**SECTION 26 13 13**

**MEDIUM-VOLTAGE SWITCH-CIRCUIT BREAKER COMBINATION SWITCHGEAR 5 kV-15 kV**

1. **GENERAL**
	1. SCOPE
		1. This section includes medium-voltage, load-interrupter switchgear with fixed-mounted vacuum circuit breakers and its associated auxiliary equipment. The equipment shall consist of ***[indoor type 1] [indoor drip-proof type 2] [indoor dust-resistant type 12] [outdoor-non-walk-in type 3R]*** switchgear.
	2. RELATED DOCUMENTS
		1. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
	3. SUBMITTALS
		1. Submit shop drawings for approval and final documentation in the quantities listed according to the Conditions of the Contract. All transmittals shall be identified by purchaser name, purchaser location and purchaser’s order number.
		2. Approval documents shall include:
			1. General arrangement drawing showing dimensioned elevation and floor plan, foundation details and one-line diagram
			2. Panel arrangement drawing showing layout of devices on the panel doors
			3. Single-line diagrams
			4. Schematics
			5. Nameplate engraving drawings
			6. Electrical bill of material.
		3. Final documents shall include:
			1. Documents listed in 1.3.B above
			2. Wiring diagrams
			3. Recommended spare parts list for start-up support
			4. Instruction manual.
		4. Where applicable or required, the following additional information shall be submitted:
			1. Connection details between close-coupled assemblies
			2. Composite floor plan of close-coupled assemblies
			3. Key interlock scheme description and sequence of operations**.**
	4. QUALITY ASSURANCE
		1. Manufacturer qualifications: The bidder must have at least five years experience in manufacturing medium-voltage switchgear.
		2. Comply with requirements of latest revisions of applicable industry standards, specifically including the following:
			1. ANSI/IEEE C37.04
			2. ANSI/IEEE C37.09
			3. ANSI/IEEE C37.20.3
			4. ANSI/IEEE C37.20.4
			5. ANSI C37.54
			6. ANSI C37.57
			7. ANSI C37.58
			8. CSA 22.2 No.31-2010
			9. CSA 22.2 No.58 – M1989
			10. CSA 22.2 No.193 – M1989
		3. Listing by Underwriters Laboratories (UL or C-UL) or Canadian Standards Association (CSA) shall be provided for 5 kV or 15 kV class metal-enclosed interrupter switchgear.
		4. The manufacturer shall be ISO9001 or 9002 certified for the equipment specified herein.
	5. DELIVERY, STORAGE AND HANDLING
		1. Deliver in convenient shipping groups. Shipping groups shall not exceed 9 feet in length.
		2. Bus bars with associated hardware for connections between shipping groups shall be shipped inside one of the units in which it shall be installed.
		3. Contractor shall store the equipment in accordance with manufacturer’s recommendations.
		4. Contractor shall provide power for space heaters in the assembly to prevent condensation during storage.
		5. Contractor shall handle and move the switchgear in accordance with manufacturer’s recommendations.
2. **PRODUCTS**
	1. MANUFACTURERS
		1. ***[The load-interrupter switchgear assembly shall be as manufactured by Siemens or approved equal. Approved manufacturers are as follows:***
			1. ***Siemens - SIEBREAK***
			2. ***.]***
	2. RATINGS
		1. System configuration: The switchgear shall be suitable for application in three-phase, ***[60 Hz] [50 Hz], [grounded-neutral] [ungrounded] [high-impedance grounded]*** system.
