

APPENDIX D
ATTACHMENT A5 - SPECIFICATIONS



**City of
Santa Clara**
The Center of What's Possible

**CITY OF SANTA CLARA,
CALIFORNIA
SILICON VALLEY
POWER**

SPECIFICATIONS

FOR THE PURCHASE OF

**145 kV MAX SF6
DEAD TANK
CIRCUIT
BREAKERS**

**July 2024
Rev 1**

SECTION 1. GENERAL

1.1 MANUFACTURING & TESTING

- 1.1.1** The manufacturing and testing facility must be within the continental United States (CONUS).

1.2 RELATED SECTIONS

- 1.2.1** SKETCH – SIMPLIFIED AC & DC SCHEMATICS FOR 145 KV CIRCUIT BREAKER
- 1.2.2** FLYER – PTC HEATER SYSTEM
- 1.2.3** 145 KV CIRCUIT BREAKERS DATA SHEETS

1.3 REFERENCES

- 1.3.1** All equipment furnished under these specifications shall conform to the latest applicable standards of ICEA, AEIC, ASTM, ANSI, IEEE, NERC, and NEMA standards.

1.4 SUBMITTALS

- 1.4.1** Requirements for submittals are specified in the individual technical sections of this specification.
- 1.4.2** Quality System Documentation, including Quality System Manual, Sub supplier List, and Inspection and Test Plan to be submitted as specified in the individual technical sections.

1.5 QUALITY SYSTEM

- 1.5.1** General: Seller shall have a documented quality management system which ensures that all equipment and commodities supplied are in conformance with required drawings and/or specifications and which meet all the guidelines (requirements) set forth in this document. The documented Quality Management System will be provided by the Seller upon PO issuance. The Seller shall be capable of providing assurance that design, purchasing, materials, manufacturing, examination and testing of equipment, shipping, storage, and related services comply with the requirements of the Exemplar Agreement and Specifications. The Seller's quality system shall include, at a minimum, procedures or methods to ensure that the following are controlled:

- 1.5.1.1** Design documents, drawings, specifications, quality assurance procedures, quality records, inspection procedures, inspection and test

status, and purchase documents maintained current, accurate, and under control.

- 1.5.1.2** Purchased materials, equipment, and services conform to the requirements of all Agreement and Request for Bid Documents.
 - 1.5.1.3** Receipt inspection, in-process inspection, examination, testing, and checkouts conducted.
 - 1.5.1.4** Shipping, storage, and preservation of equipment and commodities supplied meet all Agreement and Request for Bid Document requirements.
 - 1.5.1.5** Adequate inspection of subcontracted work.
 - 1.5.1.6** Control of special and proprietary processes associated with the manufacture, fabrication and/or installation of the products and services as specified within this Request for Bid.
 - 1.5.1.7** Proper methods employed for the qualification of personnel who are performing special and proprietary processes associated with this Request for Bid.
 - 1.5.1.8** Procedures that document and control the verification, storage, use, and maintenance of customer-supplied product provided for incorporation into manufactured equipment or commodities.
 - 1.5.1.9** Any applicable industry standards (such as ANSI, AGMA, API, ASME, etc.) shall also be incorporated into this system. This system shall be made available to the City for review upon request.
- 1.5.2** ISO 9001 and ISO 14001 Compliance: The manufacturing site(s) at which the products and components for this project are to be produced shall comply with and be based on the applicable criteria of ISO 9001 2000 and ISO 14001 processes.
- 1.5.3** Quality System Manual: The quality system shall be documented in a quality system manual. One controlled copy of the manual shall be submitted to the City. Along with the required manual, the Seller shall submit a copy of the Certification Letter that the program has been certified by a registered certification agency as satisfying the requirements of ISO 9001. The quality system manual shall be kept current by submittal of revisions as applicable for the duration of the Agreement and including applicable warranty period.
- 1.5.4** Sub suppliers
- 1.5.4.1** Seller shall submit to the City, in writing, the name, type, and location of all sub suppliers and the qualification documentation of the Seller's sub supplier prior to award of sub supplier's Purchase Order.

- 1.5.4.2** The Seller shall ensure that sub suppliers have the capabilities to fulfill all Agreement and Request for Bid Document requirements as prescribed in within the specifications. Seller shall submit objective evidence of sub supplier’s capabilities, processes, or in-process work involving the fabricating and manufacturing of materials and commodities for the City.
- 1.5.4.3** The Seller shall be responsible for sub supplier qualification and monitoring to ensure adherence to the same high-quality standards of the Seller. When deemed necessary, the City has the authority to perform quality audits and inspections and monitor and/or review sub supplier processes and facilities.
- 1.5.5** Inspections by City: The City may elect to perform inspections, quality audits, or witness testing at any time during the manufacturing process. The City may designate an authorized agent for inspections, witness testing, or quality audits. Authorized agent can be an employee of the City or an outside agency. When an outside agency is designated as an authorized agent for the City, such designation will be in writing with a copy provided to the Seller. Hereinafter, when the term “City’s representative” is used, it may also mean the City or its authorized agent.
- 1.5.5.1** Inspection and Test Plan: Prior to commencing fabrication, Seller shall submit to the City a detailed inspection and test plan (i.e., a Quality Assurance/Quality Control Plan) for the work to be performed. The inspection and test plan shall be a detailed step-by-step list of operations and requirements which shall identify the inspection and testing points for major components of the work and shall be maintained current throughout the duration of the Agreement. The plan shall include the Seller’s strategy for inspecting sub supplier’s work, including inspection by the Seller at his sub supplier’s facilities. The City will designate any test witness points or other inspection points required.
- 1.5.5.2** The Seller shall keep the City informed of the progress of the work and shall notify the City at least 15 business days in advance of the appropriate times for inspections and testing when such inspection and test points have been designated by the City for witnessing. The work shall not progress past the City’s designated witness point until the City has inspected the work or witnessed the designated test, or the City has waived its right to perform an inspection or to witness a test. The Seller shall be responsible for providing the City with post manufacturing photographs, and approved panel layout drawings prior to shipment, of the overall breaker(s) layout and internal control & wiring cabinet as verification the new breaker matches the existing breakers’ wiring, terminal block and conduit locations.

- 1.5.5.3** Access: The City will have the right to inspect the Seller's and sub supplier's work and related documents in the course of manufacture providing no delays in manufacture are caused thereby. The Seller is required to provide, at his own expense, reasonable facilities including tools and instruments for demonstrating acceptability of the work.
- 1.5.5.4** Test Witnessing: If called for in the Agreement and/or Request for Bid Documents, and when designated as a hold point, witnessing of mill or factory tests must be performed in the presence of the City's representative unless waived in writing by the City's representative. The Seller shall bear all expenses of such tests except the compensation and expense of the City's representative. All international travel will be business class.
- 1.5.5.5** Corrective Action: Upon detection of a noncompliance with the requirements of the Agreement and/or Request for Bid Documents, the Seller shall document the noncompliance issue and provide the City's representative a copy of the report. The Seller shall be required to correct, in a timely manner, all deficiencies identified at the sole cost of the seller.
- 1.5.5.6** Rejection: If any items or articles are found not to meet the requirements of the specifications, the lot, or any faulty portion thereof, may be rejected. Before offering specified material or equipment for shipment, the Seller is required to inspect the material and equipment and eliminate any items that are defective or do not meet the requirements of the Agreement and/or Request for Bid Documents. The fact that materials or equipment have been previously inspected, tested, and accepted does not relieve the Seller of responsibility in the case of later discovery of flaws or defects.

SECTION 2. PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

- 2.1.1** Unless specifically provided otherwise in each case, all materials and equipment furnished for permanent installation in the work shall conform to applicable standard specifications and shall be new, unused, and undamaged.
- 2.1.2** Miscellaneous Materials and Services: Miscellaneous materials and services not otherwise specifically called for shall be furnished by the Seller in accordance with the following, as applicable:

 - 2.1.2.1** All special tools or lifting beams and lugs for offloading.
 - 2.1.2.2** SF6 spare cylinders for one (1) breaker to be provided onsite.

2.1.2.3 Field Support Services shall be provided in accordance with the Agreement.

2.1.2.4 Spare Parts shall be provided in accordance with the Agreement.

2.1.3 Materials containing asbestos will not be allowed.

2.2 FACTORY ASSEMBLY

2.2.1 All separately packaged accessory items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip indicating what is in that container only shall be attached to the outside of each container used for packaging. A similar list shall be inside each container. A master packing slip covering all accessory items for a given piece of equipment which are shipped in separate containers shall be attached to one container.

2.3 TOOLS

2.3.1 The Seller shall furnish and ship with each piece of equipment one set of all special tools required for assembly, installation and maintenance, of the equipment and materials to be provided. The tools shall be shipped in separate, heavily constructed wooden boxes provided with hinged covers and padlock hasps.

2.3.2 Maintenance tools for each for the equipment and materials to be provided shall be boxed separately and the boxes shall be marked with the name of the project and the name of the equipment.

SECTION 3. 145 KV SF6 DEAD TANK CIRCUIT BREAKER - GENERAL

3.1 WORK INCLUDED

3.1.1 The Circuit Breaker Manufacturer (Seller), whose manufacturing and testing facility must be within the continental United States (CONUS), shall provide all the necessary and required labor, materials, tools, equipment, etc., to design, fabricate, manufacture, assemble, test and ship the breaker complete with all the accessories and the ordered spare parts to the required destination.

3.2 WORK NOT INCLUDED

3.2.1 The Seller shall not be required to unload the breaker, place it on the pad, anchor and ground the breaker, provide low voltage and high voltage external connections, fill the breaker with SF6 gas, field test and energize the breaker.

