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AGANA, GUAM

Specification No. E-039

Page 1 of 23
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

GUAM POWER AUTHORITY
P.O. Box 2977
Agana, Guam 96910

TRANSMISSION & DISTRIBUTION SPECIFICATION

Specification No. E-039
For

115 KV
AC POWER GAS CIRCUIT BREAKERS
OUTDOOR TYPE

Effective date: 01-27-09

Issued: *Joan G. Ar...*

Approved: *W. M. Machado*



GUAM
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Specification No. E-039

Page 2 of 23
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

115 KV AC POWER GAS CIRCUIT BREAKERS, OUTDOOR TYPE

	Table of Contents	Page
1.0	Scope.....	3
2.0	Conformance to Specification Requirements.....	3
	2.1 Applicable Standards.....	3
	2.2 Deviations and Non-Conformance Requirements.....	4
3.0	Data to Be Furnished.....	4
4.0	Design and Construction.....	6
	4.1 Construction.....	6
	4.2 Operating Mechanism.....	7
	4.3 Auxiliary Power Supply.....	9
	4.4 Auxiliary Power and Control Power Disconnects.....	9
	4.5 SF6 Gas System (As Applicable).....	9
	4.6 Arc Containment Chamber.....	10
	4.7 Dual Monitoring and Control System.....	10
	4.8 Space Heaters.....	10
	4.9 Current Transformers.....	11
	4.10 Line Terminals.....	11
	4.11 Accessories.....	12
	4.12 Bushings.....	12
	4.13 Porcelain Color and Paint.....	12
	4.14 Auxiliary Power and Control Circuits.....	12
	4.15 Assembly and Configuration.....	12
	4.16 Spare Parts.....	13
5.0	Tests.....	13
6.0	Quality Control.....	14
7.0	Packing and Shipping.....	14
8.0	Warranty.....	14
9.0	Specification and Data Sheets.....	15
10.0	115 kV Gas Circuit Breaker Bid Technical Form.....	19

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GUAM
POWER
AUTHORITY
AGANA, GUAM

Specification No. E-039

Page 3 of 25
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

115 KV AC POWER GAS CIRCUIT BREAKERS, OUTDOOR TYPE

1.0 SCOPE

- 1.1 This specification covers GPA's requirements for 115 kV outdoor type power circuit breakers and accessory equipment, furnished complete in ratings herein specified, inclusive of all accessories ready for immediate service.
- 1.2 The breaker is intended for use in tropical weather conditions with corrosive, sea air atmosphere, wind strengths of 175 mph, and subject to moderate to severe earthquakes.

2.0 CONFORMANCE TO SPECIFICATION REQUIREMENTS:

Breakers shall meet the requirements of the following standards and specifications, including latest revisions with respect to material, design, and tests.

2.1 Applicable Standards

American National Standards Institute, Inc. (ANSI)


C37 Series	AC High Voltage Power Circuit Breakers
C57.13-1978	Requirements for Instrument Transformers
C76.1-1976 and C76.2-1977	Requirements for Outdoor Apparatus Bushings

National Electrical Manufacturers Association (NEMA)

CC1-1977	Electric Power Connectors for Substations
SG4-1975	High Voltage Power Circuit Breakers

Effective date: 01-27-09

Issued: 

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GUAM
POWER
AUTHORITY
AGANA, GUAM

Specification No. E-039

Page 4 of 23
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

American Society for Testing and Materials (ASTM)

A153-78

Zinc coating on hardware

B117

Salt Spray Testing

2.2 DEVIATIONS AND NON-CONFORMANCE REQUIREMENTS:

- 2.2.1 Deviations from this specification or changes in the material or design after the purchase order has been placed must be approved by the Guam Power Authority's Engineering Department and acknowledged by a Purchase Order Amendment.
- 2.2.2 Units received with deviations or non-conformance, which are not acknowledged as specified in sub-paragraph 2.2.1, are subject to rejection. The supplier of units rejected in this paragraph is responsible for any corrective action including but not limited to materials, labor, and transportation necessary to dispose of, or make the units conform to the specification.
- 2.2.3 Notification of defective units discovered before or after installation that are believed to be inherent to manufacturing problems or workmanship shall be forwarded to the supplier. The description of the item, documentation of the problem and the desired information, disposition and/or follow-up (as appropriate) that GPA expects from the supplier will be specified. The supplier's response shall be made within thirty (30) days unless otherwise noted or an extension is acknowledged and approved in writing by the Guam Power Authority's Engineering Department.
- 2.2.4 Breaker approval drawings which are outlined on Section 3.1 to 3.4 must be submitted to the Engineering Department for GPA's approval prior to delivery.

