**SECTION 26 24 13**

**MEDIUM VOLTAGE TEMPORARY GENERATOR QUICK CONNECTION SWITCHGEAR**

1. **GENERAL**
	1. **DESCRIPTION**
		1. This section specifies the furnishing and testing of medium-voltage temporary Generator Quick Connection Switchgear with integrated manual transfer switching capability, indicated as “switchgear” in this section.
	2. **QUALITY ASSURANCE**
		1. The equipment furnished under this Section shall be the product of a manufacturer who has produced paralleling switchgear up to 15kV for a period of at least 15 consecutive years.
		2. The switchgear equipment manufacturer shall have all aspects of design, assembly, and testing of the equipment within the same location.
		3. The switchgear manufacturer shall have field service personnel and facility with spare parts. The spare parts stocked at the facility shall include vacuum circuit breakers, automation controllers, control switches and lights, fuses, medium voltage insulators, etc.
	3. **FACTORY TESTS**
		1. Medium-Voltage Switchgear Assembly Tests:
			1. Visual and Mechanical Inspection:
				1. Verify that fuse and switch sizes and types correspond to drawings and coordination study.
				2. Inspect bolted electrical connections using calibrated torque-wrench method.
				3. Confirm correct operation and sequencing of mechanical interlock systems.

Attempt closure on locked-open devices. Attempt to open locked-closed devices.

* + - * 1. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
				2. Inspect insulators for evidence of physical damage or contaminated surfaces.
				3. Verify correct barrier installation and operation.
				4. Exercise active components.
				5. Inspect mechanical indicating devices for correct operation.
				6. Verify that filters are in place and vents are clear (if applicable).
				7. Perform visual and mechanical inspection of instrument and control power transformers.
				8. Inspect control power transformers.

Inspect for physical damage, cracked insulation, broken leads, and tightness of connections, defective wiring, and overall general condition.

Verify that primary and secondary fuse or circuit breaker ratings match drawings.

Verify correct functioning of drawout disconnecting and grounding contacts and interlocks.

* + - 1. Electrical Tests:
				1. Perform a power frequency dielectric withstand voltage test on each bus section, each phase to ground with phases not under test grounded, according to ANSI C37.20.2 Table 1.

If no evidence of uncontrolled discharge or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.

* + - * 1. Perform current-injection tests on the entire current circuit in each section of switchgear.

Perform current tests by secondary injection with magnitudes such that a minimum current of 1.0 A flows in the secondary circuit. Verify correct magnitude of current at each device in the circuit.

Vary the magnitude of the injected current and verify overcurrent trip of all the overcurrent protective relays.

* + - * 1. Perform system function tests according to "System Function Tests" Article.
				2. Verify operation of space heaters (if applicable).
				3. Perform phasing checks on double-ended or dual-source switchgear to ensure correct bus phasing from each source.
		1. Medium-Voltage Surge Arrester Field Tests:
			1. Visual and Mechanical Inspection:
				1. Verify that equipment nameplate data complies with Design Documents.
				2. Inspect physical and mechanical condition.
				3. Inspect anchorage, alignment, grounding, and clearances.
				4. Verify the arresters are clean.
				5. Verify that the ground lead on each device is attached to a ground bus or ground electrode.
			2. Electrical Test:
				1. Microprocessor-Based Protective Relay Field Tests:

Visual and Mechanical Inspection:

Record model number, style number, serial number, firmware revision, software revision, and rated control voltage.

Verify operation of light-emitting diodes, display, and targets.

Record passwords for each access level.

Clean the front panel and remove foreign material from the case.

Check tightness of connections.

Verify that the frame is grounded according to manufacturer's instructions.

Set the relay according to results of the coordination study (if available).

Download and save settings from the relay.

Electrical Tests:

Apply voltage or current to analog inputs, and verify correct registration of the relay meter functions.

Functional Operation: Check functional operation of protective function used in the protection scheme as follows via secondary injection of the currents and voltages.