3.3 SUBMITTALS

3.3.1 All questions, clarifications, review drawings, final drawings, submittals, correspondence, etc., except as stated otherwise, shall be referred to:

City of Santa Clara
 Attn: Allie Jackman
 Silicon Valley Power
 881 Martin Ave.
 Santa Clara, CA 95050
 Phone: (408) 615-6639
 Email address: ajackman@svpower.com

- 3.3.2** The Seller shall submit three (3) sets of review drawings including, but not limited to, basic outline drawing including shipping drawings, detailed A.C. and D.C. schematics, control cabinet drawings, point-to-point wiring diagram and terminal arrangement drawings, breaker, operator and C.T. nameplate drawings, bushing drawing, bushing current transformer schematic diagram, C.T. excitation, ration correction and power factor correction curves, motor and heater details, etc., for review and comments.
- 3.3.3** After the For Approval Drawings are finalized, the Seller shall electronically submit Issued for Manufacturing Drawings in AUTOCAD files for each breaker ordered.
- 3.3.4** Drawing submittals and circuit breaker delivery shall be provided in accordance with the schedule included in the Agreement.
- 3.3.5** Due to global supply chain issues and subject to material and parts availability at time of manufacturing, Seller may use substitute parts and components per the below table in order to deliver the order or breaker on time (i.e. in order to meet the delivery schedule – this does not change the delivery schedule in the Agreement). All substitute parts and components shall be fit, form and functionally compliant with original proposed part. In case of a drawing change, Seller shall provide revised drawing(s) with breaker and send to customer contact person.

Generic Component / part Name	Detail / Functional purpose	Substitute options subject to availability of parts/components			
Bushing Current Transformers (CTs)	Metering and relay CTs	Meramec	Ameran	Narayan	
Terminal Blocks-1	power terminal	Marathon	Phoenix	GE	States
Terminal Blocks -2	CT testing	Marathon	Phoenix	GE	States
Terminal Blocks-3	Control	Marathon	Phoenix	GE	States
SEL Relays / Breaker monitoring devices	all types / customer specific	No other option available			
Relays-1	for controls	Square D	Siemens	ABB	
Relays-2	for timing	Agastat	Signaline		

- 3.3.6** For each circuit breaker ordered, the Seller shall submit three (3) sets of installation, operation and maintenance manuals complete with all drawings, C.T. curves, motor and heater details, certified test results, etc., as follows:

3.3.6.1 Mail one set to:

City of Santa Clara
Silicon Valley Power
Attn: Allie Jackman
881 Martin Avenue
Santa Clara, CA 95050

3.3.6.2 Provide one set in breaker control cabinet pocket.

3.3.6.3 Mail one set to:

City of Santa Clara Electric Shop
Attn: Ernest Benjamin
1705 Martin Avenue
Santa Clara, CA 95050

SECTION 4. 145 KV SF6 DEAD TANK CIRCUIT BREAKER– PRODUCTS

4.1 GENERAL REQUIREMENTS

- 4.1.1** The circuit breaker shall be outdoor, free-standing, weatherproof, SF6 dead tank type and complete with current transformers, accessories and controls all as specified herein.
- 4.1.2** The circuit breaker shall generally conform to the applicable requirements of the latest IEEE, ANSI and NEMA standards, except where the requirements of this specification take precedence.
- 4.1.3** The circuit breaker shall be suitable for reclosing and shall operate under ANSI Standard Usual Service Conditions, in Santa Clara, California, on a 115kV, 60Hz, solidly grounded neutral system.
- 4.1.4** The circuit breaker shall have seismic withstand capability appropriate for “High Seismic” in accordance with IEEE 693-2005. A special nameplate shall be offered stating this rating. A seismic report certifying that the design meets the seismic requirements shall be submitted.

4.1.4.1 The site conditions are shown below:

4.1.4.1.1 Seismic Design Data:

Site Class = D (ASCE 7-22, 20.3.2). Design will incorporate site specific data (borings, seismic refraction) and shear wave velocity profiles of the subsurface at or around the Substation.

Seismic Design Category = D (ASCE 7-22, Tables 11.6-1 &2)

Risk Category = III (ASCE 7-22 Table 1.5-1) or as determined by the Geotechnical Report

Seismic Importance Factor, I = 1.25 (ASCE 7-22, Table 1.5-2)
ASCE 193, IEEE 693 standards shall be met typical for California

4.1.4.2 Wind Design Data:

ASCE 7-22 (IEEE 605 loads will also be considered)
Basic wind speed = 99 mph
Exposure = C
Ambient Temperature; 42.8°C to -7.8°C

- 4.1.5** The circuit breaker shall be suitable for withstanding high concentration of hydrogen sulfide in the air resulting in corrosive conditions.
- 4.1.6** The SF6 gas leakage rates for the circuit breaker shall not exceed 0.5% annually.
- 4.1.7** The seller shall provide accurate SF6 quantity, weight in pounds, to owner for each breaker upon delivery with separate values provided for each SF6 compartment of each breaker.

4.2 RATINGS

- 4.2.1** The circuit breaker shall have the following ratings at a minimum. Consult the data sheet for additional requirements.

- 4.2.1.1** Rated Maximum Voltage – 145 kV
Power Frequency Withstand: 275 kV
Impulse Withstand (Full Wave) – 650 kV Peak
Impulse 2 μ -sec chopped wave – 838 kV
Peak Rated Continuous Current – 4,000 Amps
Rated Short Circuit Current (Symmetrical) – 80,000 Amps
Close and Latching Current – 208 kA Peak
Interrupting Time – 3 cycles
Operating Cycle: O-0.3 sec-CO-15 sec-CO
A.C. Control Voltage – 120/208V A.C.
D.C. Control Voltage – 125V D.C.

4.3 GENERAL CONSTRUCTION

- 4.3.1** All three poles of the circuit breaker shall be operated by a stored energy type mechanism.
- 4.3.2** The circuit breaker shall have a leakage rate of not more than 0.5% on an annual basis.

- 4.3.3 The operating mechanism housing shall be enclosed and weatherproof and shall have hinged doors with provisions for padlocking. All doors shall be fully gasketed. Doors shall open wide, giving full access to interior and shall have stops to prevent accidental closing.
- 4.3.4 The various control and power devices shall be grouped and connected as shown on the simplified A.C. and D.C. schematics given at the end of this section. Each molded case circuit breaker shall provide a separate N.O. and N.C. alarm wired to terminal blocks. These alarm contacts shall only operate on tripping of the molded case breaker and not on manual opening.
- 4.3.5 Two ground pads, each with two NEMA holes, shall be provided on opposite corners. Outline drawing will show the location and material for these pads.
- 4.3.6 All the devices like terminal blocks, close coil, trip coil, heaters, relays, motor, molded case circuit breakers, disconnects, etc., with their associated wires shall be so installed that they become easily accessible for checking, testing, maintaining, troubleshooting, etc.
- 4.3.7 The bushing C.T. terminal blocks shall be labeled to identify the corresponding bushing and bushing C.T.
- 4.3.8 All devices like terminal blocks, close coil; trip coil, heaters, relays, motor, molded case circuit breakers, disconnects, etc., shall be labeled in accordance with the labels used on the point-to-point wiring diagram.
- 4.3.9 The control cabinet shall have a pocket for keeping one set of breaker installation, operation and maintenance manual complete with all drawings, CT curves, motor and heater details, certified test results, etc.
- 4.3.10 Two identical trip coils shall be provided.
- 4.3.11 Stainless steel nameplates shall be mounted on the outside of the control cabinet door.
- 4.3.12 The breaker shall not use shunt capacitors to achieve the rated short circuit current.
- 4.3.13 The overall breaker(s) layout, internal control and wiring cabinet shall match the existing breakers' wiring, terminal block and conduit locations as they are required to allow the reusing of existing cables, conduit, and foundation.

4.4 BUSHINGS

- 4.4.1 All bushings shall be porcelain or composite conforming to the latest applicable ANSI and NEMA Standards. Bushings shall be approved by owner. Polymer and epoxy bushings are typically not acceptable. All bushings shall be adequate for ratings of the breaker.

- 4.4.2 Aluminum bushing conductor is acceptable if bushing is furnished with an integral NEMA 4-hole terminal pad. If bushing has threaded studs for external connections, then bushing conductor shall be copper.
- 4.4.3 If bushing conductor is copper, then the threaded studs must be tin/silver plated and all aluminum stud connectors for stud-to-flat NEMA pad must be provided with the breaker.
- 4.4.4 Bushings shall be ANSI 70 sky gray.
- 4.4.5 Bushings shall be SF6 gas filled.
- 4.4.6 Bushings shall be furnished with power factor test electrodes.

4.5 BUSHING CURRENT TRANSFORMERS

- 4.5.1 Three multi-ratio bushing current transformers, with minimum relaying accuracy matching the table in the referenced data sheet, shall be provided at each bushing for a total of eighteen (18) bushing current transformers per circuit breaker. The full ratio primary rating shall equal the continuous current rating of the breaker. These transformers shall have fully distributed windings and a minimum Thermal Rating Factor of 2.0.

4.6 AUXILIARY DEVICES

- 4.6.1 The auxiliary devices shall include, but not be limited to, the following:
 - 4.6.1.1 Operation Counter: It shall operate on circuit breaker opening.
 - 4.6.1.2 Position Indicator: It shall show the position of the main contacts. It shall be visible without opening any compartment doors.
 - 4.6.1.3 Trip coil monitor LED light to be located in the breaker control cabinet for both trip coils.
 - 4.6.1.4 Auxiliary Breaker Contacts: Not less than 6 N.O. and 6 N.C. electrically separate auxiliary contacts shall be provided for the City's use. All unused auxiliary contacts shall be wired to terminal blocks.
 - 4.6.1.5 Mechanically Operated Manual Trip Device (69M): An external and mechanically operated manual trip with a guard for protection against unintentional tripping shall be provided. This device shall have OPERATE and RESET positions. This device shall have one OPEN contact and one CLOSE contact in OPERATE position and these contacts will change state in RESET position. OPEN contact in OPERATE position shall be used in closing circuit and CLOSE contact in OPERATE position shall be wired to terminal points for

annunciation. Operation of this device shall not depend on AC and DC power.

