



**COMPETITIVE PRICE QUOTE SHEET**

11/07/2018

Company Name:  
Company Address:

Stillwater Electric Utility is requesting price quotes for the following item(s).

Specifications: Medium  
Voltage Circuit Breakers

Item(s)	Price

Signature of authorized person submitting quote: \_\_\_\_\_

Responses received after 5:00 p.m. CST on 11/26/2018 will not receive consideration.  
Please respond by 11/26/2018 to:

John Hamble  
Stillwater Electric Utility  
Stillwater Energy Center  
2000 E. Airport Road  
Stillwater, OK 74075

Tel: (405) 533-8404

Responses may be mailed to the above address, delivered to the above street address  
or faxed to (405) 747-8096 or **e-mailed to [jhamble@stillwater.org](mailto:jhamble@stillwater.org)**.

# Medium Voltage Circuit Breakers – Attachment B

## Delivery

### Delivery Date

	Three (3) Medium Voltage Vacuum Circuit Breakers	March 06, 2019*
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*\*Actual delivery dates may be plus or minus 2 weeks at Owners request.*

### Delivery Location

Stillwater Electric Utility  
Boomer Lake Substation  
1 Boomer Lake Station Drive  
Stillwater, OK 74075

### Delivery Conditions

- *Breakers to be delivered by truck to substation site.*
- *Owner will provide equipment for offloading.*
- *Supplier to verify Site readiness with Owner one (1) week prior to delivery. Shipping without Owner confirmation is at Suppliers own risk.*
- *Site hours are 7 am to 5:30 pm Monday-Thursday. Owner not responsible for receiving at other times.*
- *Delivery shall be DDP Incoterms 2010.*

## SECTION 337519 – MEDIUM VOLTAGE CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.01 SUMMARY:

- A. This specification covers three-phase, medium voltage, vacuum air insulated, dead tank circuit breakers along with maintenance tools, spare parts, and Vendor's field services.
- B. The 337519 CIRCUIT BREAKER DATASHEET is part of this specification. The DATASHEET defines the scope of work that is included in the request for a proposal.
- C. Exceptions to these specifications shall be listed in the PROPOSAL DATA SHEET.

#### 1.02 REFERENCES:

- A. Unless otherwise specified, the most recent date and revision of the referenced standard shall apply. Where there are differences between the referenced standards and this specification, the requirements of this specification shall govern.
- B. ASTM International:
  - 1. A6 - Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
  - 2. A108 - Steel Bars, Carbon and Alloy, Cold Finished.
  - 3. A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 4. A143 - Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
  - 5. A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 6. A370 - Test Methods and Definitions for Mechanical Testing of Steel Products.
  - 7. A394 - Steel Transmission Tower Bolts, Zinc-Coated and Bare.
  - 8. B8 - Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
  - 9. B188 - Seamless Copper Bus Pipe and Tube.
  - 10. B211 - Aluminum and Aluminum-Alloy Bars, Rods, and Wire.
  - 11. B232 - Concentric-Lay-Stranded Aluminum Conductors, Coated Steel-Reinforced (ACSR).
  - 12. B236 - Aluminum Bars for Electrical Purposes (Bus Bars).
  - 13. B317 - Aluminum-Alloy Extruded Bar, Rod, Tube, Pipe, and Structural Profiles for Electrical Purposes (Bus Conductors).
  - 14. D1535 - Standard Practice for Specifying Color by the Munsell System.
- C. American National Standards Institute:
  - 1. ANSI C37.2 – IEEE Standard Electrical Power System Device Function Numbers
  - 2. ANSI C84.1 – Electric Power Systems and Equipment – Voltage Ratings (60 Hz)
- D. The Institute of Electrical and Electronic Engineers (IEEE):
  - 1. IEEE 693 - IEEE Recommended Practice for Seismic Design of Substations.
  - 2. IEEE C37.04 - IEEE Standard Rating Structure for AC High Voltage Circuit Breakers.
  - 3. IEEE Std. C37.06 - AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and Related Required Capabilities for Voltages above 1000 V.
  - 4. IEEE C37.09 - IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
  - 5. IEEE C37.010 - Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
  - 6. IEEE C37.017 - IEEE Standard for Bushings for High Voltage [over 1000 V (ac)] Circuit Breakers and Gas-Insulated Switchgear.
  - 7. IEEE C37.11 - IEEE Standard Requirements for Electrical Control for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.

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8. IEEE C37.12 - IEEE Standard Requirements for Electrical Control for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
9. IEEE C37.100 - IEEE Standard Definitions for Power Switchgear.
10. IEEE C37.100.1 - IEEE Standard of Common Requirements for High-Voltage Power Switchgear Rated Above 1000 V.
11. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers.
12. IEEE C57.13.2 - IEEE Standard for Conformance Test Procedure for Instrument Transformer.
13. IEEE C57.13.6 - IEEE Standard for High-Accuracy Instrument Transformers.
- E. National Electrical Manufacturers Association (NEMA):
  1. NEMA Standards Publication 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  2. NEMA CC-1 - Electric Power Connection for Substations.
  3. NEMA ICS 2-125 – Contacts for Control Circuit Devices
  4. NEMA SG-4 – AC High Voltage Breakers
- F. The Society for Protective Coatings:
  1. SSPC Painting Manual, Volume 1, 4th Edition, Good Painting Practice.
  2. SSPC Painting Manual, Volume 2, 2008 Edition, Systems and Specifications.
- G. Underwriters Laboratories (UL):
  1. UL 1581 - Reference Standard for Electrical Wires, Cables, and Flexible Cords. submittals

