:

- a. Main contacts: Silver alloy.
 - b. Neutral contacts: Silver alloy, continuous current rating with same current the rating of the phase contacts.
 - c. Current carrying capacity of arcing contacts shall not be used in the determination of the automatic transfer switch rating, and shall be separate from the main contacts.
 - d. Main and arcing contacts shall be visible for inspection with cabinet door open and barrier covers removed.
11. Manual Operator:
- a. Capable of operation by one person in either direction under no load.
12. Replaceable Parts:
- a. Include the main and arcing contacts individually or as units, as well as relays, and control devices.
 - b. Automatic transfer switch contacts and accessories shall be replaceable from the front without removing the switch from the cabinet and without removing main conductors.
13. Sensing Features:
- a. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100% of nominal, and dropout voltage is adjustable from 75 to 98% of pickup value. Factory set for pickup at 90% and dropout at 85%.
 - b. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
 - c. Voltage/Frequency Lockout Relay: Prevent premature transfer to the engine-generator. Pickup voltage shall be adjustable from 85 to 100% of nominal. Factory set for pickup at 90%. Pickup frequency shall be adjustable from 90 to 100% of nominal. Factory set for pickup at 95%.
 - d. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 - e. Test Switch: Simulate normal-source failure.
 - f. Switch-Position Pilot Indication Lights: Indicate source to which load is connected.

- g. Source-Available Indication Lights: Supervise sources via transfer switch normal- and emergency-source sensing circuits.
 - h. Normal Power Indication: Indicate "Normal Source Available."
 - i. Emergency Power Indication: Indicate "Emergency Source Available."
 - j. Transfer Override Control: Overrides automatic retransfer control so that automatic transfer switch shall remain connected to emergency power source regardless of condition of normal source. Control panel shall indicate override status.
 - k. Engine Starting Contacts: One isolated and normally closed and one isolated and normally open; rated 5 A at 30 V DC minimum.
 - l. Engine Shutdown Contacts: Time delay adjustable from zero to 15 minutes, and factory set for 5 minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
 - m. Engine-Generator Exerciser: Programmable exerciser starts engine-generator(s) and transfers load to them from normal source for a preset time, then retransfers and shuts down engine-generator(s) after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period.
14. Controls:
- a. Controls shall provide indication of switch status and be equipped with alarm diagnostics.
 - b. Controls shall control operation of the automatic transfer switches.
15. Control Wiring between ATS and Paralleling Switchgear: The ATS shall have both hardwired and communication network interfaces to the Master Control Cubicle of the paralleling switchgear.
- a. Below are the hardwired connection requirements from the paralleling gear to each ATS fed from the paralleling gear

Hard Wire	MOD/BUSS	Operation	Wires Required
Common Wire	N/A	N/A	1, #12 AWG
Engine Start Signal	Engine Start Signal	Command	2, #12 AWG
Closed on Normal	Closed on Normal	Status	1, #12 AWG
Closed on Emergency	Closed on Emergency	Status	1, #12 AWG
Emergency Available	Emergency Available	Status	1, #12 AWG
Emergency not Available	Emergency not Available	Status	Shared with above, status On/Off
Normal Available	Normal Available	Status	1, #12 AWG
Normal not Available	Normal not Available	Status	Shared with above, status On/Off
Remote Transfer to Emergency	Remote Transfer to Emergency	Command	2, #12 AWG
Switch in Bypass	Switch in Bypass	Status	1, #12 AWG
Load Shed to Normal	Load Shed to Normal	Command	2, #12 AWG
Manual Re-Transfer Inhibit	Manual Re-Transfer Inhibit	Command	2, #12 AWG
Spare	Spare	Spare	2, #12 AWG

b. CAT 6 cable shall be provided from the ATS to the nearest telecommunications switch to provide the communication network interface with the Master Controller of the paralleling switchgear.

16. Factory Wiring: Train and bundle factory wiring and label either by color-code or by numbered/lettered wire markers. Labels shall match those on the shop drawings.