- 4.6.1.6** Space Heaters: Provide necessary Positive Temperature Coefficient (PTC) heaters with fan to avoid condensation. A flyer for PTC heater is provided at the end of this specification for reference.
- 4.6.1.7** Pressure Tank: All pressure tanks shall have an ASME label and shall be in accordance with all state and local codes. Pressure gauges shall be visible from outside the operating mechanism housing. A contact which closes on low pressure condition shall be provided and wired to terminals for annunciation of a low-pressure condition.
- 4.6.1.8** Travel Analyzer: Provisions shall be made available for the attachment of a travel analyzer.
- 4.6.1.9** Ground Bus: The Seller shall provide a suitable ground bus in the breaker control cabinet. The Seller shall bring all the ground connections to this ground bus. The Seller shall ground this ground bus by connecting it to other breaker ground pad by 6 AWG bare stranded copper wire using straight bronze terminal 2 cable to 2 hole NEMA pad, Hubbell make, Type VL2, Catalog #VL241BH or equal approved by City.
- 4.6.1.10** Convenience Outlets: The following convenience outlets in cast aluminum weatherproof boxes with covers shall be provided outside of the operating mechanism housing.
 - 4.6.1.10.1** GFCI duplex receptacle, gray, 20A, 120V A.C.
 - 4.6.1.10.2** Receptacle, twist lock type, NEMA L6-30R, gray, 30A, 208V A.C.
- 4.6.1.11** Dynamic Ratings monitor: The breaker shall be equipped with a Dynamic Ratings monitoring device, Part No. BPM-G-4-N-N-0-1-2 for Circuit Breaker and SF6 monitoring.
- 4.6.1.12** DILO fittings for gas filling.

4.7 SF6 Management

4.7.1 SF6 General Information

- 4.7.1.1** Rated pressure of SF6 gas in the circuit breaker (kg/cm² or PSI).
- 4.7.1.2** Rated pressure of SF6 gas in the gas cylinders (kg/cm² or PSI).
- 4.7.1.3** Quantity of SF6 gas required per single pole unit (kg or lb.).

- 4.7.1.4 Quantity of SF6 gas required per cylinder (kg or lb.).
- 4.7.1.5 Name of SF6 suppliers and country of origin.
- 4.7.1.6 Seller to provide supplemental pressure check tool with deliver of each circuit breaker.
 - 4.7.1.6.1 The gauge of this tool must maintain an accuracy within 0.5% of its largest value.
 - 4.7.1.6.2 The gauge of this tool must be able to measure the shipping pressure of SF6 Breaker, which is 5 psig or lower.
- 4.7.1.7 SF6 gas purity shall be 99% minimum. SF6 gas moisture content shall be less than 100 parts per million by volume (ppmV).
- 4.7.2 SF6 Information Specific to each breaker
 - 4.7.2.1 Quantity of SF6 gas supplied for:
 - 4.7.2.1.1 Actual use in breakers (kg or lb.)
 - 4.7.2.1.2 As spare (kg or lb.)
- 4.7.3 Documentation and Handling requirements
 - 4.7.3.1 Original Equipment Manufacturer (OEM) shall provide their standard document submittals in physical and electronic copies, including at a minimum: instruction books, test reports, and drawings.
 - 4.7.3.2 OEM shall inspect all equipment prior to shipment and provide sufficient documentation of SF6 gas quantities in an approved format for the owner to meet regulatory mandated reporting requirements. For example, SF6 reporting may include:
 - 4.7.3.2.1 Alarm switch pickup pressure and lockout switch pickup pressure, in psig, for breakers with frame-mounted density switch/gauge (temperature compensated).
 - 4.7.3.2.2 The SF6 pressure in psig during shipping.
 - 4.7.3.2.3 The amount of SF6 gas in the breaker, measured in pounds (lbs), during shipping.
 - 4.7.3.2.4 The purity and moisture content of SF6 in both the SF6 gas breaker and the SF6 gas cylinder.
 - 4.7.3.2.5 SF6 pressure, in psig, Leaving factory (per circuit breaker) and Delivered on site (per circuit breaker).

4.7.3.2.6 Total of SF6 (kg or lb.) purchased (including SF6 provided by OEM with or inside new equipment)

4.8 WIRING

- 4.8.1** Wire: C.T. circuits, auxiliary power and control wires shall be 10, 12 and 12 AWG minimum, respectively, 600-volt stranded copper switchboard wire, NEC type SIS or equal approved by the City. External wiring shall run in liquid-tight type flexible conduit or other suitable metal enclosure as approved by owner, adequately supported.
- 4.8.2** Terminations: Terminations shall be made with solderless, crimp type, non-insulated, ring-type lugs using a tool so designed that once the crimping action is started, the tool cannot be removed until the jaws bottom. Crimp side of lug shall be visible when lug is connected to a terminal point. Not more than two wires shall be terminated to a terminal point.
- 4.8.3** Terminal Blocks: All standard terminal blocks shall be 12-point, one piece, non-shortening type, 30A 600 volts with brass screw terminals and white marking strip, GE Type EB25 make, Catalog No. 2B112 or equal approved by the City. Spare terminal points in the amount of a minimum of 20% of the connected terminals shall be provided.
- 4.8.4** Ground Bus: The cabinet shall be provided with a ground bus located in the rear bottom section. The bus size shall be ¼ -inch x 2 inch minimum, flat copper bar and shall be mounted on the cabinet base channel. The ground terminal point of each shorting type terminal block shall be jumpered and the last jumper shall be connected to ground bus in the control cabinet.
- 4.8.5** Short circuit type terminal blocks shall be used for all current transformer circuits. Terminal blocks shall be one piece, shorting type, GE EB 27, having the quantity of terminal points specified.
- 4.8.6** Wire Training: Wiring shall be trained neatly in insulated type wiring ducts with covers. The sum of the cross-sectional area of the conductors shall not exceed 40% of the interior cross-sectional area of the wiring duct.
- 4.8.7** Wire Labels: All conductors shall be labeled at all terminations with wire names and wire destination in accordance with point-to-point wiring diagrams. Wire destination shall include not only the device but the device and its terminal number. Wire labels giving wire origins are not acceptable. Wire labels shall have two lines, first line for wire name and second line for wire destination. Label shall be permanently held in place so as to be readable when the wire is secured to the terminal point.
- 4.8.8** Spare Contact Wiring: All unused, i.e., spare contacts, shall be wired to terminal blocks in the control cabinet.

4.8.9 Terminal blocks for interconnecting with Owner's wiring shall be located in the control cabinet so that the Owner's existing cables/wiring may be reused.

4.9 PAINTING

4.9.1 All control cabinet external and internal metal parts shall receive a thorough painting using OEM's standard control cabinet painting process.

4.9.2 The painted surfaces shall not chip, crack, peel, or otherwise deteriorate due to conditions encountered during operation (i.e., changes in temperature, and exposure to various weather conditions).

4.9.3 The interior and exterior finish color shall be ANSI No. 70, Light Gray.

4.10 TESTS

4.10.1 In addition to routine tests required by ANSI Standards, the following test shall be made in accordance with the latest IEEE standard C37.09

4.10.1.1 Current Transformer Test as per the latest IEEE Standard C57.13.

4.10.1.1.1 Check the presence of correct nameplate, terminal and polarity markings.

4.10.1.1.2 Electrical polarity check.

4.10.1.1.3 Ratio check for all taps.

4.10.1.1.4 Saturation test.

4.10.1.2 Gas receiver test

4.10.1.3 Pressure test

4.10.1.4 Nameplate check

4.10.1.5 Leakage tests

4.10.1.6 Heaters and coils check tests.

4.10.1.7 Clearance and mechanical adjustment check tests.

4.10.1.8 Mechanical operations tests

4.10.1.9 Timing and travel test

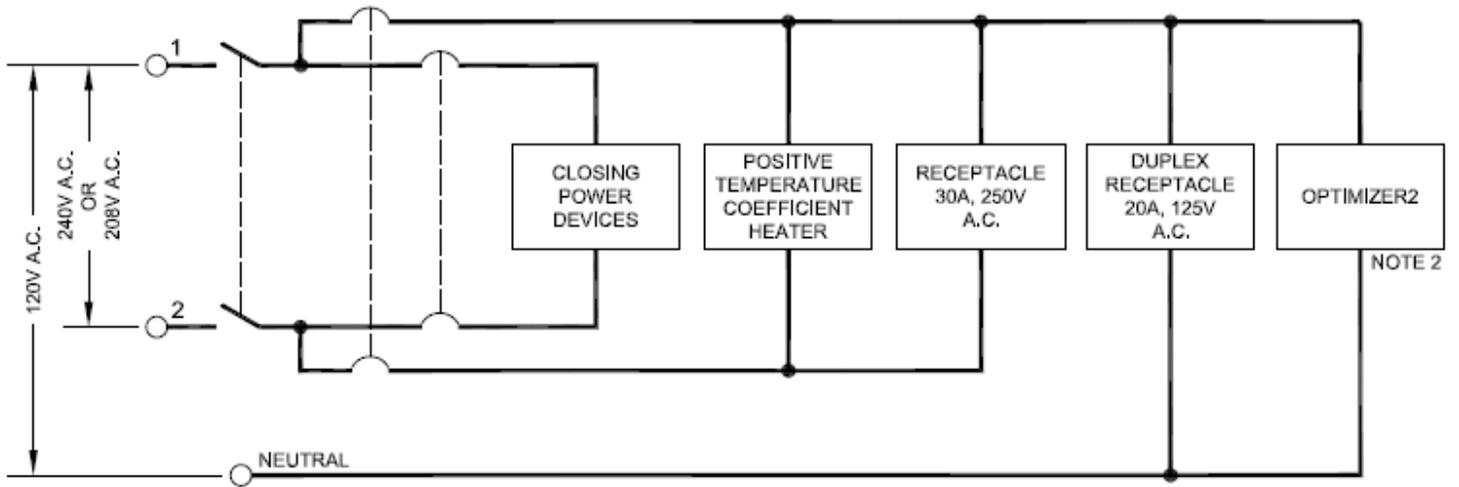
4.10.1.10 Stored energy system tests.