1.03 SUBMITTALS:

- A. Submit as specified in documentation provided by Stillwater.
- B. Drawings of the equipment including, but not limited to the following:
  1. Outline drawing showing the overall dimensions.
  2. Circuit breaker weight.
  3. Detailed list of exceptions or deviations.
- C. Documents for Owner's Review: The following drawings shall be submitted for review no later than six (6) calendar weeks after receipt of order (ARO). Review drawings shall be returned three (3) calendar weeks after receipt. Documents Include, but are not limited to, the following:
  1. Manufacturer's specifications.
  2. General outline drawings of equipment showing overall dimensions, location of major components, weights, and locations of conduit entrance plates.
  3. Loading diagrams indicating the following:
    - a. Total weight including all accessories.
    - b. Impact loads and uplift during closing and opening operations.
  4. Detailed equipment installation drawings showing foundation requirements, anchor bolt sizes and locations, base plate sizes, location of Owner's connections, and all clearances required for erection, operation, and maintenance of the equipment. Include torque specifications for all bolted connections to be installed during field assembly.
  5. Outline drawings of bushings with maximum cantilever withstand in all three axes.
  6. Schematic diagrams for electrical items showing external connections, terminal block numbers, breaker and fuse ratings, and internal wiring diagrams.
  7. A list of all instruments furnished including all gauges, switches, solenoid valves, thermocouples, transmitters, meters, etc. Each instrument shall be assigned a unique designation which shall be included on the instrument list and wherever the instrument occurs on any of the drawings.

SECTION 337519 – MEDIUM VOLTAGE CIRCUIT BREAKERS: continued

8. Bill of materials, spare parts list, and list of parts shipped loose.
9. Instrument transformer performance curves.
10. Instrument transformer connection and polarity diagrams.
11. Diagrammatic nameplate drawings including all manufacturing data and serial numbers.
12. Instruction books with all of the information listed in IEEE C37.12.1. Also include specifications for any oil, etc., required for compressor motors and other equipment. Lubricant characteristics shall be sufficiently detailed that a replacement lubricant can be selected if the lubricant manufacturer discontinues the specified lubricant. One instruction book as approved by the ENGINEER shall be shipped with each power circuit breaker in addition to those required for approval.
13. Type test, design test, routine test, and production test reports.
14. Where standard drawings are furnished which cover a number of variations of the general class of equipment, each such drawing shall be individually annotated to describe exactly which parts of the drawing apply to the equipment being furnished. Such annotation shall also include proper identification of the submittal permanently attached to the drawing.

1.04 MAINTENANCE: Vendor shall furnish all maintenance tools and replacement parts listed in the CIRCUIT BREAKER DATASHEET.

1.05 SHIPPING:

- A. Vendor shall notify the Owner of its intention to ship at least fifteen (15) working days prior to the expected ship date.
- B. Notification of shipping shall be sent to the person identified on the Owner's purchase order as the receiver or to the Shipping Contact identified on the datasheets at least three (3) working days prior to delivery of circuit breaker and materials.
- C. The circuit breaker shall be shipped as fully assembled as possible. Vendor shall identify shipping splits.
- D. All shipping crates shall be labeled with Owner's P.O. number, substation name, and number of crates (1 of 6, etc.). If multiple circuit breaker are sent in one shipment, each crate shall be clearly identified so that all parts can be matched.
- E. The equipment and accessories shall be adequately anchored, braced, and packed to prevent damage from vibration, shock, or dampness that might reasonably be encountered in transportation and handling.
- F. All circuit breakers that are delivered to the location specified in the Datasheet shall be shipped in open top or on flat bed trucks.
- G. If Vendor requires that their field service representative be present during initial installation or energization of equipment, a notice shall be clearly attached to each piece of equipment so that Owner's construction personnel are aware of this requirement. This notice shall include the name, phone number and e-mail address of the Vendor's field service representative.
- H. If heater energization is required during storage, heater extension cables shall be routed to the exterior of the crate, be properly protected and correctly labeled for the Owner's contractor to utilize.
- I. Delivery
  1. If required on the datasheets, GPS triaxial impact and environmental recorders shall be provided with circuit breaker to ensure safe delivery to the job site. If circuit breaker is shipped in separate pieces/sections, one recorder per item shall be provided. If requested by Owner, recorders shall be left on equipment during installation.

SECTION 337519 – MEDIUM VOLTAGE CIRCUIT BREAKERS: continued

2. The Vendor shall provide the Owner all necessary information for the Owner, or Owner's subcontractor, to properly unload the circuit breaker.
3. The Vendor shall inspect the equipment upon delivery and notify Owner of any damage or issues with the equipment.

PART 2 - PRODUCTS

2.01 REQUIREMENTS:

- A. The following are requirements of this specification as indicated on the CIRCUIT BREAKER DATASHEET.
  1. The quantity of three-phase units.
  2. Maximum voltage.
  3. Continuous current.
  4. Short circuit current.
  5. Closing resistors.
  6. Field services.
  7. Replacement parts.
  8. Maintenance equipment.

