

## SECTION 26 18 00 12 OUTDOOR VACUUM SUBSTATION CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This specification defines the technical requirements for outdoor substation circuit breakers with rated maximum voltage of *[15.5 kV] [27.6 kV] [38.0 kV]*. This specification covers design, manufacture and factory production testing.

#### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

#### 1.3 SUBMITTALS

- A. Submit shop drawings and product information 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.
- B. Approval documents shall include (if applicable):
  - 1. Elevations, plan and profile of unit
  - 2. Control schematics.
- C. Drawings shall be returned to manufacturer within two weeks. Drawings shall be marked as follows:
  - 1. Reviewed - indicates drawings have been examined and appear to be in conformance with specifications.
  - 2. Resubmit - indicates that drawings are not in conformance with the specifications. Changes that need to be made will be noted on drawings.
- D. Final (certified) documents shall be provided in AutoCAD format and shall include:
  - 1. Documents listed in 1.3.B above
  - 2. Wiring diagrams
  - 3. Instruction manual.
- E. Product data: Include features, characteristics and ratings of the circuit breakers and other components.
- F. Shop drawings: Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components and location and size of each field connection. Include the following:
  - 1. Nameplate legends
  - 2. Size and number of conductors in each phase
  - 3. Current ratings of bus
  - 4. Short-time and short-circuit ratings of the circuit breaker
  - 5. Detailed wiring diagrams showing wiring for power, signal and control systems including differentiation between manufacturer-installed and field-installed wiring.
- G. Instruction manuals: Manufacturers standard instruction manuals shall be provided. Instruction manuals shall contain general description, installation and connection instructions, installation checks and test instructions and maintenance information required for the circuit breakers. An instruction manual shall also be inside each unit when shipped.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer qualifications: Engage a firm with at least 20 years experience in manufacturing outdoor vacuum substation circuit breakers. The manufacturer of the outdoor enclosure shall also be the manufacturer the circuit breaker operating mechanism.

- B. Comply with requirements of latest revisions of applicable industry standards, specifically including the following:
  - 1. Outdoor vacuum substation circuit breakers
    - a. ANSI/IEEE C37.04-1999 - Standard rating structure for AC high-voltage circuit breakers.
    - b. ANSI/IEEE C37.06-2009 - Preferred ratings and related required capabilities for AC high-voltage circuit breakers
    - c. ANSI/IEEE C37.010-1999 - Application guide for AC high-voltage circuit breakers
    - d. ANSI/IEEE C57.13-2008 - Standard requirements for instrument transformers
    - e. NEMA SG-4-2009 - AC high-voltage circuit breakers.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver each circuit breaker fully assembled, except that the mounting legs may be removed to minimize shipping height.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. *[The outdoor vacuum substation circuit breakers shall be type SDV7 as manufactured by SIEMENS or pre-approved equal. Approved manufacturers are as follows:*
  - 1. **SIEMENS**
  - 2. **.J**

### 2.2 RATINGS

- A. The substation circuit breakers shall be three-pole, 60 Hz, outdoor, free-standing, using one vacuum interrupter per pole.
- B. Electrical ratings: **[Choose one of the 10 categories. Delete the other nine.]**
  - 1. **[15.5 kV maximum voltage, 20 kA interrupting class**
    - a. **Maximum design voltage: 15.5 kV**
    - b. **Impulse withstand voltage: 110 kV**
    - c. **Rated short-circuit and short-time withstand rating: 20 kA**
    - d. **Voltage range factor (K): 1.00**
    - e. **Momentary withstand and closing and latching current: 31 kA rms and 52 kA peak**
    - f. **Rated transient recovery voltage peak value (uc): 29 kV**
    - g. **Rated transient recovery voltage time (t3) to peak voltage: 36 μs.]**
  - 2. **[15.5 kV maximum voltage, 25 kA interrupting class**
    - a. **Maximum design voltage: 15.5 kV**
    - b. **Impulse withstand voltage: 110 kV**
    - c. **Rated short-circuit and short-time withstand rating: 25 kA**
    - d. **Voltage range factor (K): 1.00**
    - e. **Momentary withstand and closing and latching current: 39 kA rms and 65 kA peak**
    - f. **Rated transient recovery voltage peak value (uc): 29 kV**
    - g. **Rated transient recovery voltage time (t3) to peak voltage: 36 μs.]**
  - 3. **[15.5 kV maximum voltage, 31.5 kA interrupting class**
    - a. **Maximum design voltage: 15.5 kV**
    - b. **Impulse withstand voltage: 110 kV**
    - c. **Rated short-circuit and short-time withstand rating: 31.5 kA**
    - d. **Voltage range factor (K): 1.00**
    - e. **Momentary withstand and closing and latching current: 49 kA rms and 82 kA peak**
    - f. **Rated transient recovery voltage peak value (uc): 29 kV**
    - g. **Rated transient recovery voltage time (t3) to peak voltage: 36 μs.]**