		2. Electrical ratings:
			1. Switchgear assembly ratings shall be as follows:
				1. Maximum design voltage (V): ***[5 kV] [15 kV]***
				2. Impulse-withstand voltage: ***[60 kV] [ 95 kV]***
				3. Main bus continuous current: ***[None] [1,200 A] [2,000 A]***
				4. Main bus short-time (two-second) current rating: ***[25 kA] [38 kA]***.
			2. Switch ratings shall be as follows:
				1. Non-fused switch (continuous and load interrupting): ***[600 A] [1,200 A]***
				2. Non-fused momentary withstand: ***[39 kA] [59 kA]*** rms
				3. Non-fused switch fault close (three times minimum for 4.76 and 15 kV):
				***[39 kA] [59 kA] rms***
				4. Non-fused switch two-second short circuit: ***[25 kA] [38 kA]*** sym.
		3. Circuit breaker ratings

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Rated****system voltage****kV** | **Rated****BIL****kV** | **Continuous current****A** | **Rated** **short-time** **(2 second)****kA****symmetrical** | **Rated****momentary current** **kA rms****asymmetrical** |
| 5.0 | 60 | 600, 1,200 | 25 | 39 |
|  |  |  | 38 | 59 |
| 15.0 | 95 | 600, 1,200 | 25 | 39 |
|  |  |  | 38 | 59 |

* 1. SWITCH-CIRCUIT BREAKER GENERAL CONSTRUCTION
		1. The switchgear enclosure shall be of metal-enclosed construction as described in IEEE Std. C37.20.3 consisting of load-interrupter switch and fixed-mounted vacuum circuit breaker as specified in section 2.2 of this specification of the quantity, ratings, and types on drawings and specified herein.
		2. The switchgear shall be factory assembled and tested in convenient shipping groups. The switchgear shall be of a coordinated design so shipping groups can be easily connected together at the site into a continuous lineup. Necessary shipping split connecting bus and hardware shall be furnished and shall be attached to the switchgear in the approximate locations where they will be needed.
		3. Each switch unit shall include a three-pole, two-position open-closed switch. The following features shall be provided:
			1. Extra-large 8 in. x 18 in. viewing window that enables full view of the position of the switch blades through the closed door.
			2. The door shall be interlocked with the switch such that:
				1. The switch must be open before the door can be opened
				2. The door must be closed before the switch can be closed.
			3. A hinged-grounded metal barrier located in front of each switch to prevent inadvertent contact with any live parts, while allowing for full access and viewing for inspection of the switch blades.
			4. Provision for padlocking the switch in the OPEN and CLOSED positions.
			5. Switch position indicators with words OPEN and CLOSED in ***[English] [Spanish] [French]***.
			6. Front door(s) for indoor or outdoor enclosure equipped with ***[two non-keyed latches] [two keyed latches]***. The front door shall be equipped with padlock hasp.
		4. Vertical section(s) shall be of bolted-frame construction. All doors and covers shall be fabricated from steel equal to or greater than that specified in IEEE Std. C37.20.3.
		5. Access to all line and load terminations shall be from ***[rear] [front]***. When rear access is required to line and load terminations, each vertical section shall include ***[split removable rear covers with plastic lifting handles] [padlockable, hinged rear doors bolted closed]***.
		6. Each load-interrupter switch shall have the following features:
			1. Three-pole, gang-operated mechanism with heavy-duty coil spring to provide opening and closing energy.
			2. Manual quick-make, quick-break blades and arc chutes to provide positive, three-phase interruption of transformer magnetizing and load currents.
			3. Speed of opening and closing of the switch shall be independent of the speed of operating handle movement, and it shall be impossible to tease the switch into any intermediate position.
			4. Single, upward movement of the operating handle shall charge the operator and close the switch. A single, downward movement of the operating handle shall charge the operator and open the switch.
		7. Copper bus shall be provided, ***[silver-plated at electrical connection points] [tin-plated at electrical connection points],*** three-phase, three-wire, plus ground bus. Bus bars shall be ***[insulated] [bare]***. When specified, insulated bus shall be provided with insulation by means of fluidized-bed epoxy coating or equivalent. Sleeve-type insulation shall not be permitted. When insulated bus is specified, bus-connection joints shall be insulated with preformed PVC boots held together with nylon hardware for easy installation and removal during servicing. Copper bus bars shall be bead-blasted prior to applying epoxy coating to assure a proper bond between the epoxy and the bus bar, eliminating partial discharges. Each bus segment shall be individually high-potential tested prior to assembly. Taped joints are not permitted except in unusual joint configurations. The ground bus shall be silver-plated copper; at least ¼ by 2 in. and shall extend the full length of switchgear.
		8. Bus support shall be ***[glass-polyester] [high-track resistance]*** material.
		9. The steel used in the structure and panels shall be chemically cleaned, hot-phosphate treated, rinsed and oven-dried, and shall be given an electrostatically applied coat of ANSI 61 polyester-powder paint.