4.10.1.11 Electrical resistance of current path test/contact resistance test

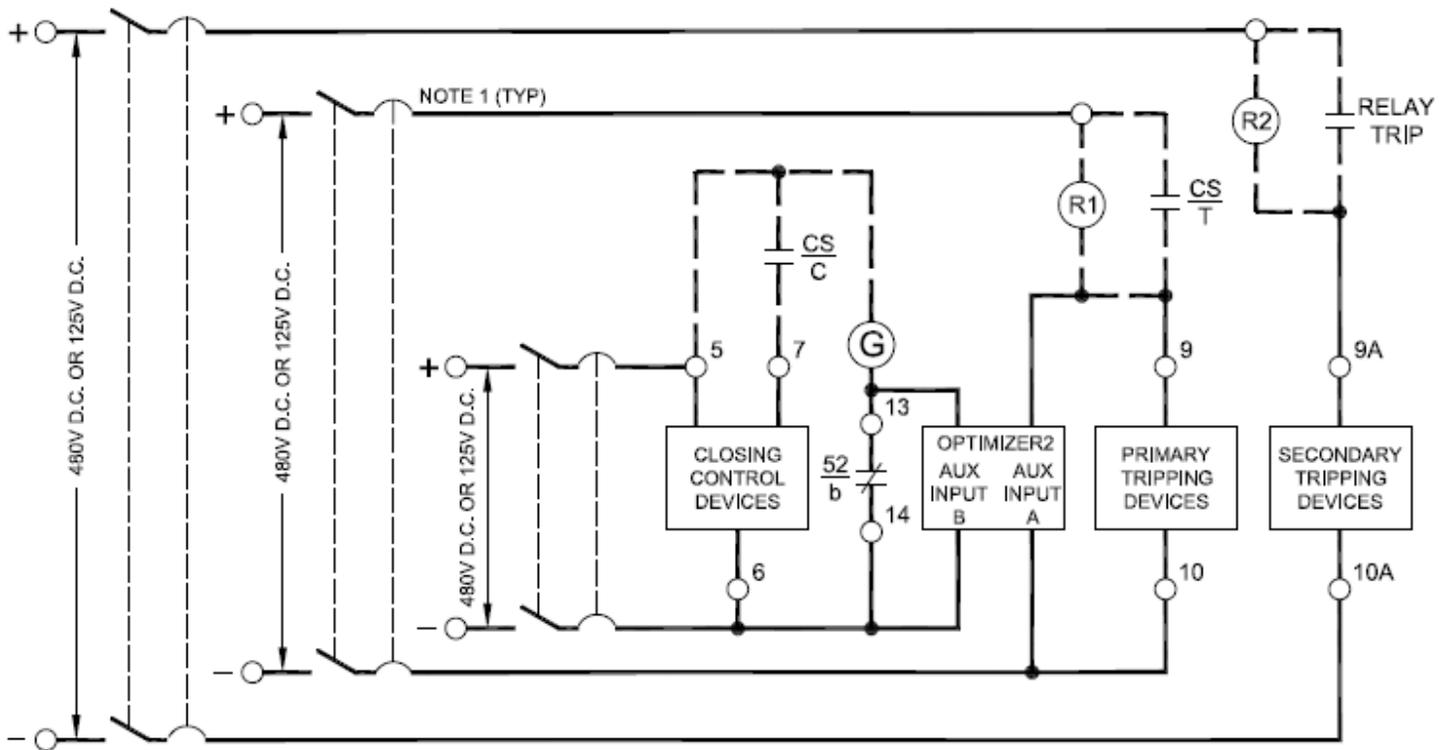
- 4.10.1.12** Power frequency withstand voltage test on major insulation components.
- 4.10.1.13** Power frequency withstand voltage test on control and secondary wiring.
- 4.10.1.14** Power factor tests on all bushings
- 4.10.1.15** Minimum pickup voltage tests on trip and close coils
- 4.10.1.16** Trip Free and Anti-pump function check
- 4.10.2** Provide a seismic report to certify the design can withstand the seismic requirements for this project as required in this specification.
- 4.10.3** The City reserves the right to witness all tests. The Seller shall give at least three (3) weeks' notice to the City prior to performing any test.

4.11 DRAWING REQUIREMENTS

- 4.11.1** Point to point wiring diagram is required. Wire chart or wire table or wire schedule in lieu of point to point wiring diagram is not acceptable.
- 4.11.2** Schematic diagrams and point to point wiring diagrams shall be separate. Schematic diagrams shall have wire name or wire designation.
- 4.11.3** All relay and auxiliary contacts shall be clearly displayed and identified as to their use.
- 4.11.4** There shall be a clear distinction between wire names and terminal numbers.
- 4.11.5** User's points of connection, such as for A.C. and D.C. power supplies, annunciation, CT circuitry, etc., shall be identified on the schematic diagrams with terminal numbers.
- 4.11.6** Outline drawing shall show front view, rear view, top view, right hand side view, left hand side view, overall dimensions of the breaker, anchoring details, conduit entrance, ground pads, C.G. of the breaker, incoming and outgoing or line and load side, 69 M device, receptacles, etc. A bill of materials shall also be provided.
- 4.11.7** Control cabinet drawings shall show the detailed physical location and layout of all equipment such as terminal blocks, ground bar, switches, relaying equipment, lights and receptacles. A bill of materials shall also be provided.
- 4.11.8** Generic drawings are not acceptable. Drawings shall be specific for the equipment supplied.
- 4.11.9** Reduced and hard to read drawings are not acceptable. All drawings shall be full size, clear and easy to read and understand.



A.C. SCHEMATIC



D.C. SCHEMATIC

DOTTED CONNECTIONS ARE EXTERNAL TO THE BREAKER



PTC Heater Systems



GENERAL DESCRIPTION

The High Voltage Supply Positive Temperature Coefficient (PTC) Heater improves the reliability of your electrical equipment by maintaining an enclosure temperature only slightly higher than the outside ambient temperature. The system offers unparalleled reliability due to the elimination of a thermostat or other controls. In addition, standard PTC Heaters use an integrated fan assembly that assures even heat distribution throughout the enclosure.

CONSTRUCTION

PTC Heaters feature a heating element constructed with a variable resistance material that automatically controls cabinet temperature. A fan (if equipped) is attached to the heat guard and provides forced conduction of the heat as well as uniform enclosure distribution. Mounting brackets allow easy cabinet or panel installation. A twelve foot wiring harness is also included to make installation as easy as possible.

Options

The PTC heaters are available in the following configurations:

1. 50 Watt, 120V panel mount convection
2. 200 Watt, 120V fan forced
3. 200 Watt, 240V fan forced
4. 400 Watt, 120V fan forced
5. 400 Watt, 240V fan forced

INSTALLATION

Electrical Connections

To connect harness to Heater/Blower plug black wire lead with (3) terminals into heater terminal block #1, Then the next lead is plugged into Heater terminal block #3, and the remaining lead is plugged into the bottom terminal on the fan motor. Plug remaining black wire lead with (2) terminals into heater terminal block #2, then the remaining lead is plugged into the top terminal on the fan motor.

OPERATION

Operation of the heater assembly is automatic and requires no adjustment. As the heat level in the enclosure increases, the resistance of the heater element also increases, resulting in a decrease of the

output wattage. Eventually, the enclosure reaches an equilibrium temperature slightly above ambient.

MAINTENANCE

The PTC heater is essentially maintenance free, with only a few necessary checks to ensure that the unit is operating normally.

Annual Inspection:

CAUTION: *The surface of the heater element is very hot and can cause burns. Never cut or remove the heat shield.*

- Visually inspect that the fan is running quietly and that no foreign material has entered the assembly.
- Inspect that heater element shield is warm to the touch.

TROUBLESHOOTING

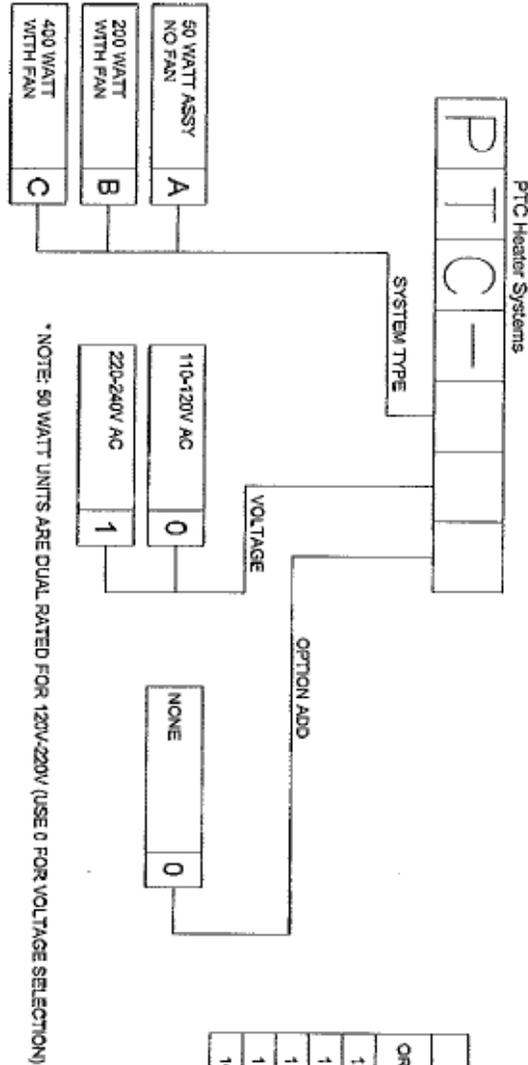
- 1) The fan or heater is not operating
 - Confirm that the voltage input to the PTC assembly is the correct voltage.
 - Check fan and heater plug-in terminals to ensure that none have become unplugged.
 - Check wiring harness for cuts or bare insulation

REPLACEMENT PARTS AND SERVICE

Please contact High Voltage Supply for parts and service at 800-338-5526 for replacement parts and/or service.