- h. ***Rated transient recovery voltage time (t3) to peak voltage: 36 μs.]***
- 4. ***[15.5 kV maximum voltage, 40 kA interrupting class***
  - a. ***Maximum design voltage: 15.5 kV***
  - b. ***Impulse withstand voltage: 110 kV***
  - c. ***Rated short-circuit and short-time withstand rating: 40 kA***
  - d. ***Voltage range factor (K): 1.00***
  - e. ***Momentary withstand and closing and latching current: 62 kA rms and 104 kA peak***
  - f. ***Rated transient recovery voltage peak value (uc): 29 kV***
  - g. ***Rated transient recovery voltage time (t3) to peak voltage: 36 μs.]***
- 5. ***[27.6 kV maximum voltage, 20 kA interrupting class***
  - a. ***Maximum design voltage: 27.6 kV***
  - b. ***Impulse withstand voltage: 150 kV***
  - c. ***Rated short-circuit and short-time withstand rating: 20 kA***
  - d. ***Voltage range factor (K): 1.00***
  - e. ***Momentary withstand and closing and latching current: 31 kA rms and 52 kA peak***
  - f. ***Rated transient recovery voltage peak value (uc): 52 kV***
  - g. ***Rated transient recovery voltage time (t3) to peak voltage: 52 μs.]***
- 6. ***[27.6 kV maximum voltage, 25 kA interrupting class***
  - a. ***Maximum design voltage: 27.6 kV***
  - b. ***Impulse withstand voltage: 150 kV***
  - c. ***Rated short-circuit and short-time withstand rating: 25 kA***
  - d. ***Voltage range factor (K): 1.00***
  - e. ***Momentary withstand and closing and latching current: 39 kA rms and 65 kA peak***
  - f. ***Rated transient recovery voltage peak value (uc): 52 kV***
  - g. ***Rated transient recovery voltage time (t3) to peak voltage: 52 μs.]***
- 7. ***[38.0 kV maximum voltage, 20 kA interrupting class***
  - a. ***Maximum design voltage: 38.0 kV***
  - b. ***Impulse withstand voltage: 200 kV***
  - c. ***Rated short-circuit and short-time withstand rating: 20 kA***
  - d. ***Voltage range factor (K): 1.00***
  - e. ***Momentary withstand and closing and latching current: 31 kA rms and 52 kA peak***
  - f. ***Rated transient recovery voltage peak value (uc): 71 kV***
  - g. ***Rated transient recovery voltage time (t3) to peak voltage: 63 μs.]***
- 8. ***[38.0 kV maximum voltage, 25 kA interrupting class***
  - a. ***Maximum design voltage: 38.0 kV***
  - b. ***Impulse withstand voltage: 200 kV***
  - c. ***Rated short-circuit and short-time withstand rating: 25 kA***
  - d. ***Voltage range factor (K): 1.00***
  - e. ***Momentary withstand and closing and latching current: 39 kA rms and 65 kA peak***
  - f. ***Rated transient recovery voltage peak value (uc): 71 kV***
  - g. ***Rated transient recovery voltage time (t3) to peak voltage: 63 μs.]***
- 9. ***[38.0 kV maximum voltage, 31.5 kA interrupting class***
  - a. ***Maximum design voltage: 38.0 kV***
  - b. ***Impulse withstand voltage: 200 kV***
  - c. ***Rated short-circuit and short-time withstand rating: 31.5 kA***
  - d. ***Voltage range factor (K): 1.00***
  - e. ***Momentary withstand and closing and latching current: 49 kA rms and 82 kA peak***
  - f. ***Rated transient recovery voltage peak value (uc): 71 kV***
  - g. ***Rated transient recovery voltage time (t3) to peak voltage: 63 μs.]***
- 10. ***[38.0 kV maximum voltage, 40 kA interrupting class***

- a. **Maximum design voltage: 38.0 kV**
  - b. **Impulse withstand voltage: 200 kV**
  - c. **Rated short-circuit and short-time withstand rating: 40 kA**
  - d. **Voltage range factor (K): 1.00**
  - e. **Momentary withstand and closing and latching current: 62 kA rms and 104 kA peak**
  - f. **Rated transient recovery voltage peak value (uc): 71 kV**
  - g. **Rated transient recovery voltage time (t3) to peak voltage: 63 μs.]**
  - h.
- C. Circuit breaker rated interrupting time: **[five-cycles (83 ms)] [three-cycles (50 ms)]**.
- D. Circuit breaker continuous current: **[1,200 A] [2,000 A] [3,000 A\*] (\*15kV 31.5 kA or 40 kA only)]**.