		10. Enclosure **[Pick one of the following five enclosure types. Delete the others. The paragraph selected should match the decision made in Section 1.1.A.]**:
			1. ***[The indoor enclosure shall be constructed of bolted sheet steel. Each vertical section shall have ventilating openings on the front and rear, both top and bottom, to allow efficient flow of air for self-cooling and prevent the buildup of moisture inside the structure. The assembly shall be equipped with space heaters in each vertical section, operating at ½ rated voltage, sized to prevent condensation.]***
			2. ***[The outdoor enclosure shall be non-walk-in type. Non-walk-in design shall consist of indoor switchgear units located in a weatherproof, painted steel housing, with formed steel-base frame and factory-applied asphaltic-base undercoating; and equipped with the following features:***
				1. ***Structural design and anchorage adequate to resist loads imposed by 100-MPH wind.***
				2. ***Each unit equipped with an exterior full-height hinged front door with provision for padlocking.***
				3. ***Space heaters in each vertical section, operating at ½ rated voltage, sized to prevent condensation.***
				4. ***Louvers equipped with screens and filters, arranged to permit air circulation while excluding exterior dust and rodents.***
				5. ***One lamp in each cell with one on-off switch per section.***
				6. ***One utility duplex receptacle with integral ground fault protection in each section.***
				7. ***Each vertical section shall have vents on the front and rear, both top and bottom, to allow efficient flow of air for self-cooling and prevent the buildup of moisture inside the structure.]***
			3. ***[Indoor enclosure shall be dust resistant. All ventilating openings shall be filtered to inhibit the ingress of dust. All external doors and covers shall be gasketed. The indoor enclosure shall be constructed of bolted sheet steel. Each vertical section shall have ventilating openings on the front and rear, both top and bottom, to allow efficient flow of air for self-cooling and prevent the buildup of moisture inside the structure. Ventilating openings shall have filters and covers to maintain dust resistance.]***
			4. ***[Indoor enclosure shall be drip-proof, to provide added protection against dripping and light splashing of water. The indoor enclosure shall be constructed of bolted sheet steel. Each vertical section shall have ventilating openings on the front and rear, both top and bottom, to allow efficient flow of air for self-cooling and prevent the buildup of moisture inside the structure. Ventilating openings shall have filters and covers to maintain dust resistance. The top plate of the enclosure shall be extended beyond the enclosure perimeter to provide drip-proof performance.]***
			5. ***[Indoor enclosure shall be gasketed. All external doors and covers shall be gasketed. The indoor enclosure shall be constructed of bolted sheet steel. Each vertical section shall have ventilating openings on the front and rear, both top and bottom, to allow efficient flow of air for self-cooling and prevent the buildup of moisture inside the structure. Ventilating openings shall have filters and covers to maintain dust resistance.]***
	2. COMPONENTS
		1. Instrument transformers shall comply with IEEE C57.13.
			1. Voltage transformers (VTs): Secondary voltage rating of 120 V and accuracy class of 0.3 with burdens of W, X and Y. The VTs shall be fixed-mounted in the front or rear of the section, connected to the ***[line side of the vacuum circuit breaker] [load side of the vacuum circuit breaker] [main bus]***. The section shall accommodate up to three VTs, with integrally mounted primary fuses.
			2. Current transformers (CTs): Ratios as indicated; burden and accuracy class as per IEEE C37.20.3, suitable for connected relays, meters and instruments. The switch section shall be able to accommodate three standard-accuracy CTs (one CT per phase). The CT secondary wiring shall be connected to shorting terminal blocks with ring-tongue terminations. CTs shall be located on the load side of the interrupter switch and on the line side of the vacuum circuit breaker.
			3. AC control power shall be furnished from: **[Pick one of the next two paragraphs. Delete the others. Then, make decisions within the remaining paragraph.]**
				1. ***[120 Vac] [125 Vdc]*** control power to be furnished by others.
				2. ***[Control power transformer (CPT) fixed mounted [5 kVA single-phase]
				[10 kVA single-phase] [15 kVA single-phase] shall be supplied in one of the switch sections.***
				3. ***[The fixed-mounted CPT and primary fuses are to be connected to the line side of the interrupter switch.] [The fixed-mounted CPT and primary fuses are to be connected to the load side of the interrupter switch.]***
			4. When specified, suitable automatic-transfer scheme is required for the secondary loads, when CPTs are provided on the incoming side of the main switch in double-ended installations to transfer the secondary load should one incoming supply fail.
