**SECTION 26 32 13**

**GENERATOR OUTPUT CIRCUIT BREAKER**

* 1. **DESCRIPTION**
		1. This section specifies the furnishing and testing of an alternator mounted generator output/distribution circuit breaker panel “panel” in this section.
		2. Panel shall be designed to allow generator protection and direct distribution circuit breaker. Permanent installation and connection of the panel to the facility’s power distribution system will minimize any unplanned power outages through safe and convenient connections at the termination cabinet.
	2. **QUALITY ASSURANCE**
		1. The equipment furnished under this Section shall be the product of a manufacturer who has produced generator-paralleling panels up to 600V for a period of at least 15 consecutive years.
		2. The panel equipment manufacturer shall have all aspects of design, assembly, and testing of the equipment within the same location.
		3. The panel manufacturer shall have field service personnel and facility with spare parts. The spare parts stocked at the facility shall include circuit breakers, automation controllers, control switches and lights, fuses, insulators, etc.
	3. **FACTORY TESTS**
		1. Low-Voltage Panel 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 panel.

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) were used as references to 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)/IEEE:

C37.50..................Test Procedures for Low-Voltage AC Power Circuit Breakers Used In Enclosures

C37.13..................Low-Voltage AC Power Circuit Breakers

C37.90.1................Surge Withstand Capability (SWC) Tests for Relays

and Relay Systems Associated with Electric Power Apparatus

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

PB-2....................Deadfront Distribution Panels

PB-2.1..................Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Panels Rated 600 Volts or Less

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

70-17...................National Electrical Code (NEC) 2017

* + 1. Underwriters Laboratories, Inc. (UL):

489-09..................Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

1. **PRODUCTS**
	1. **GENERAL REQUIREMENTS**
		1. Manufacturers: Subject to compliance with requirements, provide panel of the following:
			1. Advanced Power Technologies (APT) GM-Series – Contact Brandon Lopez or 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. Panel shall be in accordance with NFPA and UL to have the following features:
			1. Panel shall be a complete, grounded, continuous-duty, integral assembly, metal enclosed, dead-front, self-supporting panel assembly. Incorporate devices shown on the drawings and all related components required to fulfill operational and functional requirements.
			2. Panel 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. Panel shall conform to the arrangements and details shown on the drawings.
			4. Panel 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 panel to be stretch wrapped and mounted to a skid and to provide adequate protection against rough handling during shipment.
			7. Panel shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Adequate ventilation within the enclosure shall be provided.
		3. Design Requirements:
			1. Provide key interlocks as indicated on the Drawings.
		4. Performance Requirements:
			1. Minimum short circuit interrupting rating:
				1. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of (18/35/65) kA symmetrical at rated voltage unless otherwise shown on the Drawings.
			2. Voltage and current ratings: as indicated on the Drawings.
			3. Surge Withstand Capability: per ANSI/IEEE C62.41 without damage.
			4. The equipment and components shall operate continuously at its rated current under the following environmental conditions without damage or degradation of operating characteristics or life:
				1. Operating Ambient Temperature: 0 degrees C to 40 degrees C maximum ambient temperature.
				2. Storage Temperature: -40 degrees C to 65 degrees C.
				3. Relative Humidity: 0 to 95%, non-condensing.
				4. Altitude: Operating to 6500 ft, de-rate for higher elevations.
	2. **HOUSING**
		1. Frames and enclosures:
			1. Enclosure shall be designed according to NEMA (1) standard for (indoor) operation.
			2. The panel enclosure frame shall be produced from at least 11-gauge mild steel and the panel enclosure doors shall be produced from at least 12-gauge mild steel.
			3. Panel width shall comply with the generator drawings.
			4. The panel shall not exceed the space as allocated on the floor plan with a maximum depth dimension of approximately (18) inches.
			5. Enclosure shall be of rigid frame construction.
			6. Each panel section shall have removeable front panels, manufactured from at least, 12 Gauge steel.
			7. The enclosure shall be steel, leveled, and not less than the gauge required by applicable publications.
			8. All bolts, nuts, and washers shall be zinc-plated steel.
			9. For ease of on-site cable connections and maintenance an open bottom and open top rear shall be provided.
		2. Markings and Nameplates:
			1. Each panel section shall have a label permanently affixed to it, listing the following information: Name of manufacturer, system voltage, ampacity, type, and manufacturer's shop order number.
			2. A nameplate shall identify each control switch, indicating light or other mounted component.
			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. Painted (ANSI 61 Light Gray/CAT Yellow/Cummins Green) shall be applied to all interior and exterior surfaces.
	3. **BUS & LUGS**
		1. For insulated case circuit breakers or molded case circuit breakers >1200A, provide sliver plated copper bus with mechanical lug connections for each permanent connection, fully rated for the amperage shown on the drawings.
			1. Each Mechanical Lug shall accommodate:
				1. One (1) #1/0 AWG - 750kcmil AL/CU cable or
				2. Two (2) #1/0 AWG - 300kcmil AL/CU cables
		2. Mount the bus on appropriately spaced insulators and brace to withstand the available short circuit currents.
		3. All bus (main, neutral, ground, extension, etc.) shall be produced from silver plated copper.
		4. Silver-plated copper, appropriately sized bus bar and extensions shall have NEMA standard hole pattern to accommodate cable connections.
		5. Install a silver-plated copper ground landing pad inside the panel assembly.
		6. 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.
	4. **CIRCUIT BREAKERS**
		1. Insulated case circuit breakers shall be UL (489) listed and utilized for the permanent generator circuit breaker with the following features:
			1. Circuit Breaker shall be (fixed mount), 100% rated, with a stored energy mechanism, and “a” and “b” aux. contacts.
			2. Circuit breaker control interface shall have color-coded visual indicators to indicate contact open or closed positions as well as mechanism charged and discharged positions.
			3. Manual control pushbuttons on the breaker face for opening and closing the circuit breaker shall be provided.
			4. Interrupting Rating:
				1. For a circuit breaker rated under 1600A, interrupting rating shall be (65kA)@480VAC.
			5. Trip unit shall be solid-state, electronic microprocessor-based with true three phase RMS sensing of sinusoidal and non-sinusoidal currents.
			6. Provide the following minimum independent time-current curve shaping adjustments for each power circuit breaker:
				1. Adjustable long time pick-up and delay.
				2. Adjustable instantaneous pickup.
		2. Molded case circuit breakers shall be UL 489 listed and utilized for the feeder distribution circuit breakers, as shown on the drawings, with the following features:
			1. Panel shall be equipped with manually operated circuit breakers.
			2. Circuit breakers shall be fixed mount, 80/100% rated
			3. Circuit breaker Trip mechanism shall be quick-make, quick-break, mechanically trip-free over-center switching mechanism operated by a toggle-type handle. Handle shall indicate breaker position. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
			4. Interrupting Rating shall not be less than the overall panel interrupting rating indicated on the drawings.
			5. Trip Unit shall be solid-state, electronic microprocessor-based with true three phase RMS sensing of sinusoidal and non-sinusoidal currents. Provide the following minimum independent time-current curve shaping adjustments for each power circuit breaker:
				1. Adjustable long time setting.
				2. Adjustable short time setting.
				3. Adjustable instantaneous setting.
			6. All circuit breaker ratings shall be as indicated per the drawings.
			7. Circuit breaker 24VDC shunt trips and 1a/1b auxiliary contacts to be provided.
	5. **CONTROL POWER**
		1. Customer to provide 24VDC circuit for control power as required from engine starting batteries.
2. **EXECUTION**
	1. **COMMISSIONING**
		1. Install panel in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.

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