2.02 SERVICE CONDITIONS:

- A. The circuit breaker(s) shall conform to the usual service conditions given in IEEE Std. C37.04 and as indicated on the CIRCUIT BREAKER DATASHEET.
- B. The specified service conditions are the service conditions and operating conditions for all components of the circuit breaker.
- C. Circuit breaker shall be suitable for operation in a power system with the following characteristics:
  1. Three phase.
  2. 60 Hertz.
  3. Effectively grounded.
  4. Electrical system faults that are single phase-to-ground; phase-to-phase grounded and ungrounded; and three phase grounded and ungrounded.
- D. Circuit breakers of the same manufacturer, model, and rating, shall be electrically, mechanically, and physically interchangeable with one another. Each component of each circuit breaker shall be electrically, mechanically, and physically identical to components in all circuit breakers and spare parts furnished under these specifications.
- E. Low voltage AC station service voltage is 60 Hz, single phase, or three phase wye connected, and effectively grounded. Station service voltage magnitude and phases are indicated on the DATASHEET. Voltage is Voltage Range B for utilization voltage given in Table 1 of ANSI C84.1.
- F. Low voltage DC station service is ungrounded with nominal voltage shown on the DATASHEET. Voltage range is -25%, +10% of nominal.

2.03 CIRCUIT BREAKERS:

- A. The quantity of circuit breakers shall be as indicated on the CIRCUIT BREAKER DATASHEET.
- B. IEEE circuit breaker ratings shall be in accordance with IEEE C37.06.
- C. Dielectric ratings shall be in accordance with C37.06 Table 15 for the specified rated maximum voltage.

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- D. The rated closing and latching current (kA, peak) of the circuit breaker shall be 2.6 times the rated short-circuit current. Maximum permissible tripping delay (duration of short-time current) shall be 1 second.
- E. DC time constant of rated short-circuit current shall be 45 m-sec.
- F. Capacitance current switching shall be the Class C0, C1, or C2 in accordance with the Datasheet.
- G. If single-pole trip is indicated on the CIRCUIT BREAKER DATASHEET, all components shall be as required for single pole trip and reclose.
- H. Rated standard operating duty (rated operating sequence) shall be in accordance with IEEE C37.04 for rapid auto-reclosing duty i.e. O-0.3 sec- CO-15 sec-CO.
- I. The circuit breaker shall have the mechanical endurance that is indicated on the DATASHEET.
- J. Circuit breaker construction:
  - 1. Degree of protection for operating mechanism shall be 3S in accordance with NEMA 250.
  - 2. All circuit breaker materials shall be in accordance with the referenced ASTM standards.
  - 3. Eye bolts or lugs and jacking pads shall be provided for lifting the assembled circuit breaker.
  - 4. The main circuit enclosure and auxiliary enclosures shall have inspection windows, hand holes, and manholes as required for the Vendor's recommended inspection and maintenance. All handholes and manholes shall be provided with handles.
  - 5. Terminals on outdoor circuit breakers shall be identified as 1, 3, 5, 6, 4, and 2 in a clockwise pattern around the breaker, so that terminals 1 and 2 are on pole 1; 3 and 4 are on pole 2; and 5 and 6 are on pole 3.
  - 6. Corrosion-resistant cotter pins, fasteners, washers, and locking devices shall be used throughout. All clevises and hangers shall be designed to allow rotating pins to move without excessive wear of cotter pins and other fasteners.
  - 7. Circuit breaker shall be provided with a reliable grounding terminal having a ground pad for connection of a grounding conductor suitable for specified fault conditions. Parts of metallic enclosures connected to the grounding system may be considered as a grounding conductor. All metallic components and enclosures that may be touched during normal operating conditions and are intended to be grounded shall be connected to a ground pad. Each grounding pad shall be a four-hole pad in accordance with NEMA CC-1, Figure C-4.
  - 8. All surfaces exposed to the environment and that are not corrosion resistant shall be protected with a coating. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Protective coatings shall be in accordance with the Guides and Standards of the Society for Protective Coatings (SSPC). Circuit breaker coating color shall be ANSI 70 light gray and in accordance with ASTM D1535.
  - 9. The design of gasket and seals shall be such that the gasket or seals will not be displaced by pressure caused by circuit breaker operation at rated short-circuit current and at related required capabilities.
  - 10. Wiring of control and auxiliary devices shall be electrically isolated from the main circuit with earthed metallic partitions.
- K. The power circuit breaker shall be of dead-end tank design utilizing vacuum interruption. The breaker design shall be such that each phase interrupter in its own vacuum bottle.
- L. Circuit breaker operating mechanism and stored energy system:
  - 1. The operating and stored energy system auxiliaries shall operate from the AC control and auxiliary voltages indicated in the CIRCUIT BREAKER DATASHEET. The stored