		2. Protection Relay Multifunction protective relaying. Microprocessor-based three-phase relays shall be UL-Listed or UL-Recognized and shall be provided as follows:
			1. ***Main circuit breakers.***
				1. ***The relays shall be SIEMENS 7SJ63 or 7SJ64 bay controller or equivalent. The relays shall include the following protection functions: 50/51, 50N/51N, 67/67N, 27, 59, 81O/U and 25 (7SJ64 only).***
				2. ***The communication protocol shall be [Profibus DP] [Modbus RTU] [DNP3.0] [IEC 61850].***
			2. ***[Feeder protection.***
				1. ***The relays shall be SIEMENS 7SJ80 protective relay or equivalent. The relays shall provide the following functions: 50/51, 50N/51N, 67, 64, 87N, 37, 49, 46, 27, 59, 81O/U, 50BF, 46, 47, 25, 79 and 21FL.***
				2. ***The communication protocol shall be [Profibus DP] [Modbus RTU] [DNP3.0] [IEC 61850].***
			3. ***[Motor protection***
				1. ***The relays shall be SIEMENS 7SK80 protective relay or equivalent. The relays shall provide the following protection functions: 50/51, 50N/51N, 67N, 67Ns, 50Ns, 59N/64, 37, 48, 66, 14, 51M, 49, 46, 27, 59, 81O/U, 50BF, 46 and 47.***
				2. ***The relays shall have five RTD inputs.***
				3. ***The relays shall have the option to connect 12 additional RTD inputs through an Ethernet connection.***
				4. ***The communication protocol shall be [Profibus DP] [Modbus RTU] [DNP3.0] [IEC 61850].***
			4. ***[Virtual main substation application.***
				1. ***The transformer differential protection relays shall be SIEMENS 7UT81 or equivalent. The relays shall provide the following protection functions: 87T, 87N, 50/51 for primary and secondary, 50(N)/51(N) for primary and secondary, and 86.***
				2. ***The transformer differential relays shall have a through-fault restraint setting to prevent tripping due to high current external faults.]***
				3. ***The communication protocol shall be [Profibus DP] [Modbus RTU] [DNP3.0] [IEC 61850].]***
				4. ***The transformer differential protection relay shall be connected to the CTs in the interrupter switch unit and to CTs in the [main bus] [main circuit breaker compartment] of the secondary switchgear.***
		3. When specified, multifunction digital-meters shall be UL-Listed or UL-Recognized, microprocessor-based units. Units shall be mounted on the instrument compartment door and as follows:
			1. For incoming monitoring for main incoming line switch, Siemens model ***[PAC3100] [PAC3200] [PAC4200] [9410] [9510] [9610]*** multi-function power meter with ***[Profibus] [Modbus] [DNP3.0]*** communication protocol shall be provided.
			2. For feeder switch, Siemens model ***[9200] [PAC3200] [9330]*** multi-function power meter with ***[Profibus] [Modbus] [DNP3.0]*** communication protocol shall be provided.
		4. Control wiring: Factory installed, complete with bundling and overcurrent protection where necessary and complying with the following:
			1. Extra-flexible conductors for wires across hinges and for interconnections between shipping units. Control and secondary wiring shall be at least No. 14 AWG.
			2. Conductors sized according to NFPA 70® (NEC®).
			3. Internal wiring shall be carried in inter-unit wiring area, which protects the wires. The wires shall be bundled and secured to metal anchors. Wire ties secured with self-sticking tape or adhesive shall not be permitted.
	3. VACUUM CIRCUIT BREAKERS
1. Vacuum circuit breakers: fixed-mounted units using three individual vacuum interrupters and including the following features:
	* + 1. Circuit breaker design shall operate at rated voltage to interrupt fault current within its rating within three-cycles of trip initiation.
			2. ***[Six NO and six NC] [12 NO and 12 NC]*** auxiliary contacts shall be provided.
			3. Operating mechanism shall be electrically charged, mechanically and electrically trip-free and stored-energy operated.
			4. Closing velocity of moving contacts shall be independent of both control voltage level and operator.
			5. Design of mechanism shall permit manual charging of mechanism.
			6. Control power shall be ***[250 Vdc for closing and tripping] [125 Vdc for closing and tripping] [48 Vdc for closing and tripping] [230 Vdc for closing, 230 Vac with capacitor tripping] [120 Vac for closing, 120 Vac with capacitor tripping].***
			7. The operating mechanism shall be front accessible so that it is not necessary to remove the circuit breaker in order to perform maintenance on the operating mechanism.
			8. Circuit breaker tripping provisions shall include shunt trip coil for tripping with protective relays, lockout relays, control switch or manual command signal from the relay. The circuit breaker shall include mechanical push button for manual tripping.
