**SECTION 26 13 29**

**MEDIUM VOLTAGE AUTOMATIC TRANSFER SWITCHGEAR**

1. **GENERAL**
	1. **DESCRIPTION**
		1. This section specifies the furnishing and testing of medium-voltage automatic transfer switchgear, 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 & transfer switchgear up to 15kV for a period of at least twenty (20) 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 automation controllers, control switches and lights, control 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 switch 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 to determine compliance with Contract Documents.
		2. Drawings: Submit shop drawings for approval. Include components, materials, finishes, detailed plan and elevation views, openings, and accessories.
		3. Deviations from the Contract Documents shall be indicated within the quotation/proposal. Each deviation shall reference the corresponding drawing or specification section number.
		4. Manufacturer specific contact information
		5. Manufacturer's catalog data indicating model numbers, equipment specifications and construction features including all furnished options, and accessories.
		6. Enclosure type, rating, material and finishes
		7. Shop Drawings: Submit shop drawings for product and components required. Include information not fully detailed in manufacturer’s standard product data. Submit shop drawings indicating outline dimensions, enclosure construction, lifting and supporting points, electrical single line diagram, and equipment electrical ratings.
		8. Wiring Diagrams: Submit wiring diagrams detailing power and control systems, clearly differentiating between manufacturer-installed wiring and field-installed wiring, and between components provided by the manufacturer and those provided by others.
	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)/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

C37.40..................Standard Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories

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. **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. System Ampacity: (200) amps, continuous.
		5. Source 1 (Utility/Generator) Grounding System: (Solid Effectively Grounded/Low Impedance Neutral Grounded through Resistors/High Impedance Grounded/Ungrounded)
		6. Source 2 (Utility/Generator) Grounding System: (Solid Effectively Grounded/Low Impedance Neutral Grounded through Resistors/High Impedance Grounded/Ungrounded)
	2. **GENERAL REQUIREMENTS**
		1. Manufacturers: Subject to compliance with requirements, provide switchgear of the following:
			1. Advanced Power Technologies (APT) MS6-Series 2.4kV-38kV Manual Transfer Switchgear (MTS) described in ALN522-AT – 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 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, where used, 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 (48.5) inches.
			5. Enclosure shall be of rigid frame construction.
			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 ensure proper alignment, and to allow for future additions.
			9. Each NEMA 3R vertical section containing a switch shall have a single, full-length, flanged front door and shall be equipped with a rotary latch-type padlockable handle.
			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. Internal climate control to include anti-condensation space heaters with a thermostat (& humidistat).
			14. Stainless Steel exterior hardware shall be utilized on NEMA 3R units.
			15. For ease of transportation and rapid installation, equipment shall ship fully assembled and be mounted to a minimum of a 6” metal base to be set on top of the concrete pad.
		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. Double Steam Cleaner Rinsed
				2. High Pressure Pretreatment process (phosphate free)
				3. Steam Clean Water Final Rinse
				4. 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. **LOAD INTERRUPTER SWITCHES**
		1. Each power source switchgear section shall be equipped with one ANSI C37.20.4 compliant load break switch.
		2. Load interrupter switches: 3 Pole, two position, gang operated.
		3. Switch operator: Quick make, quick break, over center mechanism.
		4. The operating speed of the interrupter switch shall be independent of the operator handle speed.
		5. The device shall not rely on chains or cables to drive the blade assemblies open and closed. The operating mechanism shall be isolated from high voltage by a steel barrier and coupled through a direct drive shaft. Access to mechanism parts shall not require de-energizing of the equipment.
		6. The motor operator shall be located in the mechanism compartment and shall not alter the dimensions of the equipment. The motor operator shall have a control voltage disconnect switch accessible on front of mechanism cover.
		7. The operating mechanism shall be isolated from high voltage by a steel barrier and coupled through a direct drive shaft. Access to mechanism parts shall not require de-energizing of the equipment.
		8. The following features shall be supplied on every vertical section containing a three-pole, two position open-closed switch:
			1. A viewing port shall permit visible verification of the switch blade position.
			2. Provision for padlocking the switch in the open or closed position.
			3. Green OPEN, Red CLOSED switch position indicators.
		9. Switch shall be rated per the following:
			1. Continuous and load break current ratings shall be as indicated on the drawings.
	6. **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.
	7. **SURGE ARRESTERS: (if applicable)**
		1. Provide (station/intermediate/distribution) class metal-oxide type surge arresters, one per phase rated (X)kV, (X)MCOV, as indicated on the drawings.
	8. **CONTROL SWITCHES & 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. Load break control switches with maintained “Open”, “Auto” spring returned to center “Close” positions and two (2) position indicating lights (Open and Closed) shall be provided for each switch.
		3. Form C dry contacts rated for 8 Amp at 30VDC or 250VAC for customer use as follows:
			1. Switch position status
	9. **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 side of the switch as indicated on the drawings.
		3. Power Metering:
			1. The following true RMS, 3 element power metering of each power source 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