3.0 DATA TO BE FURNISHED

- 3.1. Outline drawings showing location and dimensions of frames and tanks, control cabinet, bushings, terminal connectors, operating mechanism, conduit and ground connections. This shall be submitted on a per circuit breaker basis.

Effective date: 01-27-09

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GUAM
POWER
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AGANA, GUAM

Specification No. E-039

Page 5 of 23
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

- 3.2 Foundation diagram showing location of anchor bolts and information necessary for foundation design. This shall be submitted on a per circuit breaker basis.
- 3.3 Schematic and connection diagrams for supply and control circuits, showing the supply voltage and power required for operation. Wiring and schematic diagrams of control, current transformers, and heater circuits. This shall be submitted on a per circuit breaker basis.
- 3.4 Dimensional drawing of the bushing including complete dimensions of the bushing current transformers. This shall be submitted on a per circuit breaker basis.
- 3.5 Wiring and schematic diagrams shall be drawn in separate 11" x 17" paper with reproducible vellum. The right side of the paper at least $\frac{1}{4}$ of the total size shall be left blank for GPA's use. This shall be submitted on a per circuit breaker basis.
- 3.6 Six (6) complete sets of instruction books containing the following:
 - a. Instruction and data for ordering of all parts and accessories
 - b. Instructions covering installation, assembly, operation, maintenance, and adjustment of the operating mechanism and interrupting devices.
 - c. Copies of recommended spare parts lists.
 - d. Characteristic curves and data for bushing current transformers.
 - e. A list of maintenance tools being provided.
- 3.7 The breaker shall be provided with a permanent nameplate showing all of the information required including voltage, MVA, and current rating, BIL, weight, etc.

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GUAM
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AUTHORITY
AGANA, GUAM

Specification No. E-039

Page 6 of 23
Revision No. 0
Date: 01/27/09

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4.0 DESIGN AND CONSTRUCTION

4.1 Construction

- 4.1.1 Breakers shall be three-pole, frame or base mounted, and of oil-less type. For Gas Breakers, single pressure puffer type using SF6 gas as the insulation and arc quenching medium is required.
- 4.1.2 The circuit breaker design shall be dead-tank type with current transformers mounted on each side of the interrupters.
- 4.1.3 For SF6 breakers, the circuit breaker shall be capable of withstanding without damage or internal flashover 1.5 times nominal line-to-ground system voltage under one atmosphere of SF6 gas pressure. Under this condition, the circuit breaker is not required to open or close.
- 4.1.4 All steel frames shall be hot-dip galvanized, metalized, or painted with at least two coats of a zinc-rich primer.
- 4.1.5 The operating mechanism and necessary auxiliary and control devices shall be furnished in a stainless steel, weatherproof, dust resistant enclosure (control cabinet) mounted on the breaker frame. The breaker control cabinet shall provide the internal wiring for the breaker system and the interface between the Owner's control and power circuits to the breaker. The control cabinet shall allow sufficient space for termination of Owner-furnished control and power circuits.

Enclosure door handles shall include provisions for padlocking.

All control switches, push buttons, fuses, shorting type terminal blocks, and other devices requiring Owner interface shall be mounted at a height and location to be easily accessible. Such devices shall be located less than 5 feet but more than 2 feet above the top of foundation.

- 4.1.6 Each of the two grounding connections provided shall consist of a flat surface and bronze clamp-type connector attached with bronze bolts. The connectors shall be suitable for No. 4/O AWG stranded copper cable.