SECTION 337519 – MEDIUM VOLTAGE CIRCUIT BREAKERS: continued

- energy system for the open and close operation of circuit breaker shall be magnetic actuator operated type.
2. Sufficient protection and alarm devices shall be supplied to prevent damaging the breaker and to detect any malfunction. Protection and alarm devices include the following, as applicable to the type of system.
    - a. Stored energy alarm switch set to close its contacts at appropriate point above minimum operating energy of the mechanism.
    - b. Minimum operating-energy switch, which shall prevent the electrical control system from attempting to operate the breaker when the stored energy of the mechanism is below the minimum value required to complete an opening operation at rated short-circuit current, or at related required capabilities. As an alternative, this switch shall cause the breaker to be opened automatically when the stored energy is below this minimum value.
    - c. Visual indication that the mechanism is fully charged.
  3. All cabinets shall have a removable conduit plate for field installed conduit.
  4. The wiring for all control devices shall terminate on terminal blocks adjacent to the provisions for field installed conduit.
  5. A means of local manual mechanism operation shall be provided. Operation shall not cause movement of the breaker main contacts.
  6. Operator control shall include provisions to block automatic operation of the breaker during operator maintenance.
  7. A means to fully discharge any stored energy prior to maintenance activities shall be provided.
- M. The circuit breaker nameplate shall include all information listed in C37.04. Nameplate data shall have metric units. The nameplate shall be mounted on the control cabinet. For an assembly of three single poles, the nameplate shall be mounted at each pole.
- N. Circuit breaker noise level shall be in accordance with NEMA SG4.
- O. The control system supply voltage shall conform to the requirements of IEEE C37.06.
- P. The breaker shall be electrically release-free (trip free) as defined in IEEE C37.100.
- Q. The design of the operating mechanism shall be tested together with the circuit breaker interrupter design to ensure positive opening of the circuit breaker and circuit interruption, whether the tripping impulse is received in the fully closed or any partially closed position.
- R. Closing the circuit breaker into a standing trip signal or opening the circuit breaker into a standing close signal shall not cause damage to the circuit breaker. If the release or tripping circuit is completed through an auxiliary switch, electrical release or tripping will not take place until such auxiliary switch is closed.
- S. The circuit breaker shall have two (2) circuit breaker trip coils and one (1) close coil. Each coil shall be electrically, magnetically, and physically independent. Each coil circuit shall have a two pole disconnecting switch with circuit protective fuse in each pole. The protective fuse and fuse holder shall allow replacement of the fuse.
- T. The circuit breaker shall be equipped with auxiliary contacts that change state with the breaker main contacts. The number of breaker auxiliary contacts is specified in the CIRCUIT BREAKER DATASHEET.
1. One set of auxiliary contacts shall change state when the breaker main contacts reach the open position, and one set of auxiliary contacts shall change state when the contacts reach the closed position. Each auxiliary contact shall be convertible from a normally open contact to a normally closed contact, and vice versa.



SECTION 337519 – MEDIUM VOLTAGE CIRCUIT BREAKERS: continued

2. The circuit breaker shall have one (1) normally open contact and one (1) normally closed contact, each of which has set point for the change of state, individually adjustable over the entire travel of the operating mechanism.
- U. The circuit breaker shall be equipped with an operation counter that is mounted in the breaker control cabinet.
- V. An indicator that shows the position of the main contacts shall be provided. The closed position shall have a red indicator and marked with the symbol “1”. The open position shall have a green indicator and marked with the symbol “0”. The contact position indicator shall be mounted in the breaker control cabinet and visible when the cabinet door is closed.
- W. For an assembly of three single pole breakers if specified on the CIRCUIT BREAKER DATASHEET, the control system shall control each individual pole for close and trip operation.
  1. Breaker pole control shall be electronically and mechanically independent.
  2. Each pole of the circuit breaker shall be equipped with auxiliary contacts that change state with the breaker main contacts
  3. Each pole of the circuit breaker shall have one (1) normally open contact and one (1) normally closed contact, each of which has set point for the change of state, individually adjustable over the entire travel of the operating mechanism.
  4. Each pole shall have two (2) circuit breaker trip coils and one (1) close coil. Each coil shall be electrically, magnetically, and physically independent.
  5. Each pole shall be equipped with an operation counter and an indicator that shows the position of the main contacts.

2.04 CIRCUIT BREAKER BUSHINGS:

- A. The circuit breaker bushing shall conform to IEC 60137.
- B. The dielectric and thermal ratings of the bushing shall be coordinated with the ratings of the associated circuit breaker. Ratings shall be the standard ratings of IEC 60137.
- C. Minimum creepage over the ceramic bushing insulating surface shall be in accordance with Annex C of IEEE C37.100.1. Polymer minimum creepage shall be determined with the principles of IEC 60815-1 and IEC 60815-3.
- D. Bushing mounting angle shall not exceed 30 degrees from the vertical.
- E. Bushing cantilever withstand load shall be in accordance with Table 1 of IEC 60137.
- F. Each external bushing connection shall have a four-inch by four-inch, four-hole aluminum pad in accordance with Figure D.2 of NEMA CC 1.
- G. Bushing terminals shall be silver or tin plated.
- H. Bushings shall have a puncture strength greater than dry flashover value.
- I. All porcelain used shall be manufactured by the wet process and shall be homogeneous, free from laminations, cavities, and other flaws, and impervious to moisture. The glazing shall be free from imperfections such as blisters or burns.

2.05 BREAKER CONTROLLED SWITCHING:

- A. When a circuit breaker controlled switching system is required, as indicated on the CIRCUIT BREAKER DATASHEET, the closing control systems shall have control, monitoring, and communications functions.
  1. The control system shall have individual electronic control of each pole.
  2. Individual electronic control of each pole shall have field adjustable set points on the voltage waveform for each terminal.

