**SECTION 26 24 17**

**MEDIUM VOLTAGE TEMPORARY GENERATOR/LOAD BANK QUICK CONNECTION SWITCHGEAR**

1. **GENERAL**
	1. **DESCRIPTION**
		1. This section specifies the furnishing and testing of medium-voltage temporary Generator/Load Bank Quick Connection (GLQC) Switchgear, indicated as “switchgear” in this section.
		2. Medium Voltage Generator/Load Bank Quick Connection Switchgear shall be designed to allow quick and safe connection of a mobile Generator/Load Bank set and/or transformer to facilities with (2.4kV to 15kV) experiencing loss of power. Permanent installation and connection of the switchgear to the facility power distribution system will minimize any unplanned power outages.
	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. Inspect bolted electrical connections using calibrated torque-wrench method.
				2. Confirm correct operation and sequencing of mechanical interlock systems.

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

* + - * 1. Inspect insulators for evidence of physical damage or contaminated surfaces.
				2. Verify correct barrier installation and operation.
				3. Exercise active components.
				4. Inspect mechanical indicating devices for correct operation.
				5. Verify that filters are in place and vents are clear (if applicable).

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

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

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.

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

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

C37.58..................Switchgear-Indoor AC Medium-Voltage Switches for Use in Metal-Enclosed Switchgear— Conformance Test Procedures

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. Bus Ampacity: (600/1200) amps, continuous.
	2. **GENERAL REQUIREMENTS**
		1. Manufacturers: Subject to compliance with requirements, provide switchgear of the following:
			1. Advanced Power Technologies (APT) MF2-Series – Contact Brandon Lopez/Lance Dubea 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 (3R) standard for (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. Enclosure shall be of rigid frame construction.
			5. Each switchgear section shall have a full-length door, manufactured from at least, 12 Gauge steel.
			6. The assembly shall be braced with integral reinforcing gussets using bolted connections to assure rectangular rigidity.
			7. The enclosure shall be steel, leveled, and not less than the gauge required by applicable publications.
			8. Switchgear shall have mounting holes for connecting adjacent structures to insure proper alignment, and to allow for future additions.
			9. 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. Busbar/customer connections and switch shall be accessible via screw cover sheets. Unit shall be dead front with no parts exposed and accessible with the main door open.
			10. All bolts, nuts, and washers shall be zinc-plated steel.
			11. For ease of on-site cable connections and maintenance an open bottom and removable full depth side sheets shall be provided.
			12. 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.
			13. The enclosure shall include a half sized lower door per section with a single latch to access permanent cables.
			14. Stainless Steel exterior hardware shall be utilized on NEMA 3R units.
			15. One (1) padlockable handle on main 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:

Alkaline cleaned (phosphate free)

Double rinsed

Conversion coating process (phosphorous-free)

Final rinse with reverse osmosis processed water

* + - 1. Powder coat of ANSI 61 Light Gray shall be applied to all interior and exterior surfaces for superior corrosion protection.
	1. **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.
	2. **BUSHING TYPE RECEPTACLES**
		1. Each air insulated (load/dead) break 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.
	3. **LOAD INTERRUPTER SWITCHES (if required)**
		1. Each switchgear section shall be equipped with one ANSI C37.20.4 compliant manual load break 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 rotation of the front mounted shaft operator with removeable 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 grounded metal barrier with viewing window shall be bolted in front of every switch to prevent inadvertent contact with any live part and 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) compartment(s).
		5. Optional: Monitoring functions: where shown on the Drawings, provide addressable relays to communicate status points over the network. Each relay shall be rated for the application and have a unique address to view each load interrupter switch's status from a remote computer:
			1. An addressable relay shall monitor an auxiliary switch contact that monitors the primary load interrupter switch position (open and closed).
			2. A blown high voltage fuse condition on each set of three fuses shall be monitored by an addressable relay.
		6. Switch shall be rated per the following:
			1. Continuous and load break current ratings shall be as indicated on the drawings.
	4. **OVERCURRENT PROTECTION (if required)**
		1. Fuses:
			1. Switchgear shall be equipped with one set of three output fuses if indicated on the drawings.
			2. Fuses shall be full range current limiting type capable of interrupting any continuous current between the minimum current that can cause melting of its elements and its rated maximum interrupting current 50kA.
			3. Fuses shall be hermetically sealed construction ensures that no gases escape from the fuse during current interruption.
			4. (Blown fuse indicator designed to prevent affecting the fuse’s arcing performance.)
		2. Fuse ratings shall be as indicated on drawings.
	5. **CONTROL POWER (Choose A or B)**
		1. Control Power Transformers (CPTs) & Battery Backup:
			1. Switchgear shall self-derive the control power required for the switchgear space heaters, battery charger, indicating lights, and other consumers.
			2. The control power transformers shall be properly protected by primary current-limiting fuses.
			3. CPT shall feed battery charger to provide backup control power to the unit.
		2. Customer to provide 120VAC, 10A circuit for control power. (SPEC WRITER NOTE: Make sure the source is backed up if necessary, for the application.)
	6. **ANNUNCIATION (if required)**
		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.
	7. **SENSING (if applicable)**
		1. Potential Transformers (PTs):
			1. Potential transformers shall be appropriately fused, fixed mounted, (14400):120VAC connected in (open delta/WYE) configuration.
		2. Phase Rotation Monitoring
			1. Phase Rotation Monitoring shall ensure portable genset phase rotation matches that of the facility.
			2. An indicating light shall provide visual assurance of correct phasing.
			3. Instructions to easily fix incorrect phase rotation shall be included on a label inside each panel.
	8. **METERING (if applicable)**
		1. Current Transformers (CTs):
			1. Current transformer ratios shall be 200:5 or customer specified.
		2. 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:

Class 10 0.5% for energy.

0.2% of reading and 0.02% of full scale for voltages and currents.

0.3% of reading and 0.02% of full scale for active and apparent power.

* + - 1. Dedicated high-brightness digital LED displays shall be provided which are visible in the bright sun light or in the dark.
	1. **SURGE ARRESTERS (if required)**
		1. Provide (distribution/intermediate/station) class MOV surge arresters in sets of three in locations shown on drawings.
		2. Surge arresters shall be rated for the line to ground voltage of the system.
	2. **MANUAL TRANSFER SWITCH INTERLOCKING (if required, generator only application)**
		1. Interlock between facility main and the switchgear enclosure shall be to prevent inadvertent paralleling of the utility and temporary generator.
		2. The Kirk Key shall be removed from the main to hold the it in the ‘open’ position, and to be inserted in the switchgear lock to allow connection of the generator to the facility.
	3. **TYPICAL SEQUENCE OF OPERATION (generator only application)**
		1. Should the utility fail, the facility’s main circuit breaker would be manually opened and the portable generator set would be connected to the bushing type receptacles in the MF2-Series located behind lower flip door.
		2. The facility’s manual transfer switch would be switched to the emergency source position by the facility’s qualified personal to allow the temporary generator to provide electrical power to the facility load.
		3. Upon restoration of the utility’s power, the temporary generator would be powered down and disconnected from the switchgear bushing wells.
		4. The facility’s manual transfer switch would be switched back to the normal source position by the facility’s qualified personal, and the facility breaker can be closed to allow the utility to restore the facility to the normal utility power source.
	4. **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.
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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