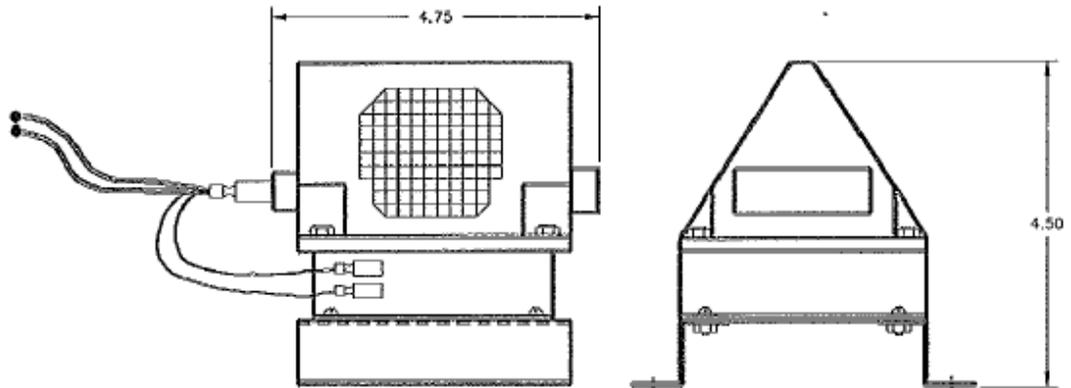
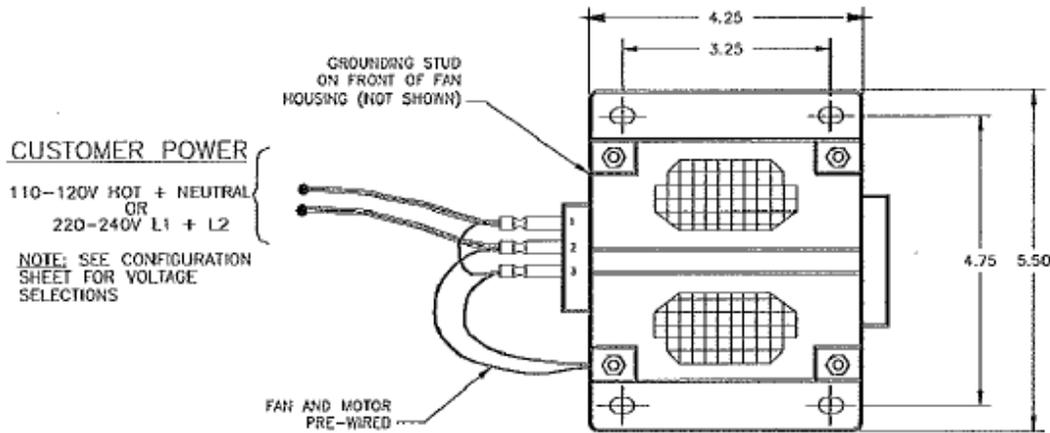


PTC Heater Systems

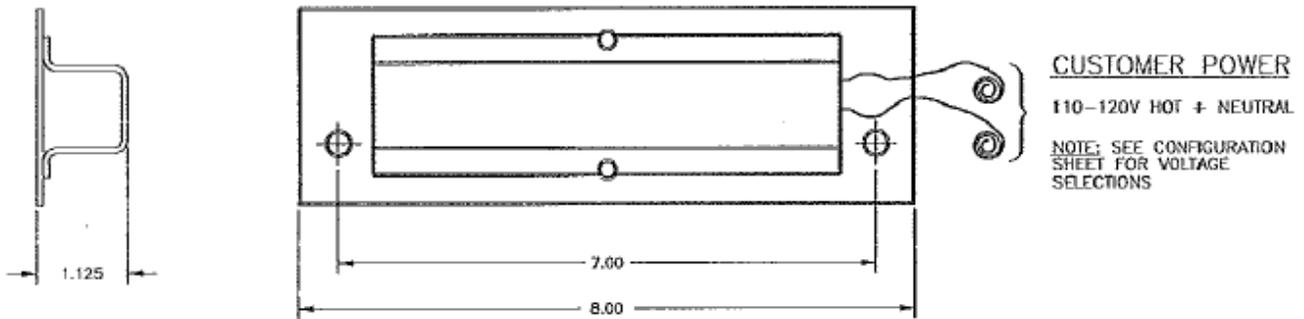


REFERENCE TABLE	
ORIGINAL PART #	NEW PART #
1030-018K-V1	PTC-B00
1030-018K-V2	PTC-C00
1030-018K-V3	PTC-B10
1030-018K-V4	PTC-C10
1030-018K-V5	PTC-A00

PTC Heater Systems



FAN FORCED UNITS

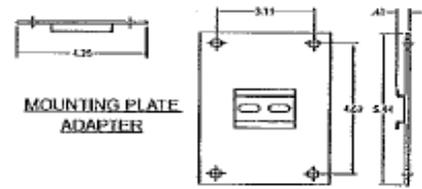
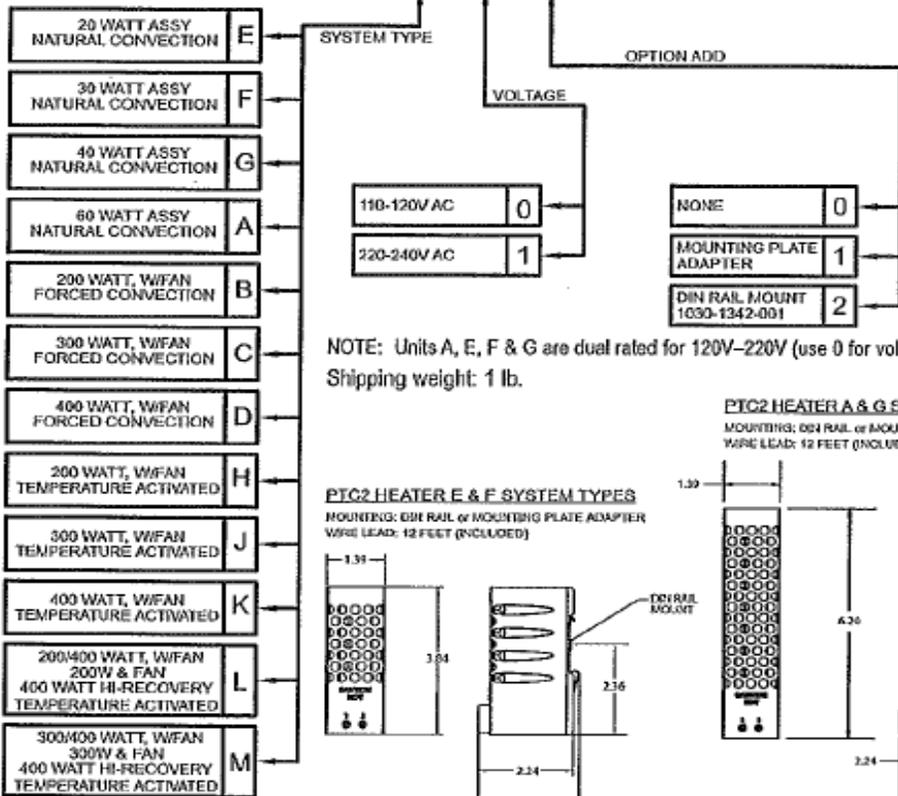


CONVECTION UNITS

Build Your Own Part Number Using Configuration Below:

For More Information
 call **800-338-5526**
 e-mail **HVSinfo@waukesha.spx.com**

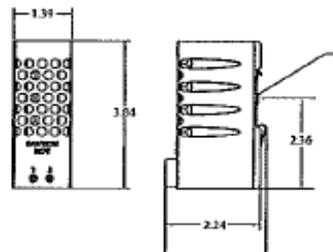
PTC2-XXX



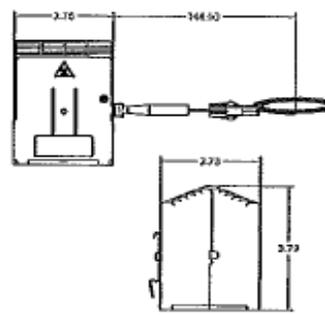
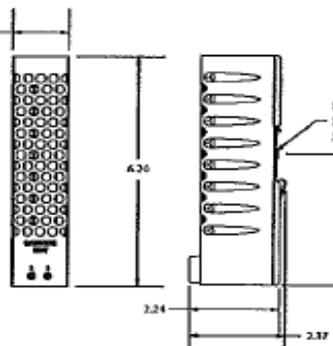
PTC2 HEATER B, C, D, H, J, K, L & M SYSTEM TYPES
 MOUNTING: DIN RAIL or MOUNTING PLATE ADAPTER
 WIRE LEAD: 12 FEET (INCLUDED)