SECTION 337519 – MEDIUM VOLTAGE CIRCUIT BREAKERS: continued

3. The system shall have adaptive control for each pole. Adaptive control shall be based on the following variables, and all necessary variable sensors and transducers shall be provided. All data shall be stored and available electronically for use by the Owner.
    - a. Contact travel time.
    - b. Ambient temperature.
    - c. Control voltage.
    - d. Drive energy for hydraulic stored energy operating mechanism.
    - e. Gas density.
    - f. Time from last breaker operation.
  4. Current and voltage Oscillography available electronically for use by the Owner.
  5. A communications interface shall be provided as indicated in the CIRCUIT BREAKER DATASHEET.
- B. The closing control shall have the following features.
1. The control shall detect line trapped charge voltage polarity and magnitude.
  2. The control shall have field adjustable time set points for close control. The range of set points shall extend beyond the time of zero magnitude gap voltage.
  3. The control time data shall be determined from detection of breaker close command (trip coil energization) and current inception through the contacts.
  4. Data for the rate of decay of dielectric strength across the breaker contacts shall be submitted in accordance with the Owner requirements. The closing control system, all specified sensors and transducer, and the breaker shall be tested for controlled closing. The closing control shall successfully complete the test if the result is current initiation within the defined optimum target window.
- C. The tripping control shall have the following features:
1. Data for the rate of rise of dielectric strength across the breaker contacts shall be submitted in accordance with the Owner requirements.

2.06 CURRENT TRANSFORMERS:

- A. The circuit breaker bushing current transformers shall conform to IEEE C57.13.
- B. The C57.13 metering accuracy current transformers shall be 0.3 and the relaying accuracy current transformers shall be C800.
- C. For C57.13.6 High Accuracy current transformers, the accuracy shall be 0.15 and the metering burden shall be E-0.04.
- D. The short time thermal and the mechanical current ratings of the bushing current transformer shall be coordinated with the ratings of the associated circuit breaker.
- E. Provisions shall be made to prevent arcing across the enclosure insulation.
- F. Current transformer secondaries shall be terminated at shorting terminal blocks.
- G. Each current transformer shall have provisions for testing without the removal of gas in the circuit breaker.

2.07 CIRCUIT BREAKER CONTROL AND AUXILIARIES:

- A. The circuit breaker control and auxiliary cabinets shall conform to NEMA 250.
- B. Circuit breaker electrical control shall conform to the requirements of IEEE C37.12.
- C. All components required for circuit breaker operation and maintenance, including circuit breaker controls, indicating devices, components for remote data transfer, CT leads, terminal blocks, and grounding connections that are provided for use by the Owner shall be in one control cabinet.
- D. Degree of protection shall be 3S in accordance with NEMA 250.

SECTION 337519 – MEDIUM VOLTAGE CIRCUIT BREAKERS: continued

- E. The control cabinet shall have full width hinged doors having provisions for padlocking and provided with guides to hold the doors in the open position. The bottom plate of the control enclosure shall be acceptable for field installation of schedule 40 rigid galvanized steel conduit.
- F. All components in the cabinets shall be accessible for maintenance and adjustments. All control and indicating devices and all cable terminations that are provided for use by the Owner shall be mounted no more than 1700 mm above the base of the circuit breaker support frame.
- G. Wiring from all terminals on all devices in the control and auxiliaries cabinets for connection to the Owner's systems shall be terminated on terminal blocks located in the control cabinets. Terminal blocks shall accommodate Owner's ring tongue or spade lug external cable wiring. Furnish with twenty-five percent (25%) spare terminals.
- H. The control cabinet shall have one green indicating lamp for breaker "open" position and two red indicating lamp for breaker "closed" position and trip coils are healthy. Indicating lamps shall be General Electric ET-16, with LED lamps by Ledtronics.
- I. When single-pole trip and reclosing are required on the CIRCUIT BREAKER DATASHEET, the circuit breaker control system shall have capability for single-pole and three-pole operation.
- J. When required as shown on the CIRCUIT BREAKER DATASHEET, there shall be one local breaker "close-open" control switch mounted within the breaker control cabinet. The local breaker control switch shall be two-position to close and open the breaker contacts, and spare contacts wired to terminal blocks for use by Owner.
- K. When required as shown on the CIRCUIT BREAKER DATASHEET, there shall be one breaker control "local-remote" two position switch mounted within the breaker control cabinet. The "local-remote" switch shall block all breaker remote control signals. The switch shall have spare contacts wired to terminal blocks for use by Owner.
- L. Each control cabinet shall have circuit protective devices for the Owner's low voltage AC and DC auxiliary power supplies. The cabinet shall have an individual branch circuit molded case circuit breakers for the DC closing circuit; and AC heaters, lighting, receptacles, motors, etc.
- M. A copper grounding bar with a minimum dimension of 0.635 cm x 2.54 cm x 15.24 cm shall be bolted inside the control cabinet to terminate all control and instrumentation grounding wires.
- N. All cables internal to the control and auxiliaries cabinets shall have a flame retardant construction that passes the VW-1 (Vertical-Specimen) Flame Test of Underwriters Laboratories 1581, Section 1080.
- O. Each device mounted in the breaker control cabinet shall have a permanently attached device identification nameplate that is mounted on, or immediately adjacent to the device. The nameplate shall be phenolic or metal, and the device identification shall be made by engraving the nameplate. The device identification shall be identical to the device identification that is shown on schematic and wiring diagrams that are included with the breaker instruction manuals.
- P. The interior of control and auxiliaries cabinets shall be finished with gloss white enamel.
- Q. If heaters are required, a heater thermostat control system shall be furnished as required to prevent condensation over the specified range of relative humidity.
- R. Lighting fixtures and lamps shall be permanently installed in each control cabinet. The lighting equipment shall provide 270 lux of illumination on all control and indicating devices without supplemental lighting. The control cabinet shall have one (1) 20 amperes, 120 V AC, two pole, three wire, grounding type, ground fault interrupting, duplex receptacle.