* 1. **CONTROL POWER SYSTEM**
		1. Control Power Transformers (CPTs):
			1. Switchgear shall self-derive the control power required for the switchgear space heaters, battery charger and other consumers.
			2. Control power transformers shall be provided if required for proper switchgear operation if indicated elsewhere in this specification or the drawings.
			3. The control power transformers shall be properly protected by primary current-limiting fuses.
		2. Batteries:
			1. A fully integrated battery system shall be of the sealed lead-acid recombination type with a float voltage charge of 13.62V/bloc at 77°F. The batteries shall be UL 1778 recognized and have up to 10-year design life at 77°F on float.
			2. The cell shall utilize the recombination principle. Oxygen evolved from the positive plates shall diffuse through the highly porous glass microfiber separator to the negative plate where it shall chemically be reduced to water. This process will reduce the total liquid evolved from the cell. Recombination efficiency shall be greater than 99%.
			3. Plates shall be plastic type with the positive plate being cast in a grid alloy consisting of lead, calcium and alloy.
			4. Plates shall be gravity casted grids from high purity lead calcium tin alloy to provide an optimal current conducting framework for high rate discharge. In order to inhibit grid corrosion, no antimony or cadmium shall be used in the plates to prolong service life.
			5. No gel or sealed top wet batteries shall be allowed for safety and charge life considerations. Battery posts shall incorporate copper inserts for ease of installation and maximum conductivity. Lead flag terminals or push-on terminals are not accepted.
			6. Post Seals shall have a high integrity post seal design to prevent electrolyte leakage over a wide temperature range.
			7. One-way Safety Valves shall open at 5 PSI and close at 3 PSI to allow excess gas to escape when overcharging.
			8. Flame Arrestors shall be provided to prevent any errant spark or flames from entering the battery.
			9. Container and cover shall be made from thick-walled flame-retardant ABS plastic. Thermally welded case to cover sealing eliminates leaks.
			10. Battery lids shall be of robust resin type. Flame rating shall meet the standard of UL 94V-O with a minimum oxygen index of 28% to ensure flame retardancy.
			11. Batteries shall have a shelf life of 6 months before boosting is required (< 2% self-discharge per month at 77°F).
			12. Operating pressure shall be 10-49 kPA.
			13. Battery connector covers for protection against external short circuits shall be provided.
			14. Cells shall be supplied fully charged and ready for use.
		3. Battery Charger:
			1. The appropriately sized stationary battery charger shall be supplied and integrated in the switchgear.
			2. The stationary battery charger shall be supplied with the following features:
				1. AC input voltage range at 60Hz: 120, 208, or 240
				2. Magnetic Amplifier Circuitry
				3. Automatic AC Voltage Compensation
				4. Float/Equalize Mode Switching
				5. +/- 0.5% DC Voltage Regulation
				6. Fused AC input and DC output protects Battery and Charger/Power Supply
				7. Analog DC Ammeter and DC Voltmeter
				8. Current Limiting Circuitry prevents overload and provides current control from 50 to 120% of rated output (factory set at 115%)
	2. **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.
	3. **SEQUENCE OF OPERATION**
		1. (ATO) – APT Automatic Standby Open Transition Transfer Control Module:
			1. APT ATO (model ATS-5335) Automatic Source Transfer Control Module monitors the voltage and frequency of the of the two different power sources. The power sources can be Utility, Generator or any combination of both. The module will monitor Source 1 (S1) and in the event of a failure of Source 1 will initiate automatic transfer of load to Source 2 (S2).
			2. When Source 2 is available and its Voltage and Frequency are within set limits, the control module will control the transfer devices and switch the load from S1 to S2. Once the S1 supply returns to within set limits, the control module will command a load return to S1 and shut down S2.
			3. Features and Options:
				1. Dust tight and splash proof (from any direction) front panel and HMI:

Rated IP65/NEMA 12

* + - * 1. HMI with backlit LCD display and menu navigation buttons
				2. Operating Temperature:

-22 ºF to +158 ºF (-30 ºC to +70 ºC)

* + - * 1. Storage Temperature:

-40 ºF to +176 ºF (-40 ºC to +80 ºC)

* + - * 1. LED and LCD alarm indication
				2. Real time clock
				3. True RMS Voltage and Frequency monitoring and optional Current, Power and Energy monitoring
				4. Line -Line or Line- Neutral voltage sensing
				5. Optional Remote monitoring capability (Modbus RTU via RS485 and Modbus TCP/IP Ethernet)
				6. Configurable Source 1/Source 2 priority
				7. Configurable control of Source 1 and/or Source 2 Load Inhibit via customer supplied contact
				8. Configurable for Automatic Return to Preferred Source inhibit (customer contact or local control)
				9. Configurable Automatic or Manual return to Preferred Source
				10. Optional Load and/or No-Load Generator Set Exercise Scheduler
				11. Optional dry contacts for various alarm and status conditions
				12. Configurable status display LEDs, with typical configuration for:

Source 1 available

Source 2 available

Source 1 supplying load

Source 2 supplying load

Warning alarm

System in Auto

* + 1. (ATO-BI) – APT Automatic Open Transition Transfer with Bypass/Isolation:
			1. Includes Normal Source, Normal Bypass, Emergency Source, & no Emergency Bypass switches.
			2. Upon sensing loss of utility, the Time Delay Engine Start timer shall begin timing. If utility failure condition remains upon expiration of the Time Delay Engine Start timer, the associated generator set shall be automatically started, and the utility switch shall open. Once the associated generator set reaches rated speed and voltage the generator switch shall close onto the dead bus.
			3. Upon sensing return of utility power, the Time Delay Emergency to Normal timer shall begin timing.
			4. If utility power remains healthy upon expiration of the Time Delay Emergency to Normal timer, the generator switch shall open, and the utility switch shall close (after adjustable time delay neutral). At this time, the genset shall be put in the cool down mode of operation.
			5. If the generator set should fail while Time Delay Emergency to Normal timer is timing, the Time Delay Emergency to Normal timer shall be bypassed and the load immediately transferred to the utility.
			6. The switchgear shall include a Normal bypass switch and no Emergency bypass switch. This will allow automatic bypass of the normal source switch on failure (if authorized). This shall also allow a manually initiated bypass of the Normal or Emergency switch for testing or maintenance purposes.
			7. The switchgear shall include provisions for manual transfer operation.
			8. “Not In Auto” Flashing light included.
1. **EXECUTION**
	1. **COMMISSIONING**
		1. Install switchgear in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
		2. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
		3. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.
		4. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer’s written instructions and recommendations, and as indicated on the Drawings.
		5. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.
	2. **FIELD QUALITY CONTROL**
		1. Functional testing, commissioning, and first parameter adjusting shall be carried out by a factory-trained manufacturer’s field service representative or installing electrical contractor.
		2. A third-party testing company shall, upon satisfactory completion of inspection and testing, attach a label to all serviced devices indicating the date serviced and testing company responsible.
	3. **OPERATIONAL READINESS TESTING**
		1. The Contractor shall inspect and test furnished equipment and associated systems for conformance to the contract documents, including equipment manufacture’s recommendations, and readiness for operation. The test shall include the following as a minimum:
			1. Visually inspect for physical damage and proper installation
			2. Perform tests in accordance with applicable codes
			3. Perform tests to ensure compliance with Contract Documents
			4. Perform tests that equipment is ready for operation
			5. Touch-up paint all chips and scratches
		2. Contractor shall submit an operational readiness test report documenting all test results, including all assumptions, conditions, allowances and corrections made during the test. The report shall provide a listing of all modifications and adjustments made onsite to include any settings / parameters not identified as factory defaults within the test report documentation. The test report shall include a signed statement from the Contractor, installer(s) and/or the factory-trained manufacturer’s representative(s) certifying that the furnished equipment and associated system have been installed, configured, tested, and is ready for operation.
	4. **TRAINING (if required)**
		* 1. O&M Training: Onsite training specific to the equipment furnished shall be provided to the Owner’s staff by a factory trained manufacturer’s representative. Training duration shall be adequate to cover the operation and maintenance of the equipment.
			2. The instructor shall provide enough time and detail in training session to cover the following as a minimum:
				1. Theory of operation
				2. Major components of equipment
				3. Operation of equipment
				4. Configurations of equipment
				5. Maintenance, troubleshooting and repair
				6. Replacement of component level parts

---END---