* + 1. System Function Tests:
			1. Conduct testing of the sequence of operation according to the Specification.
			2. Simulate the Power System conditions as required.
			3. Verify operation sequence.
	1. **SUBMITTALS**
		1. Product Data: Submit manufacturer's printed product data.
		2. Drawings: Submit shop drawings for approval. Include components, materials, finishes, detailed plan and elevation views, openings, and accessories.
	2. **APPLICABLE PUBLICATIONS**
		1. 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 basic designation only.
		2. American National Standards Institute (ANSI):

C37.54..................Indoor Alternating Current High-Voltage Circuit

Breakers Applied as Removable Elements in Metal-Enclosed Switchgear - Conformance Test Procedures

C37.55..................Medium-Voltage Metal-Clad Assemblies –

Conformance Test Procedures

* + 1. Institute of Electrical and Electronics Engineers (IEEE):

C37.09..................Standard Test Procedure for AC High-Voltage Circuit

Breakers Rated on a Symmetrical Current Basis

C37.20.3................IEEE Standard for Metal-Enclosed Interrupter Switchgear

C37.20.4................IEEE Standard for Indoor AC Switches (1kV-38kV) for Use in Metal-Enclosed Switchgear

C37.22..................IEEE Standard Preferred Ratings and Required Capabilities for Indoor AC Medium-Voltage Switches Used in Metal-Enclosed Switchgear.

C57.13..................Standard Requirements for Instrument Transformers

* + 1. National Electrical Manufacturer's Association (NEMA):

C37.57..................Switchgear-Metal-Enclosed Interrupter Switchgear Assemblies - Conformance Testing

LA 1....................Surge Arrestors

SG-2....................Standards for High-Voltage Fuses

SG-5....................Standards for Power Switchgear Assemblies

SG-6....................Standards for Power Switchgear Equipment

* + 1. National Fire Protection Association (NFPA):

70-11...................National Electrical Code (NEC)

* + 1. International Electrotechnical Commission (IEC):

60694...................Common specifications for high-voltage switchgear and controlgear standards