### 2.3 GENERAL REQUIREMENTS

- A. Operating mechanism: The operating mechanism shall be (spring) stored-energy Type 3AH35 electrically and mechanically trip-free with anti-pump circuit.
- B. Control voltage: The circuit breaker control power shall be:
  1. Trip circuit: **[48 Vdc] [125 Vdc] [250 Vdc] [120 Vac capacitor trip]**
  2. Close circuit: **[48 Vdc] [125 Vdc] [250 Vac] [120 Vac] [240 Vac]**
  3. Spring charging motor circuit: **[48 Vdc] [125 Vdc] [250 Vdc] [120Vac] [240Vac]**.
- C. Operation counter: The circuit breaker shall be equipped with an operation counter to count close operations.
- D. Emergency trip: There shall be an externally operable emergency (69) trip mechanism equipped with an automatic lockout switch to prevent electrical reclosing. The emergency trip device shall be colored red and prominently located on the outside of the circuit breaker.
- E. Manual spring charging crank: The circuit breaker shall be provided with a manual spring charging crank which is stored inside the breaker cabinet.
- F. Grounding: The circuit breaker shall have two stainless steel ground pads located at diagonally opposite bottom corners of the cabinet. Ground pads located on support legs rather than on the cabinet are not acceptable.
- G. Heaters: The circuit breaker shall be equipped with thermostatically controlled space heaters in the low-voltage and high-voltage compartments.
- H. Paint finish: The circuit breaker finish color shall be ANSI 61 light gray. The paint system shall provide a durable finish, which is highly resistant to fading. It shall be applied at a minimum of two mils dry film thickness to both the internal cabinet and external surfaces.
- I. Bushings: The bushing electrical ratings shall be equal to or greater than those of the circuit breaker. The color of the bushings shall be ANSI light gray. The external terminals shall be threaded stud type copper. Bushing terminals shall be tin plated at both ends. Bushings shall be porcelain.
- J. Current transformers (CTs): The circuit breaker shall be equipped with multi-ratio, bushing type CTs suitable for relaying and metering. The secondary current rating shall be 5 A. All secondary leads shall be wired to short-circuiting type terminal blocks in the operator compartment. The ratio of CTs and the required relay accuracy class shall be as follows: **[Choose one of the categories. Delete the others.] [600:5 C100] [600:5 C200] [1200:5 C200] [1200:5 C400] [2000:5 C400] [2000:5 C800] [3000:5 C400] [3000:5 C800]**. The circuit breaker shall be furnished with **[1] [2] [3] [4]** CTs per phase.
- K. Auxiliary switch: The circuit breaker shall have six 'a' and six 'b' contacts available for purchaser's use.

### 2.4 ACCESSORIES

- A. Provide accessories as needed for operation of the circuit breaker including a manual spring charging crank.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. General: electrical contractor shall install outdoor vacuum substation circuit breakers in accordance with manufacturer's written instructions and the following specifications.

#### **3.2 ADJUSTMENTS AND CLEANING**

- A. Protective relay settings: Set relays in accordance with the purchaser's coordination study (not part of this Contract).
- B. Inspect interior and exterior of installed outdoor vacuum substation circuit breakers. Remove paint splatters and other spots, dirt and debris. Touch-up scratches and mars of finish to match original finish.

#### **3.3 TESTING**

- A. The outdoor vacuum substation circuit breakers furnished under this specification shall be fully tested and documented by certified production test reports in accordance with IEEE C37.09-1999.
- B. As a minimum, the following production tests shall be conducted for the medium-voltage outdoor vacuum substation circuit breakers in accordance with IEEE C37.09-1999:
  1. Resistors, heaters and coil check tests
  2. Control and secondary wiring check tests
  3. Mechanical operation tests
  4. Timing tests
  5. Stored energy system tests
  6. Conductivity of current path test
  7. Power frequency withstand voltage tests on primary insulation components
  8. Power frequency withstand voltage tests on control, secondary wiring and components to include motor, release coils, etc.
  9. Nameplate check
  10. Vacuum integrity test.

#### **3.4 WARRANTY**

- A. 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.

**END OF SECTION**