SECTION 337519 – MEDIUM VOLTAGE CIRCUIT BREAKERS: continued

- S. All control and auxiliary devices on the breaker shall be labeled per ANSI C37.2 with device numbers and/or function i.e. 52X, 63 etc.
  - T. Auxiliary contacts shall be rated N600 as designated by NEMA ICS 2-125.
- 2.08 SEISMIC QUALIFICATION:
- A. Seismic qualification level shall be low, moderate or high. Definition of these qualification levels, methods for determining the required level based on seismicity, and qualification methods shall be in accordance with IEEE 693.
  - B. Electrical functionality shall be demonstrated by testing at the performance level. Electrical functionality is the breaker operating duty, i.e. O-0.3 sec- CO-15 sec-CO.
  - C. Damping shall be determined by the methods given in IEEE 693, Sub clause 6.9, or Annex A.
  - D. The performance level denoted as “Low” requires no testing beyond the apparatus testing required by these specifications.
  - E. The performance level denoted as “Moderate” and “High” shall be qualified in accordance with IEEE 693, and Annex C of the Standard.
  - F. Where a controlled switching system is required, the seismic qualification shall be the level of the circuit breaker.
- 2.09 TOOLS AND SPARE PARTS:
- A. Furnish the following:
    - 1. One (1) manual maintenance closing/opening device.
    - 2. A complete set of special tools, wrenches and other equipment necessary or convenient for maintenance by Vendor or Owner for each type breaker furnished.
    - 3. One (1) gallons of touch up paint for each circuit breaker to match finish coat on breakers if finish coat is to be factory furnished.
    - 4. One (1) set of control relay coils complete with contacts.
    - 5. One (1) closing coil and one (1) trip coil.
    - 6. Other accessories regularly furnished with this class of equipment.
- 2.10 ACCESSORIES:
- A. Each cabinet shall contain the following equipment for control, indication and protection of switches, circuit breakers, and associated components:
    - 1. Mechanism housing heaters with thermostatic control.
    - 2. Emergency circuit breaker trip device.
    - 3. Latch check switch.
    - 4. Alarm switch on compressors or pumps to indicate excessive operating time.
    - 5. Furnish and install in the breaker control cabinet a system to determined breaker contact travel time for contact maintenance.
- 2.11 SOURCE QUALITY CONTROL:
- A. Vendor shall have an ISO 9000/9001 certified Quality Assurance Program covering quality control and assurance measures. The ISO certified program shall be imposed by Vendor on the work within the scope of these specifications and upon sub-suppliers or subcontractors.
  - B. Owner shall at any time be permitted to have representatives visit Vendor’s factory to examine the circuit breaker(s) or any part to ascertain if the material and processes conform to this specification.
  - C. Owner shall have the option of witnessing production tests.
  - D. Vendor shall submit the test protocol to Owner for approval before conducting the routine tests for which there are no Standards procedures.

SECTION 337519 – MEDIUM VOLTAGE CIRCUIT BREAKERS: continued

1. Circuit breaker(s) shall have design tests, production tests, and conformance tests including the requirements for test reports, shall be made in accordance with IEEE C37.09.

PART 3 - EXECUTION

3.01 VENDOR'S FIELD SERVICES:

- A. When indicated on the CIRCUIT BREAKER DATASHEET, Vendor shall furnish field services in accordance with these specifications.

3.02 FIELD TESTING AND COMMISSIONING:

- A. When indicated on the SPECIFIC CIRCUIT BREAKER DATASHEET, Vendor shall furnish field services in accordance with these specifications.
- B. If assistance or attendance is required, it will be provided by others and they will be instructed to perform tasks under the technical direction of the Vendor's service personnel. Service personnel of this Contract shall be responsible for the procedures used to test and inspect the equipment and place the equipment into service.
- C. Standard tools will be provided by others. Vendor's service personnel shall report with any test equipment and special tools that are required specifically for the type of equipment. Vendor's service personnel shall perform all tests, inspections and adjustments required by the manufacturer and as specified in this Section and other documentation provide by Stillwater.
- D. Tests and inspections shall include the following.
  1. Perform manufacturer's recommended standard inspection of all components including checking all connections for tightness, cleanliness, etc.
  2. Complete test and adjustment of circuit breaker stored energy system, breaker operating mechanism, and auxiliary contacts.
  3. Check and adjust contact alignment, clearances, compression, stroke, etc.
  4. Perform operational test manually and by electrical controls.
  5. Measure the impedance of each main contact, internal wiring, and ground connections.
  6. Measure the opening and closing operating duration of each power circuit breaker pole. Tests are to be performed with stored energy systems compressor or pumps de-energized.
  7. Test contact resistance of each pole of each power circuit breaker with a Ductor tester.
  8. Provide a technical description of all tests and record the results.
- E. At the end of the commissioning activity, a complete and comprehensive report shall be prepared by the Vendor's services personnel. Report shall be an indexed three-ring binder consisting of the following.
  1. Tests performed, what was expected, what was found and adjustments made.
  2. Testing equipment used complete with their calibration dates and certificates.
  3. If more than one circuit breaker is tested, a completely separate report shall be generated. One copy of each report shall be left at the site before Vendor's services personnel leave, and extra copies provided in accordance with the requirements of 01 33 00 – 'Submittal Procedures.'