1. **PRODUCTS**
	1. **SYSTEM RATING**
		1. System Voltage: (2.4/4.16/12.47/13.2/13.8) kV nominal, three-phase, 60 Hz.
		2. Maximum Design Voltage: (4.76/15) kV.
		3. Impulse Withstand (Basic Impulse Level): (60/95) kV.
		4. Main Bus Ampacity: (500/1200) amps, continuous.
	2. **GENERAL REQUIREMENTS**
		1. Manufacturers: Subject to compliance with requirements, provide switchgear of the following:
			1. Advanced Power Technologies (APT) – Contact Brandon Lopez for quotation.
			2. In order to be an approved manufacturer, the manufacturer seeking to be approved shall send pertinent product information, qualifications, references, and evidence of support capabilities as per section 1.2 of this specification thirty days prior to the bid date to both customer and engineer.
		2. Switchgear shall be in accordance with ANSI, IEEE, NEMA, NFPA, IEC as shown on the drawings, and have the following features:
			1. Switchgear shall be a complete, grounded, continuous-duty, integral assembly, metal enclosed, dead-front, self-supporting switchgear assembly. Incorporate devices shown on the drawings and all related components required to fulfill operational and functional requirements.
			2. Switchgear shall be supplied as a complete system and shall include all the necessary components and equipment to accommodate described system operation unless otherwise noted.
			3. Switchgear shall conform to the arrangements and details shown on the drawings.
			4. Switchgear shall be fully assembled, connected, and wired at the factory so that only external circuit connections are required at the construction site.
			5. All non-current-carrying conductive parts shall be grounded.
			6. Packaging shall include the switchgear to be stretch wrapped and mounted to a skid and to provide adequate protection against rough handling during shipment.
	3. **HOUSING**
		1. Frames and enclosures:
			1. Enclosure shall be designed according to NEMA (1/3R) standard for (indoor/outdoor) operation.
			2. Each switch and fuse assembly or auxiliary unit shall be mounted in an individual, free standing, self-supporting, metal enclosed cubicle constructed of sheet steel.
			3. The switchgear enclosure frame shall be produced from at least 11 gauge mild steel and the switchgear enclosure doors shall be produced from at least 12 gauge mild steel.
			4. Switchgear width shall not exceed the space as allocated on the floor plan with maximum depth dimension of (72) inches.
			5. Enclosure shall be of rigid frame construction.
			6. Each switchgear section shall have a full length door, manufactured from at least, 12 Gauge steel.
			7. The assembly shall be braced with integral reinforcing gussets using bolted connections to assure rectangular rigidity.
			8. The enclosure shall be steel, leveled, and not less than the gauge required by applicable publications.
			9. Switchgear shall have mounting holes for connecting adjacent structures to insure proper alignment, and to allow for future additions.
			10. Each vertical section containing a switch shall have a single, full-length, flanged front door and shall be equipped with two rotary latch-type padlockable handles. Provision shall be made for operating the switch and storing the removable handle without opening the full length door. Front doors shall be hinged and gasketed. The door shall be interlocked with the switch so that:
				1. The switch must be opened before the door can be opened.
				2. The door must be closed before the switch can be closed.
			11. All bolts, nuts, and washers shall be zinc-plated steel.
			12. For ease of on-site cable connections and maintenance an open bottom and removable full depth side sheets shall be provided.
			13. For ease of the switchgear service, maintenance and future upgrades, all the support structures, braces and cover sheets shall be removable and attached to the frame via bolts.
			14. The enclosure shall include a half sized lower door per section with a single latch to access permanent cables.
			15. The upper half sheet of each section shall include an integral manual load break transfer switch viewing window. This is to provide operators with a visual of air that physically disconnected blades of the manual transfer switches.
			16. The lower half door of the section shall include an integral lower flip open door on the lower door of the section containing the quick connection bushing wells to allow cable connection of the portable generator set.
			17. The access doors shall have half height left or right hinge to allow easy access to the switchgear bushing type connections for cable connections to the mobile generator or site loads. The bottom portion of the lower door shall have an additional horizontal hinge to allow for the door to be closed while cables are connected. The hinged bottom portion of the door shall flip up to the extent needed to accommodate the cable entry/exit while providing a shield for the components inside of the enclosure.
			18. Stainless Steel exterior hardware shall be utilized on NEMA 3R units.
			19. One (1) padlockable handle on lower half front door and one (1) padlockable handle on lower flip door.
		2. Markings and Nameplates:
			1. Each switchgear section shall have a label permanently affixed to it, listing the following information: Name of manufacturer, system voltage, ampacity, interrupting rating, enclosure type, and manufacturer's shop order number.
			2. Each control switch, indicating light or other component mounted on the inner panel shall be identified by a nameplate.
			3. The nameplates shall be produced from clear textured polycarbonate, laminated on high performance pressure sensitive adhesive. The printing shall be done on the interior surface of the laminate to avoid scratching or other deterioration of text. The lettering shall be white on black background.
		3. Finish:
			1. All metal surfaces shall be thoroughly cleaned with the following cleaning process:
				1. Alkaline cleaned (phosphate free)
				2. Double rinsed
				3. Conversion coating process (phosphorous-free)
				4. Final rinse with reverse osmosis processed water
			2. Powder coat of ANSI 61 Light Gray shall be applied to all interior and exterior surfaces for superior corrosion protection.
	4. **BUS**
		1. Provide sliver plated copper bus, fully rated for the amperage shown on the drawings for entire length of the switchgear.
		2. Bus connections to switches shall be rated to carry the full continuous current of the device.
		3. Mount the bus on appropriately spaced insulators and brace to withstand the available short circuit currents.
		4. All bus (main, neutral, ground, extension, etc.) shall be produced from silver plated copper.
		5. Silver-plated copper, appropriately sized bus bar and extensions shall have NEMA standard hole pattern to accommodate cable connections.
		6. Install a silver plated copper ground bus the full length of the switchgear assembly.
		7. All bolts, nuts, and washers shall be zinc-plated steel. Bolts shall be torqued to 55 foot-lbs for 1/2” hardware and 35 foot-lbs. for 3/8” hardware.
	5. **BUSHING TYPE RECEPTACLES**
		1. Each air insulated bushing well shall be a single pole receptacle with drain wire grounded insulating caps.
		2. Number and ratings of receptacles to be used as indicated on the drawings.
		3. Insulated caps shall be installed on bushing inserts when cables are not connected using elbows.
	6. **LOAD INTERRUPTER SWITCHES**
		1. Each switchgear section shall be equipped with one ANSI C37.20.4 compliant manual loadbreak switch.
		2. Load interrupter switches: 3 Pole, two position, gang operated, bottom hinged stationary load break type, mounted on a rigid, welded steel frame. Main switch blades shall be high conductivity, hard drawn copper. Mechanical linkages shall be porcelain or epoxy, with leakage and flashover distances equal to the mounting insulators. Circuit interrupting arc shall be completely contained and vented within the arc chutes.
		3. Manual switch operator: Quick make, quick break, non-defeatable, high speed, stored energy operating mechanism actuated by an external operating handle. Opening and closing shall be accomplished by a single upward or downward stroke of the handle. The operating speed of the interrupter switch shall be independent of the operator handle speed.
		4. The following features shall be supplied on every vertical section containing a three-pole, two position open-closed switch:
			1. A high-impact viewing window that permits full view of the position of all three switch blades through the closed door.
			2. Provision for padlocking the switch in the open or closed position.
			3. Green OPEN, Red CLOSED switch position indicators.
			4. A hinged grounded metal barrier that is bolted closed in front of every switch to prevent inadvertent contact with any live part, yet allows for a full-view inspection of the switch blade position.
			5. Full depth interphase and side barriers of insulating material in switch and fuse compartments.
		5. Switch shall be rated per the following:
			1. Continuous and loadbreak current ratings shall be as indicated on the drawings.
	7. **OVERCURRENT PROTECTION**
		1. Fuses:
			1. Switchgear shall be equipped with one set of three output fuses if indicated on the drawings.
		2. Fuse ratings shall be as indicated on drawings.
	8. **SURGE ARRESTERS:**
		1. Provide distribution class surge arresters, if required, as indicated on the drawings.
	9. **ANNUNCIATION**
		1. All indicating lights shall be of high visibility, LED type with lenses of at least 1 inch outside diameter with service life of 100,000 hours at 77°F temperature.
		2. Manual transfer switching device position indicating lights shall be located on the upper sheet above the front lower half sized doors; customer to supply 120VAC, 10A circuit.
		3. Form C dry contacts rated for 8 Amp at 30VDC or 250VAC for customer use as follows:
			1. Switch position status
	10. **SENSING & METERING**
		1. Current Transformers (CTs):
			1. Provide current transformer ratios as shown on the drawings. Accuracies shall be coordinated with the associated relays by the switchgear manufacturer to assure proper operation at the selected pick-up and operating current values.
			2. The current transformer mounting assembly shall be insulated for the full voltage rating of the switchgear.
			3. All the current circuits shall be wired using ring type terminals.
		2. Potential Transformers (PTs):
			1. Potential transformers shall be appropriately fused, fixed mounted, connected in (wye/open delta) configuration to the line or load side of the loadbreak switch as indicated on the drawings.
		3. Power Metering:
			1. The following true RMS, 3 element power metering of each power source and bus shall be provided as a minimum:
				1. Line to line voltages:

Vab, Vbc, Vca

* + - * 1. Phase currents:

Ia, Ib, Ic

* + - * 1. Frequency, Hz
				2. Three phase power parameters:

kW (per phase and total)

Power Factor (per phase and total)

KVAR (per phase and total)

kVA (per phase and total)

* + - * 1. Three energy export and import power parameters:

kWh, kVARh, kVAh

* + - * 1. Power Quality parameters:

%THD Volts per phase

%THD Amps per phase

%TDD Amps per phase

K-factor per phase

Individual odd Voltage harmonics per phase up to order 39

Individual odd current harmonics per phase up to order 39

Fundamental component of KW and Power Factor (per phase and total)

* + - * 1. Other parameters:

Percent ampere peak capacity of the highest phase

Neutral current

Current unbalance

Voltage unbalance

Maximum kW demand

Maximum kVA demand

Minimum and maximum values for voltages, currents frequency and power parameters

* + - 1. Metering accuracy shall be in accordance with ANSI C12.20-1998 and rated as follows:
				1. Class 10 0.5% for energy.
				2. 0.2% of reading and 0.02% of full scale for voltages and currents.
				3. 0.3% of reading and 0.02% of full scale for active and apparent power.
			2. Dedicated high-brightness digital LED displays shall be provided which are visible in the bright sun light or in the dark.
	1. **MANUAL TRANSFER SWITCH INTERLOCKING**
		1. Interlock between facility main service manual loadbreak switch and temporary generator loadbreak switch shall be to prevent inadvertent paralleling of the Utility and Temporary Generator.
		2. The Kirk Key shall be removed from the main service manual loadbreak switch lock to hold the switch in the ‘open’ position, and to be inserted in the temporary generator loadbreak switch lock to allow connection of the generator to the facility.
	2. **SEQUENCE OF OPERATION**
		1. Should the Utility fail, the facility’s main load break switch would be manually opened and the portable generator set would be connected to the bushing type receptacles in the panel located behind lower flip door.
		2. The Temporary Generator Connection load break switch would be manually closed to allow the temporary generator to provide electrical power to the facility load.
		3. Upon restoration of the Utility’s power, the Temporary Generator Connection load break switch would be manually opened to allow for the closing of facility’s main utility load break switch to restore the facility to the normal Utility power source.
	3. **CONTROL WIRING**
		1. Switchgear control wiring shall be UL/CSA approved stranded copper, minimum size No. 18 AWG, 600 Volt, 90 degrees C, flame retardant, Type SIS.
		2. Voltage and Current transformer circuits shall utilize minimum size No. 12 AWG wire. Install wiring complete at the factory, adequately bundled and protected.
1. **EXECUTION**
	1. **COMMISSIONING**
		1. Install switchgear in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.

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