17. Annunciation, Control, and Programming Interface Components: Devices for communicating with remote programming devices,

- annunciators, or control panels and paralleling switchgear shall have open-protocol communication capability matched with remote device.
18. Provide contacts for connection to elevator controllers, one closed when automatic transfer switch is connected to the normal source, and one closed when automatic transfer switch is connected to the emergency source.
 19. Elevator Pre-Transfer Signal Relay: Provide a pre-signal relay on all automatic transfer switches that will indicate to an elevator controller or controllers that a transfer or re-transfer is about to occur.
 20. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to the automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit in-rush and seal currents are rated for actual currents to be encountered.
 21. Accessories: The ATS shall be provided equipped with the following accessories.
 - a. Power Manager: Collects real-time power system information and performs all monitoring and setting functions for the ATS.
 - b. Connectivity Module: Built-in web page that monitors the ATS and connected loads automatically when accessed by a standard web browser. This module shall allow the ATS to transmit via ModBus over an Ethernet connection. This module shall also allow control of the ATS functions and operations over Ethernet.
 - c. Auxiliary contact to close when the bypass switch is not in the automatic position or when the transfer switch isolation contacts are not connected.
 - d. 2P D/T contacts that operate when emergency source voltage is present at the transfer switch terminals.
 - e. 2P D/T contacts that operate when normal source voltage is present at the transfer switch terminals.
 - f. Load Shed Contacts: Load shedding circuit to match the generator capacity to the load. The load shed contact shall control load shed. When the load is connected to emergency source and the contact open, the transfer switch shall transfer the load back to the normal source. Transfer shall occur regardless of the condition of the normal source.

- g. Selective load disconnect circuit to provide pre-transfer and/or post-transfer signal when transferring from emergency to normal and/or normal to emergency. Additionally, the signal can be programmed to occur during all transfers or only when the transfer is occurring between two live sources. The length of the pre and post transfer delays can be set to 0 to 5 minutes, 59 seconds.
- h. Auxiliary Contacts:
 - i. Provide contacts as necessary to accomplish the functions shown on drawings and specifications. In addition, provide one spare normally open contact and one normally closed contact.
 - ii. Provide remote contact to by-pass re-transfer time delay to normal source.
 - iii. In-Phase Monitoring: factory-wired, internal relay controls transfer to allow transfer only when the two sources are synchronized in phase. The relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70% or more of the nominal voltage.

2.2 SEQUENCE OF OPERATION

- A. The specified voltage decrease in one or more phases of the normal power source shall initiate the transfer sequence. The automatic transfer switch shall start the engine-generator(s) after a specified time delay to permit override of momentary dips in the normal power source.
- B. The automatic transfer switch shall transfer the load from normal to emergency source when the frequency and voltage of the engine-generator(s) have attained the specified percent of rated value.
- C. Engine Start: A voltage decrease, at any automatic transfer switch, in one or more phases of the normal power source to less than the specified value of normal shall start the engine-generator(s) after a specified time delay.
- D. Transfer to Emergency System Loads: Automatic transfer switches for Emergency System loads shall transfer their loads from normal to emergency source when frequency and voltage of the engine-generator(s) have attained the specified percent of rated value. Only those switches with deficient normal source voltage shall transfer.
- E. Transfer to Equipment Branch Loads: Automatic transfer switches for Equipment Branch loads shall transfer their loads to the engine-generator on a time-delayed, staggered basis, after the Emergency System switches

have transferred. Only those switches with deficient normal source voltage shall transfer.

- F. Load Shed: If the load on the paralleling switchgear bus exceeds 85% of the capacity of all the generator sets combined on the bus for 10 seconds, the ATS shall load shed based on the set priority level directed by the paralleling switchgear PLCs. Load shed is defined as the ATS transferring to the alternate source position regardless of the condition of that source. If power is not available at the alternate source, the ATS shall be capable of transferring onto a dead bus.

The ATS load shed function shall also be controlled through the remote manual hard-wired switches located on the ATS Manual Operation Control cubicle of the paralleling switchgear.

- G. Retransfer to Normal (All Loads): Automatic transfer switches shall retransfer the load from emergency to normal source upon restoration of normal supply in all phases to the specified percent or more of normal voltage, and after a specified time delay. Should the emergency source fail during this time, the automatic transfer switches shall immediately transfer to the normal source whenever it becomes available. After restoring to normal source, the engine-generator(s) shall continue to run unloaded for a specified interval before shut-down.
- H. Exercise Mode: Transfer to the emergency power source shall be accomplished through the remote manual hard-wired switches on a selective basis. These switches are located on the ATS Manual Operation Control cubicle of the paralleling switchgear.

2.3 BYPASS-ISOLATION SWITCH

- A. Provide each automatic transfer switch with two-way bypass-isolation manual type switch. The bypass-isolation switch shall permit load by-pass to either normal or emergency power source and complete isolation of the automatic transfer switch, independent of transfer switch position. Bypass and isolation shall be possible under all conditions including when the automatic transfer switch is removed from service.
- B. Operation: The bypass-isolation switch shall have provisions for operation by one person through the movement of a maximum of two handles at a common dead front panel in no more than 15 seconds. Provide a lock, which must energize to unlock the bypass switch, to prevent bypassing to a dead source. Provide means to prevent simultaneous connection between normal and emergency sources.
1. Bypass to normal (or emergency): Operation of bypass handle shall allow direct connection of the load to the normal (or emergency) source, without load interruption or by using a break-before-make design, or provide separate load interrupter contacts to momentarily interrupt the load.
 - a. Ensure continuity of auxiliary circuits necessary for proper operation of the system.
 - b. A red indicating lamp shall light when the automatic transfer

switch is bypassed.