END OF SECTION 337519

MEDIUM VOLTAGE CIRCUIT BREAKERS  
DATASHEET  
(ATTACHMENT TO SECTION 337519)

SUBSTATION:

SUBSTATION NAME: Boomer Lake Substation

SERVICE LOCATION: Stillwater, Oklahoma

DELIVERY LOCATION: 1 Boomer Lake Station Drive, Stillwater, OK 74075

GENERAL REQUIREMENTS:

QUANTITY OF CIRCUIT BREAKERS: 3 (2 Breakers will be used as Transformer Main Breakers and 1 Breaker will be used as a tie breaker)

MAXIMUM VOLTAGE, kV, r.m.s.: 15

CONTINUOUS CURRENT: 2000 A

SHORT-CIRCUIT CURRENT: 10 kA

CLOSING RESISTORS REQUIRED: YES , NO

CONTRACTOR'S FIELD SERVICES REQUIRED: SUPPLIER to provide FIELD SERVICE labor rates. FIELD SERVICE could include supervision, training, and instruction for set-up and commissioning of the breaker for OWNER personnel assembling and operating the breaker.

LIST REPLACEMENT PARTS: One (1) gallons of touch up paint per breaker; one (1) set of control relay coils complete with contacts; one (1) closing coil and one (1) trip coil; One (1) manual maintenance closing/opening device

LIST MAINTENANCE EQUIPMENT REQUIRED: SUPPLIER recommendations

DESCRIPTION OF OPERATING MECHANISM: In lieu of spring mechanism, magnetic actuator operating mechanism shall be provided.

SERVICE CONDITIONS FOR ALL CIRCUIT BREAKER COMPONENTS:

PHASE ROTATION, A-B-C: A-B-C

LINE AND BUS CONFIGURATION: (2) Main Breakers and (1) Tie Breaker

MAXIMUM AMBIENT TEMPERATURE RANGE: 40 °C

MINIMUM AMBIENT TEMPERATURE RANGE: -30 °C

TWENTY-FOUR HOUR AVERAGE MAXIMUM TEMPERATURE: 35 °C

MAXIMUM SOLAR RADIATION INTENSITY: 1000 WATTS/METER<sup>2</sup>

ALTITUDE: 930 FEET

MAXIMUM AMBIENT POLLUTION, IEEE C37.010: Heavy

ICE COATING: 0.75 INCH

MAXIMUM WIND SPEED: 90 MPH

MEDIUM VOLTAGE CIRCUIT BREAKERS  
DATASHEET  
(ATTACHMENT TO SECTION 337519)

PRECIPITATION: 37 INCHES PER YEAR

RELATIVE HUMIDITY RANGE: 38-91 %

SEISMICITY: 0.5 G

STATION LOW VOLTAGE AC POWER SUPPLY: 120/240 (single-phase) PHASE/VOLTS

STATION LOW VOLTAGE DC SUPPLY: 125 VOLTS DC

APPLICABLE STATE AND LOCAL REGULATIONS FOR PRESSURIZED VESSELS: Stillwater,OK

CIRCUIT BREAKER RATINGS:

INTERRUPTING TIME: 3 CYCLES

MECHANICAL ENDURANCE (OPERATIONS): IEEE C37.06 or better

CAPACITOR CURRENT SWITCHING RATING: SUPPLIER recommendation

CLOSING RESISTOR NOMINAL VALUE: SUPPLIER recommendation OHMS

SYNCHRONOUS CLOSING CONTROL REQUIRED (CAPACITOR, REACTOR, NA): NA

BREAKER SINGLE POLE TRIP & RECLOSE REQUIRED: YES , NO

SEISMIC QUALIFICATION LEVEL: High

BREAKER AUXILIARY CONTACTS PER POLE, PER BREAKER POSITION: Provide necessary internal control and interlocking for SUPPLIER's standard control scheme; provide a minimum of (16) additional type "a" and (16) additional type "b" contacts wired to terminal blocks for implementation of protection and control schemes; provide (1) separate type "a" contact and one (1) separate type "b" contact for use in instantaneous reclosing schemes which shall each have its operating point individually adjustable over the entire travel of the operating mechanism.

BREAKER "CLOSE-OPEN" LOCAL CONTROL SWITCH REQUIRED: YES , NO

BREAKER CONTROL "LOCAL-REMOTE" SWITCH REQUIRED: YES , NO

CIRCUIT BREAKER EXTERIOR COATING COLOR: ANSI 70

CURRENT TRANSFORMERS:

SOURCE SIDE TERMINALS:

FULL WINDING RATIO FOR FIRST THREE PHASE SET OF CT'S ON PRIMARY WINDING: 2000/5A,

C800 Accuracy, TRF = 2.0 @ 30° C MULTIPLE RATIO: YES , NO

FULL WINDING RATIO FOR SECOND THREE PHASE SET OF CT'S ON PRIMARY WINDING: 2000/5A,

C800 Accuracy, TRF = 2.0 @ 30° C MULTIPLE RATIO: YES , NO

LOAD SIDE TERMINALS:

FULL WINDING RATIO FOR FIRST THREE PHASE SET OF CT'S: 2000/5A, C800 Accuracy, TRF = 2.0 @ 30° C

MULTIPLE RATIO: YES , NO

MEDIUM VOLTAGE CIRCUIT BREAKERS  
DATASHEET  
(ATTACHMENT TO SECTION 337519)

FULL WINDING RATIO FOR SECOND THREE PHASE SET OF CT'S: 2000/5A, C800 Accuracy, TRF = 2.0 @  
30° C

MULTIPLE RATIO: YES , NO

CIRCUIT BREAKER BUSHINGS:

BUSHING CONSTRUCTION: SUPPLIER recommendation

IEC MINIMUM WITHSTAND CANTILEVER LOAD LEVEL: Level I

BUSHING COLOR: SUPPLIER standard

CIRCUIT BREAKER BUSHING CURRENT TRANSFORMER RATINGS:

QUANTITY: Four (4) sets of three-phase CT's

TYPE: Multi-ratio

CURRENT RATING: 2000/5 A

CONTINUOUS THERMAL RATING FACTOR: 2.0 at 30° C

ACCURACY: C800

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DIVISION 33751913 – INFORMATION TO BE PROVIDED WITH CIRCUIT BREAKER PROPOSAL

PART 1 - GENERAL

1.01 GENERAL INFORMATION:

- A. Include exceptions to the Specification 337519.23 – Circuit Breaker and CIRCUIT BREAKER DATA SHEET. Reference Article, Paragraph, Sub-Paragraph, and specific requirement to which the exception is taken.
- B. If Field Services are specified, provide a description of the services and the qualifications of field services personnel.

1.02 QUALITY ASSURANCE:

- A. Summary of Contractor’s Quality Assurance Program.
- B. A list of type test reports for circuit breaker, bushings, and current transformers.
- C. A list of type test reports for circuit breaker with closing resistor.

1.03 REQUIREMENTS:

- A. Recommended replacement parts, list.
- B. Recommended maintenance tools, list.

1.04 CIRCUIT BREAKER RATINGS: (If ratings equal specified ratings, enter “Spec”)

- A. Power-frequency 1 minute dry withstand voltage \_\_\_\_\_ kV
- B. Lightning impulse full wave withstand voltage \_\_\_\_\_ kV
- C. Lightning impulse chopped wave withstand voltage \_\_\_\_\_ kV
- D. Switching impulse terminal-ground withstand (breaker closed) \_\_\_\_\_ kV
- E. Switching impulse terminal-terminal withstand (on one phase, breaker open) \_\_\_\_\_ kV
- F. Short circuit and short time current \_\_\_\_\_ kV
- G. Interrupting time \_\_\_\_\_ m-sec
- H. Capacitor current switching rating, C0/C1/C2 \_\_\_\_\_
- I. Closing resistor minimum value (if applicable) \_\_\_\_\_ ohms

DIVISION 33751913 – INFORMATION TO BE PROVIDED WITH CIRCUIT BREAKER PROPOSAL: continued

1.05 CIRCUIT BREAKER CONSTRUCTION:

A. Please provide outline drawings, photographs, illustrations, or descriptive sheets and sketches to describe clearly the construction and dimensions.

B. Maximum structural load on circuit breaker foundation (provide sketches showing modules, vector loads, and location(s) of maximum loads):

1. Vertical Static \_\_\_\_\_ N

2. Vertical Dynamic \_\_\_\_\_ N

3. Horizontal Static \_\_\_\_\_ N

4. Horizontal Dynamic \_\_\_\_\_ N

C. Number of series interrupting contacts \_\_\_\_\_

D. Capacitors required for circuit breaker ratings, e.g. short line fault, TRV (Yes or No) \_\_\_\_\_

E. Heaters required in the tank for low temperature (Yes or No) \_\_\_\_\_

F. Temperature below which heater operation is required \_\_\_\_\_ °C

G. Description of gas monitoring system, including sensors, output contact set-points, and number of output contacts. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

H. Description of circuit breaker stored energy system. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

I. Description of overpressure protection (by system design or pressure relief devices – see ASME BPV Code, Section 8, Division 1, Subsection A). \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

J. Design pressure of main circuit breaker tank \_\_\_\_\_ kPa

DIVISION 33751913 – INFORMATION TO BE PROVIDED WITH CIRCUIT BREAKER  
PROPOSAL: continued

K. Design pressure of compressed gas/fluid stored energy system (if applicable) \_\_\_\_\_ kPa

L. Description of protective coating system for breaker, support, control cabinet. \_\_\_\_\_

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M. IEEE 693 seismic qualification level \_\_\_\_\_

1.06 CLOSING RESISTOR (IF SPECIFIED):

A. Nominal resistance \_\_\_\_\_ ohms

B. Closing resistor rated temperature \_\_\_\_\_ °C

C. Maximum resistor temperature \_\_\_\_\_ °C

D. Resistance at maximum resistor temperature \_\_\_\_\_ ohms

E. Minimum resistor temperature \_\_\_\_\_ °C

F. Resistance at minimum resistor temperature \_\_\_\_\_ ohms

G. Number of re-closing operations after one C-O without exceeding maximum rated resistor temperature \_\_\_\_\_

H. Closing resistor manufacturer \_\_\_\_\_

I. Description of closing resistor material and fabrication. \_\_\_\_\_

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J. Description of closing resistor operating mechanism and operation sequence. \_\_\_\_\_

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1.07 CONTROLLED CLOSING SYSTEM (IF SPECIFIED):

A. Description of controlled closing system, including operation, manufacturer/model. \_\_\_\_\_

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DIVISION 33751913 – INFORMATION TO BE PROVIDED WITH CIRCUIT BREAKER  
PROPOSAL: continued

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1.08 CURRENT TRANSFORMERS (CT'S):

A. CT short time mechanical current rating, A \_\_\_\_\_ r.m.s.

B. CT short time thermal current rating, A \_\_\_\_\_ r.m.s.

END OF DIVISION 337519.13 PROPOSAL DATA