PTC2 HEATER E & F SYSTEM TYPES
 MOUNTING: DIN RAIL or MOUNTING PLATE ADAPTER
 WIRE LEAD: 12 FEET (INCLUDED)

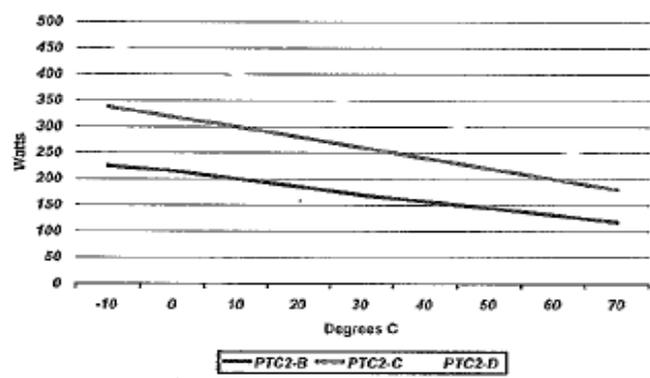


PTC2 HEATER A & G SYSTEM TYPES
 MOUNTING: DIN RAIL or MOUNTING PLATE ADAPTER
 WIRE LEAD: 12 FEET (INCLUDED)

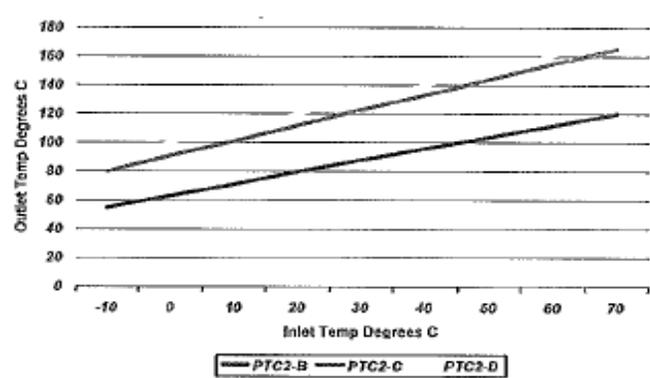


HOW TO PICK YOUR HEATER:

WATTAGE VS. HEATER INLET TEMPERATURE



HEATER INLET VS. OUTLET TEMPERATURE



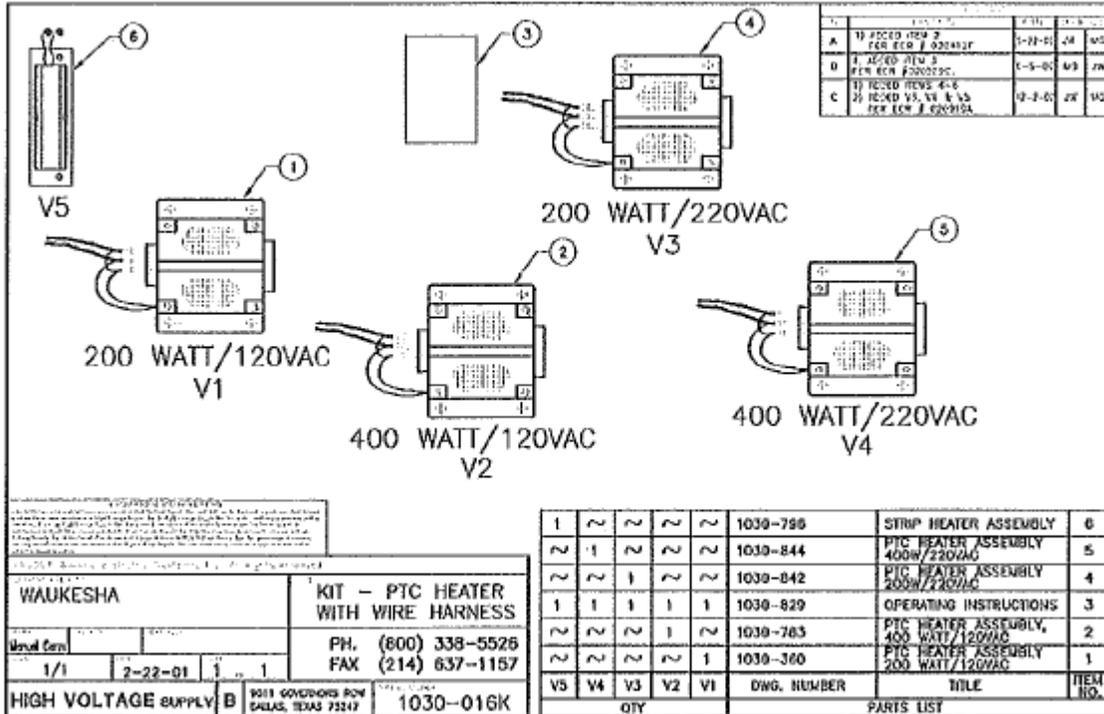
9011 Governors Row
 Dallas, TX 75247
800-338-5526

www.HighVoltageSupply.com

Positive Temperature Coefficient (PTC2) heaters are distributed by High Voltage Supply, a division of Waukesha Electric Systems, Inc.

To continually improve its products and services, Waukesha Electric Systems reserves the right to change specifications and features without notice. Please contact HVS for certified dimensions and drawings.

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 PTC2-0801 (Rev. 3/10)



ATTACHMENT A5 - 145kV CIRCUIT BREAKER DATA SHEET

All information on the technical data sheet is provided to establish Agreement requirements and guaranteed design values. All design values must be finalized during the design phase by mutual agreement of the City and Seller, in writing, prior to equipment manufacture.

ITEM	DESCRIPTION OF SPECIFICATION	UNITS	SPECIFIED RATING/DETAILS AND GUARANTEED PERFORMANCE VALUES
1.	PROJECT		SILICON VALLEY POWER 1. Breaker Replacement at the Northern Receiving Station
2.	LOCATION (NEAREST TOWN)		SANTA CLARA, CALIFORNIA
3.	ALTITUDE (ELEVATION ABOVE SEA LEVEL)		167.6 METERS (550-FEET)
4.	DESIGN AMBIENT TEMPERATURE AT LOCATION (<i>From Weatherbase</i>)		EXTREME HIGH: 42.8°C
			EXTREME LOW: -7.8°C
			HIGHEST AVERAGE WITHIN A 24-HOUR PERIOD: 17.1°C
5.	CONTAMINATION LEVELS		HIGH SALT LEVELS, HIGH HYDROGEN SULFIDE LEVELS
6.	CIRCUIT BREAKER ELECTRICAL PERFORMANCE RATINGS		
	Class		C2C0 (General Purpose Outdoors)
	Independent Pole Operation		No
	Motor Type		Stored Energy
	Number of Trip Coils		2
	Rated Power Frequency	HZ	60
	Nominal System Voltage	kV rms	115
	Maximum Continuous Voltage	kV rms	145
	Power Frequency Withstand Voltage (10-seconds Wet)	kV rms	275
	Power Frequency Withstand Voltage (1-minute Dry)	kV rms	275
	Full Wave Lightning Impulse Withstand Voltage (BIL)	kV Peak	650
	Chopped Wave Withstand Voltage (2-Microseconds)	kV Peak	838
	Maximum out of phase switching current	kA	20
Minimum Continuous Current Rating	A	4,000	

ATTACHMENT A5 - 145kV CIRCUIT BREAKER DATA SHEET

All information on the technical data sheet is provided to establish Agreement requirements and guaranteed design values. All design values must be finalized during the design phase by mutual agreement of the City and Seller, in writing, prior to equipment manufacture.

ITEM	DESCRIPTION OF SPECIFICATION	UNITS	SPECIFIED RATING/DETAILS AND GUARANTEED PERFORMANCE VALUES
	Short-Time Withstand Current (3 seconds duration)	kA sym	80
	Minimum Closing and Latching Current	kA	208
	Rated Interrupting Time	cycles	3
	Minimum Overhead Line Switching Current	A	50
	Minimum Capacitive Power Switching Current	A	50
	Peak Withstand Current	kA peak	208
	Maximum RIV @1 MHz	μV	2500
	DC Control Voltage	V DC	125
	AC Supply Power	V AC	120/208
	Charging Motor Primary Power Source	V DC	125

ITEM	DESCRIPTION OF SPECIFICATION	UNITS	SPECIFIED RATING/DETAILS AND GUARANTEED PERFORMANCE VALUES
7.	CIRCUIT BREAKER PHYSICAL PERFORMANCE RATINGS		
	Site elevation above 3300 feet above sea level		No
	Allowable Temperature Rise of bushing terminals (per IEEE C37.04)	°C	65
	Live Parts Material		Copper or Aluminum
	Pole Phase Spacing	inches	84
	Bushing Type		Porcelain
	Minimum creepage (leakage) distance of bushing weather sheds	inches	115
	Bushing color	ANSI 70	Lt. Gray

ITEM	DESCRIPTION OF SPECIFICATION	UNITS	SPECIFIED RATING/DETAILS AND GUARANTEED PERFORMANCE VALUES
	Height from base to energized bushing components	inches	102
	Minimum strike distance over bushing weather sheds	inches	41
	Maximum static horizontal transverse terminal load force (85% of test value as proscribed in IEEE C57.19.01-per IEEE C57.19.100)	Newtons	2635
	Height from base to bushing flange	inches	159.3
	Minimum height from base to bottom of pole control compartment	inches	39.9
	Minimum height from base to bottom of common control compartment	inches	39.9
	Maximum height from base to center of control/relay devices	inches	39.933
	Maximum height from base to center of control/relay devices	inches	~60
	ASME "U-Stamp" Required		Yes
	Bushing terminal type	NEMA	8-hole U-terminal, Aluminum terminal pad is acceptable if bushing conductor is aluminum, Threaded studs are required if bushing conductor is copper.
	Ground Terminal pads hole pattern	NEMA	2-hole, 2 pads positioned diagonally
	Terminal pads hole pattern and width	NEMA	U Shaped Terminal Pads