- c. Bypassing source to source: If the power source is lost while in the bypass position, bypass to the alternate source shall be achievable without re-energization of the automatic transfer switch service and load connections.
2. Isolation: Operation of the isolating handle shall isolate all live power conductors to the automatic transfer switch without interruption of the load.
 - a. Interlocking: Provide interlocking as part of the bypass-isolation switch to eliminate personnel-controlled sequence of operation, and to prevent operation to the isolation position until the bypass function has been completed.
 - b. Padlocking: Include provisions to padlock the isolating handle in the isolated position.
 - c. Visual verification: The isolation blades shall be visible in the isolated position.
 3. Testing: It shall be possible to test (normal electrical operation) the automatic transfer switch and engine-generator(s) with the isolation contacts closed and the load bypassed without interruption of power to the load.
- C. Ratings: The electrical capabilities and ratings of the bypass-isolation switch shall be compatible with those of the associated automatic transfer switch, including any required additional withstand tests.

2.4 REMOTE ANNUNCIATOR SYSTEM

- A. Remote annunciation shall annunciate conditions for the automatic transfer switches located in Building 100, ME-2, and the new automatic transfer switches located in Building 103A at the Generator Paralleling Switchgear, as per Section 26 23 15.
- B. Shall have two (2) Remote Annunciation Panels [LED type] that shall fully duplicate the Master Operator Interface Panel with virtual monitoring (no control) capability to provide individual ATS remote status, alarm and display functions. The locations of these Remote Annunciation Panels shall be Bldg. 40 Boiler Plant office and the Police Station, Building 100, first floor.
 1. The remote annunciation shall be integrated with the existing Building 100 EPSS SCADA remote monitoring systems located at the Bldg. 40 Boiler Plant office and the Police Station, Building 100, first floor.
 2. Malfunction of remote annunciator and control system or communication link shall not affect functions of the automatic transfer switches. Automatic transfer switch sensing, controlling, or operating functions shall not depend on remote annunciator and control system for proper operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install automatic transfer switches in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
- B. Anchor automatic transfer switches with rustproof bolts, nuts, and washers not less than 12 mm (1/2 inch) diameter, in accordance with manufacturer's instructions, and as shown on drawings.
- C. Automatic Transfer Switches shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- D. Mount automatic transfer switches 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 automatic transfer switch manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the 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 manufacturer's required field tests 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. Confirm correct application of manufacturer's recommended lubricants.
 - d. Verify appropriate anchorage, required area clearances, and correct alignment.
 - e. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
 - f. Verify grounding connections.

- g. Verify ratings of sensors.
 - h. Vacuum-clean enclosure interior. Clean enclosure exterior.
 - i. Exercise all active components.
 - j. Verify that manual transfer warning signs are properly placed.
 - k. Verify the correct operation of all sensing devices, alarms, and indicating devices.
2. Electrical tests:
- a. Perform insulation-resistance tests.
 - b. After energizing circuits, demonstrate the interlocking sequence and operational function for each automatic transfer switch at least three times.
 - 1.) Test bypass-isolation unit functional modes and related automatic transfer switch operations.
 - 2.) Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.
 - 3.) Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.
 - 4.) Low phase-to-ground voltage shall be simulated for each phase of normal source.
 - 5.) Operation and settings shall be verified for specified automatic transfer switch operational feature, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, load shed/load add, and supplemental features.
 - 6.) Verify pickup and dropout voltages by data readout or inspection of control settings.
 - 7.) Verify that bypass and isolation functions perform correctly, including the physical removal of the automatic transfer switch while in bypass mode.
 - c. Ground-fault tests: Verify that operation of automatic transfer switches shall not cause nuisance tripping or alarms of ground fault protection on either source.
 - d. When any defects are detected, correct the defects and repeat the tests as requested by the COR at no additional cost to the Government.

3.3 FIELD SETTINGS VERIFICATION

- A. The automatic transfer switch settings shall be verified in the field by an authorized representative of the manufacturer.

3.4 FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the automatic transfer switches are in good operating condition and properly performing the intended function.

3.5 INSTRUCTION

- A. Furnish the services of a factory-trained technician for one 4-hour training period for instructing personnel in the maintenance and operation of the automatic transfer switches, on the dates requested by the COR.

END OF SECTION 26 36 23