			9. Circuit breaker closing provisions shall include close (spring release) coil for closing by electrical signal from control circuitry, control switch or manual command signal from the relay. The circuit breaker shall include mechanical push button for manual closing.
			10. Current transfer path from the interrupter moving stem to the circuit breaker pole shall be flexible copper laminations with long mechanical life. Brush, roller or wiping contacts shall not be permitted.
			11. Vacuum interrupters and circuit breaker shall be manufactured and warranted by the same manufacturer.
			12. Vacuum interrupter design shall limit the chopping currents to below 5 A to obviate the need for surge protection against switching transients during fault interruption for most loads.
	1. ACCESSORIES
		1. Manual racking crank.
		2. Manual spring charging crank.
		3. Contact lubricant.
		4. ***[Three spare fuses of each type and rating of fuse used. Include spares for voltage transformer fuses and control power fuses.]***
		5. ***[One spare indicating lamp of each type installed.]***
		6. ***[½ pint of touchup paint matching enclosure finish.]***
	2. IDENTIFICATION
		1. All nameplates shall be mounted on the front door of each vertical section as specified on the drawing.
		2. ***[Mimic.]***
	3. FINISH
		1. Prior to assembly, all enclosure steel shall be thoroughly cleaned and coated. The metal shall be prepared for coating using seven-stage metal pre-treatment process that cleans the metal, and creates a coating of zinc phosphate on the metal. The powder shall be electrostatically applied in a continuous coating system. The coated parts shall be conveyed through an oven in which the coating is thermally set to achieve a hard, durable finish. The finish color shall be ANSI 61 gray, with texturized appearance.
	4. SPECIAL CONFIGURATIONS
		1. Duplex switches
			1. When specified or shown on drawings, duplex switches shall be supplied consisting of two vertical sections per duplex switch arrangement. Each duplex switch shall consist of two manually-operated switch mechanisms with individual incoming power terminations to accommodate two different line sources. The two switches shall be connected to common load-side, fixed-mounted vacuum circuit breaker.
			2. ***[A key interlock system shall be provided to prevent paralleling the incoming line sources as well as prevent opening to the front door of either section unless both switches are open.]***
		2. Front-access. When specified or shown on drawings, switch-circuit breaker combination for single circuit breaker or lineup configurations shall be arranged for front access (no rear access required for installation or maintenance). The vertical sections shall be configured such that all line and load terminations are accessible from the front. The front-access configuration shall permit the rear of the equipment to be installed near the wall.
2. **EXECUTION**
	1. INSTALLATION.
		1. General: Electrical contractor or switchgear installer shall install switchgear in accordance with manufacturer’s written instructions and the following specifications.
	2. ADJUSTMENTS AND CLEANING
		1. Remove debris from switchgear and wipe dust and dirt from all components.
		2. Repaint marred and scratched surfaces with touch-up paint to match original finish.
	3. INSPECTION
		1. Check tightness of all accessible mechanical and electrical connections to verify they are torqued to the minimum acceptable manufacturer’s recommendations.
		2. Check all installed switchgear for proper grounding, fastening, and alignment.
	4. FIELD QUALITY CONTROL
		1. Field inspection and testing shall be performed by ***[the installing contractor.] [a testing firm under separate contract to owner.]***
		2. Visually inspect for physical damage.
		3. Perform site tests as specified in manufacturer’s instruction manual.
		4. Touch-up paint to repair any damaged surfaces using manufacturer-furnished paint. Leave remaining touch-up paint with owner.
		5. Verify operation of interlocks.
		6. Perform power-frequency withstand voltage tests in accordance with IEEE Std. C37.20.3-2013, clause 6.19.
	5. WARRANTY
		1. Equipment manufacturer shall warrant that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation, but not more than 18 months from date of shipment.
	6. START-UP SERVICE
		1. Switchgear manufacturer shall provide a factory-authorized service representative for a period of one day to train Owner's maintenance personnel in the following:
			1. Procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventive maintenance.
			2. Review data in the instruction manuals. Refer to Division 1 Section ["Contract closeout."] ["Operation and maintenance data."]
			3. Schedule training with Owner with at least three week’s advance notice.
	7. FIELD SERVICE
		1. ***[Switchgear manufacturer’s field service office (same name as the manufacturer) shall be located not more than a three-hour drive from the installation site].***

**END OF SECTION**