Bushing Current Transformers					
Device Numbers	Bushing	Position	Ampere Ratio	Accuracy	CT Curve
SVP will provide/specify device numbers once determined by EORs and agreed to by SVP.	1, 3, 5	X, Y and Z	4000:5 MR	C1200 with C800 @ 2000:5	3106N
	2, 4, 6	X, Y, and Z	4000:5 MR	C1200 with C800 @ 2000:5	3106N

Notes:

Position "X" is the bushing current transformer position closest to the bushing's line terminal

Position "Z" is directly below Position "X", and closest to the interrupting contacts

ITEM	DESCRIPTION OF SPECIFICATION	UNITS	SPECIFIED RATING/DETAILS AND GUARANTEED PERFORMANCE VALUES
8.	SEISMIC QUALIFICATION LEVEL		
	MINIMUM QUALIFICATION LEVEL		High, Zone 4
9.	ADDITIONAL REQUIREMENTS/CLARIFICATIONS		
	BREAKER CAN MEET THE SHORT CIRCUIT REQUIREMENT WITHOUT CAPACITORS		Yes
	BUSHING CONDUCTOR MATERIAL		Copper
	BUSHINGS ARE EQUIPPED WITH POWER FACTOR TESTING ELECTRODES		Yes
	POSITIVE TEMPERATURE COEFFICIENT (PTC) TYPE SPACE HEATER WILL BE PROVIDED		Yes
	A MANUAL TRIPPING DEVICE WILL BE PROVIDED		Yes
	PROVISION FOR A TRAVEL ANALYZER WILL BE INCLUDED		Yes
	DYNAMIC RATING MONITOR EQUIPMENT FOR SF6 AND BREAKER MONITORING IS INCLUDED		Yes

9a.	SHIPPING LOTS FOR 145 KV 4000A CIRCUIT BREAKER		
	NUMBER OF UNITS REQUIRED FOR THIS PROJECT (Delivery)	Lot	See Bid Pricing Form – Attachment D2
	CB DEVICE NUMBERS		TBD
ITEM	DESCRIPTION OF SPECIFICATION	UNITS	SPECIFIED RATING/DETAILS AND GUARANTEED PERFORMANCE VALUES
10.	MANUALS & TESTING PLAN DOCUMENTATION SCHEDULE		
	INSTRUCTION MANUALS		Seller will provide with design submittal package or sooner, see contract agreement for design submittal delivery date.
	FACTORY ACCEPTANCE TESTING PLAN AND PROCEDURES		Seller will provide with design submittal package or sooner, see contract agreement for design submittal delivery date.
11.	WARRANTY PERIOD		
	SPECIFIED PERIOD (MINIMUM)	YEARS	5 (AFTER INITIAL ENERGIZATION)
12.	COMMERCIAL		
	PROVIDE A PRELIMINARY OUTLINE DRAWING, INCLUDING OVERALL DIMENSIONS AND WEIGHTS, WITH PROPOSAL		Attached as Appendix D-1
	PROVIDE A PRELIMINARY NAMEPLATE DRAWING WITH PROPOSAL		Attached as Appendix D-2
	PROVIDE A QUALITY ASSURANCE (QA) PROCEDURES SUMMARY DOCUMENT WITH PROPOSAL		Seller will provide QA handbook/manual with design submittal package or sooner, see contract agreement for design submittal delivery date.

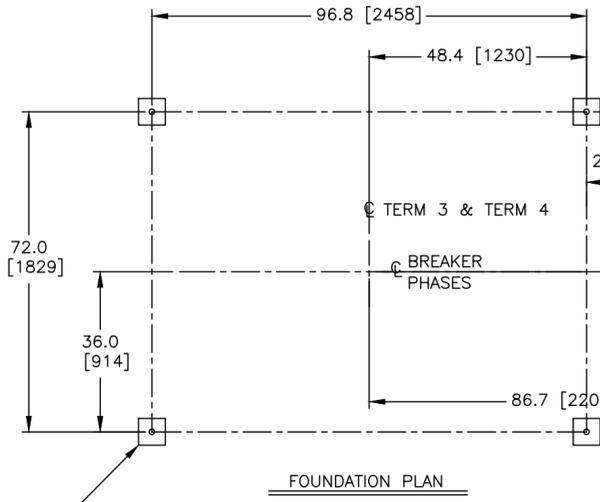
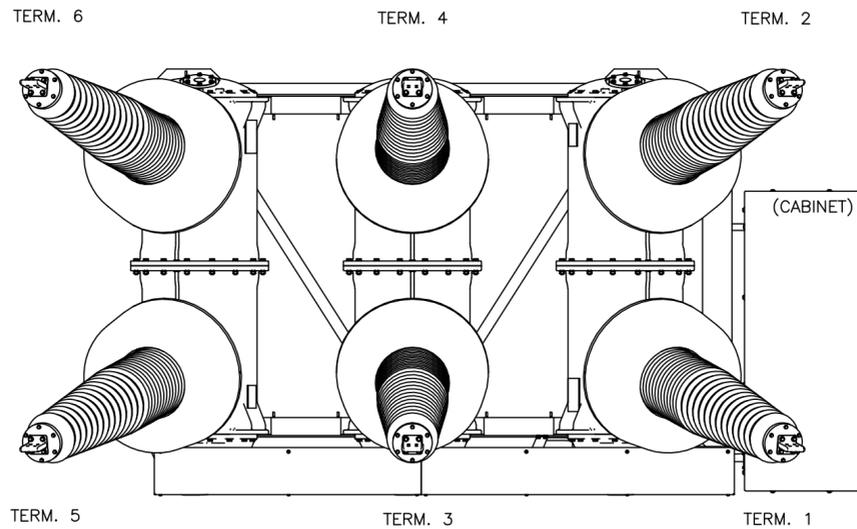
Site Locations and Directions

Project Name	Breaker Replacement at the Northern Receiving Station Project
State	CA
County	Santa Clara
Nearest City or Town	Santa Clara
Latitude (approximate substation location)	37.40215
Longitude (approximate substation location)	-121.96625
Project Site Physical Address	4952 Bill Walsh Way, Santa Clara, CA 95050

Owner Project Personnel

Owner Name:	Silicon Valley Power, City of Santa Clara
PRIMARY CONTACT:	Allie Jackman
Phone	(408) 615-6639
E-mail	ajackman@santaclaraca.gov

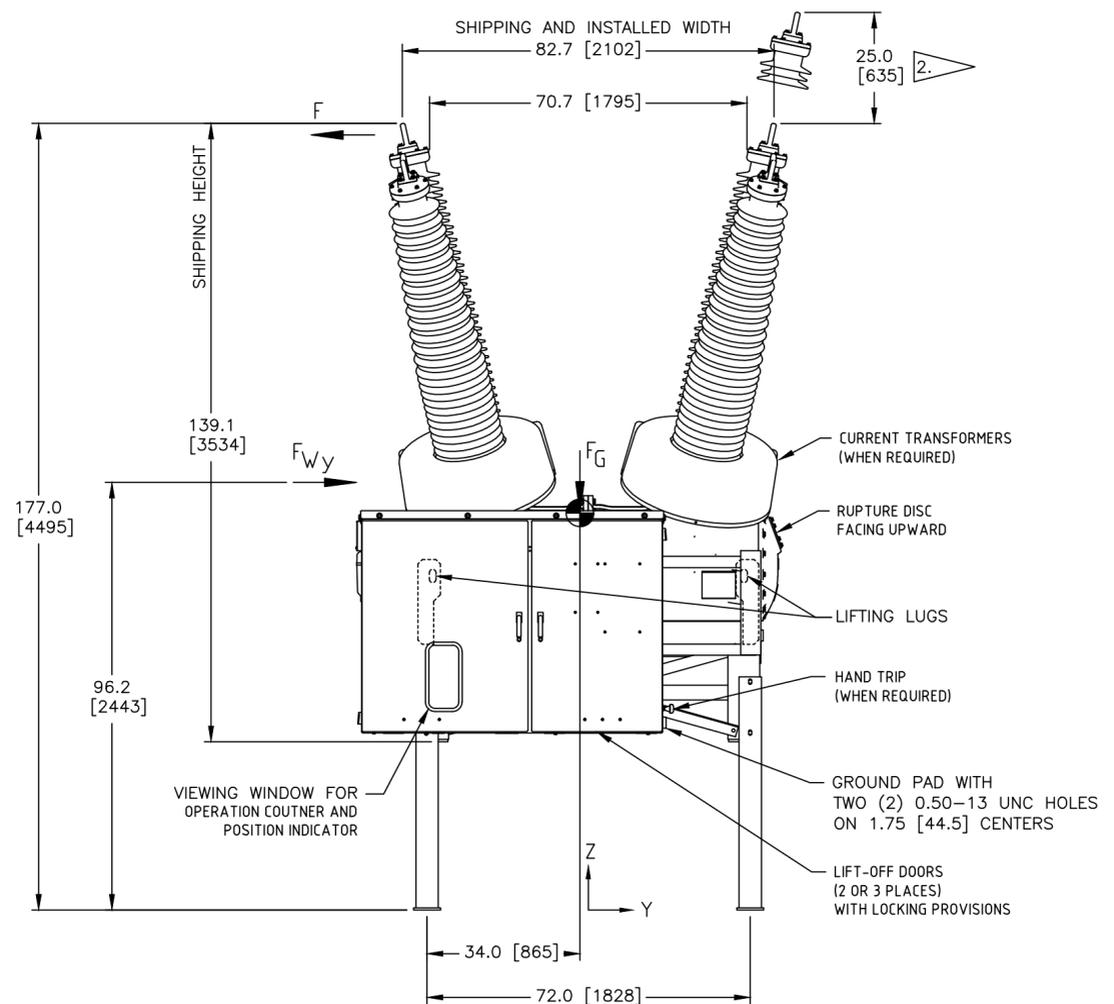
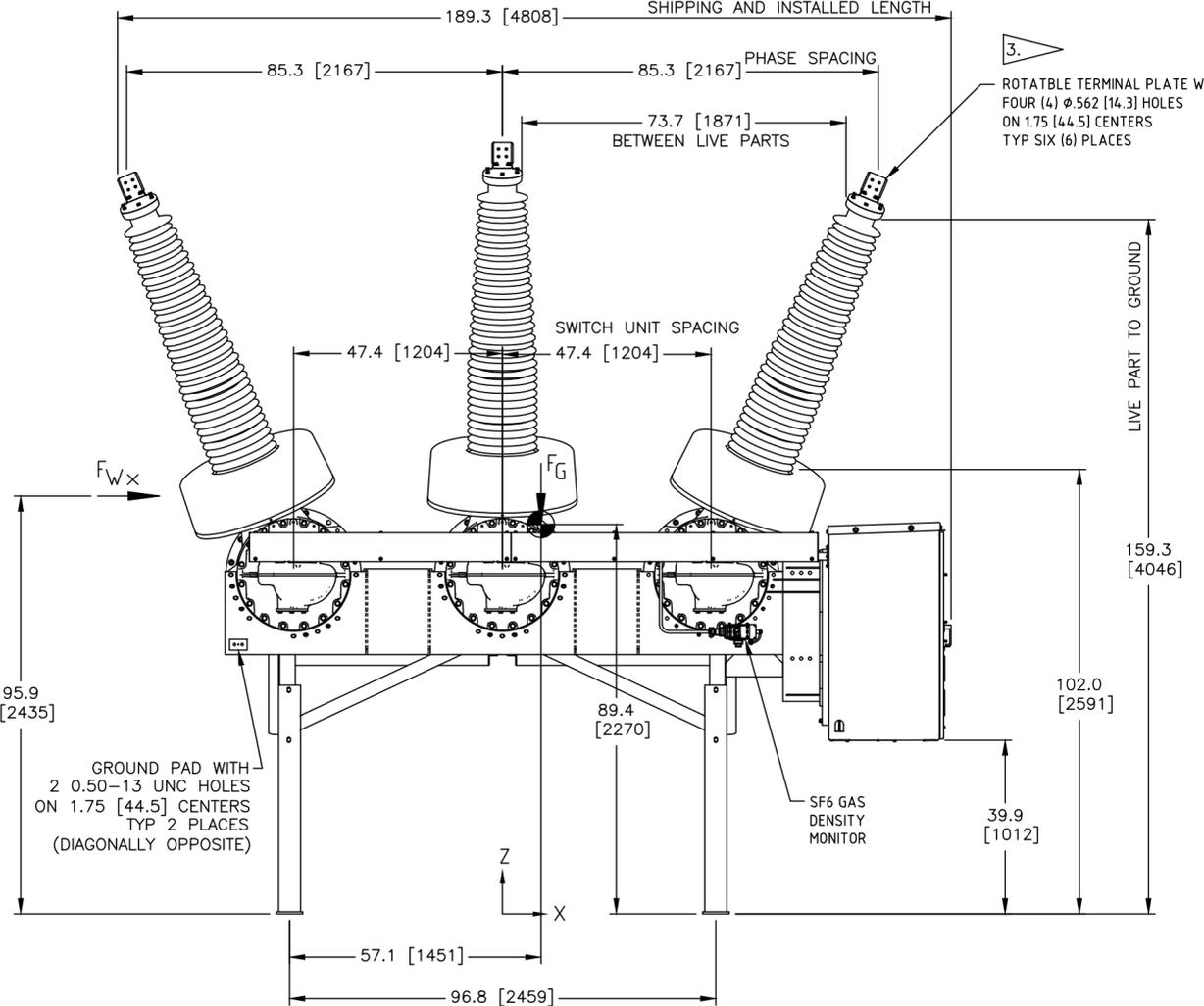
APPENDIX D-1



F _G	F _{WX}	F _{WY}	F _{STAT}	F _{STAT+DYN}
TOTAL WEIGHT LOADS	WIND LOADS, AT WIND SPEED OF 75 MPH [33 M/S]		TENSILE LOAD AT TERMINAL	
13,000 LBF [57.9 kN]	990 LBF [4.4 kN]	1,169 LBF [5.2 kN]	450 LBF [2 kN]	1,124 LBF [5 kN]

OPERATING LOADS PER LEG		
HORIZONTAL F _H		VERTICAL F _V
X-DIR	Y-DIR	
2,024 LBF [9 kN]	2,698 LBF [12kN]	±8,094 LBF [±36 kN]

BASE PLATE, 6.0 [152] SQ X .75 [19] THICK, WITH ϕ 1.50 [38] HOLE AT ITS CENTER FOR 1.25-8 UNC ANCHOR BOLT OF ASTM A36 OR HIGHER GRADE TYP 4 PLACES (ANCHOR BOLTS TO BE FURNISHED BY CUSTOMER).



- NOTES:
- METRIC DIMENSIONS [XX.X] IN MILLIMETERS.
 - CLEARANCE REQUIRED FOR INSULATOR REMOVAL.
 - ALUMINUM TERMINAL PLATES WITH HOLES ACCORDING TO NEMA.
 - APPROX. WEIGHTS: BREAKER COMPLETE.....13,000 LBS [5,896 KG]
SF6 GAS.....224 LBS [102 KG]

- WEIGHTS AND CENTER OF GRAVITY COMPUTED WITH STANDARD CREEP PORCELAIN INSULATORS AT 4.10 LBS [186 KG] EA.
- CENTER OF GRAVITY REPRESENTED BY

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
MACHINED SURFACE TEXTURE
- PLACE DECIMAL ± 0.00
- PLACE DECIMAL ± 0.01
- PLACE DECIMAL ± 0.01
INTERNAL DIA EXCLUDED
FOR TOL NOT SPECIFIED SEE 500 SERIES SHOP PRAC STD

72381331401

Property of **Siemens Energy, Inc.**

DWG NAME: **OUTLINE, SPS2-121-170kV 80kA**

SCALE: 1:25 WT R F SHEET 1 OF 2

ISSUE A

SIEMENS		
Sulfur Hexafluoride Circuit Breaker Type SPS2-145-80		
Rated Max. Volts 145 kV	Rated Voltage Range Factor 1.0 (K)	Rated Interrupting Time 3.0 Cycles
Rated Continuous Current A	Rated Short Circuit Current 80000 A	Rated Capacitance Current Switching Line Charging 200 A Isolated Bank Sw. 1200 A Back -to- Back Sw. 700 A Inrush Peak 25000 A Inrush Freq. 4250 Hz
Frequency 60 Hz	Rated Out of Phase Current 20000 A	
Wt. of Breaker With Gas Lbs	Full Wave Impulse Withstand CB Closed Terminal-Ground 750 kV CB Open Terminal-Terminal 750 kV	Rated Operating Duty Cycle OCO-15SEC-CO
Weight of SF6 Gas 224 Lbs	Serial #	
Rated Operating Pressure at 68° F/20° C 87 psig	PO #	
Minimum Operating Pressure at 68 F/20° C 72 psig	Short Time Current Duration 3 SEC	
SF6 Alarm Pressure at 68° F/20° C 75 psig	Close and Latch 215 kA	Parts List No.
SF6 Cutout Pressure at 68° F/20° C 72 psig	Rated Chopped Wave @ 2 microS 968 kV	Instruction Book PB-
% of DC Component 57 %	CB Warranty From Date of mfr. 5 Years	Date of Mfr.
Siemens Industry, Inc. Manufactured or Assembled of U.S. and Foreign Components		Jackson, MS 72-184-636-002

NOTES:

1. INST. BOOK-ENGRAVE PER S/O SEQUENCE NO. 00012.
2. SERIAL -S/O-ENGRAVE PER SALES ORDER INVOLVED.
3. DATE OF MFR-ENGRAVE MONTH/YEAR TO BE SHIPPED FOR ORDER INVOLVED.
4. ENGRAVE DASH NO. AFTER BRKR TYPE (EXAMPLE SPS2-362-63-1) SEE S/O SEQUENCE NO. 00015 FOR DASH NO.

	002	72-200-184-027	ALUMINUM	---	F-0	---
	MARK	MAKE FROM	MATERIAL	CODE	FINISH	RGH ---
UNLESS OTHERWISE SPECIFIED			Property of			
ALL DIMENSIONS ARE IN INCHES			Siemens Industry, Inc.			
1-PLACE DECIMAL ± .050		MACHINED SURFACE TEXTURE 1001	-Confidential-			
2-PLACE DECIMAL ± .020						
3-PLACE DECIMAL ± .005			NAMEPLATE			
INTERNAL DIA EXCLUDED						
FOR TOL NOT SPECIFIED SEE 500 SERIES SHOP PRAC STD		UNLESS OTHERWISE SPECIFIED	BREAKER, 145Kv-80Ka			
		SIMILAR TO 72184636001				
DRAWN	JHA	DATE	1-30-17	A	FSCM NO.	DWG NO.
CHECK	JHA	DATE	1-30-17		72184636002	ISSUE
APVD	LT	DATE	3-21-17		01	
ISSUE	SH	DATE	3-22-17	SCALE	NTS	WT R F
				SHEET	1	OF 1