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GUAM
POWER
AUTHORITY
AGANA, GUAM

Specification No. E-039

Page 7 of 23
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

4.2 Operating Mechanism

- 4.2.1 The operating mechanism shall consist of either pneumatically-operated, hydraulically-operated, or a motor rewind spring-operated device.
- 4.2.2 The mechanism shall operate to open and close the three phases of the breaker simultaneously. The breaker shall be electrically trip-free and mechanically, pneumatically, or hydraulically trip-free if applicable and shall include anti-pump auxiliary relays and devices.
- 4.2.3 The operating mechanism shall include a mechanical position indicator. The indicator shall provide a positive indication of the breaker position by direct mechanical coupling to the operating rod. The indicator shall consist of a suitable sign utilizing green with the word "OPEN" when in the open position, and red with the word "CLOSED" when in the closed position.
- 4.2.4 The operating mechanism shall include dual, low energy type (below 10 amperes operating current) trip coils. The trip coils shall be electrically, mechanically, and magnetically independent. The trip coils shall be located such that heat or fire damage to one trip coil shall not preclude the proper operation of the other trip coil. The trip coils shall be suitable for parallel trip coil operation. Loss of dc voltage to one trip coil shall not impair the operation of the other trip coil or the breaker close mechanism. The trip coils shall be wired to individual terminals to allow independent activation and testing.
- 4.2.5 The pneumatic or hydraulic operating mechanism shall include a pressure gauge and pressure switch with two alarm contacts which close to alarm low air or oil/nitrogen gas pressure. A low-pressure cutout switch (with two alarm contacts) shall be provided to prevent initiating a close signal should the operating pressure be below the minimum required for a complete close-open operation. The low-pressure cutout device shall not prevent a complete close-open operation should pressure drop after the close-open operation is initiated.
- 4.2.6 The stored energy operating mechanism shall operate according to the duty cycle stated on the Specification and Data Sheets without auxiliary power available. Each operating mechanism shall store sufficient energy for

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GUAM
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AGANA, GUAM

Specification No. E-039

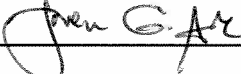
Page 8 of 23
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

three close-open operations without the need for running pumps or compressors. If this requirement cannot be met, the breaker shall include an automatic throw over scheme to alternately supply the mechanism motor from the Owner's dc station service system should normal auxiliary power be lost. In such case, the requirement for emergency dc control power shall be clearly stated in the Proposal Data section as well as the duty cycle available without auxiliary power.

- 4.2.7 The stored energy mechanism recharging time to full operating pressure or condition from a completely discharged condition shall not exceed 1 hour.
- 4.2.8 The operating mechanism housing and any adjacent cabinet shall have blank removable floor plate for conduit connections to permit entrance of control circuits.
- 4.2.9 Provision shall be made for locking the mechanism housing doors with a padlock.
- 4.2.10 Push-button controls, or a control switch, mounted in the mechanism housing shall be furnished to permit electrical opening and closing of the breaker locally.
- 4.2.11 At least four spare terminals shall be provided. Terminal blocks for remote connections, except for current transformer leads, shall be provided with disconnecting links.
- 4.2.12 Extra auxiliary contacts (minimum of 3 each Normally Closed and Normally Open) shall be provided for Owner's use in addition to those normally required for breaker operation. Switch contacts shall have a voltage rating not less than 125 Vac and a continuous current rating not less than 15 amperes. The spare auxiliary switch contacts shall be mechanically linked to the mechanism operating rod and shall be field adjustable as either "a" or "b" contacts.
- 4.2.13 One permissive control switch (69 device) shall be furnished. It shall be a two-position, manually operated switch that in one position permits the closing of the circuit breaker and in the other position prevents the circuit breaker from being operated. It shall be mechanically interlocked with a manual trip lever that is accessible from outside the control cabinet so that, if the breaker is tripped by this lever, the 69 device must be manually reset

Effective date: 01-27-09

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GUAM
POWER
AUTHORITY
AGANA, GUAM

Specification No. E-039

Page 9 of 23
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

before the breaker can again be operated. The manual trip device shall electrically trip all three poles, with the 69 device being moved to the lockout position. The manual trip lever shall be painted red, shall have a guard to prevent accidental activation, and shall have a plastic engraved label worded "Emergency Trip."

4.2.14 Each breaker close control scheme shall include a field adjustable 0.1 to 1 second time delay pickup close relay, factory preset to provide a 20 cycle automatic reclude time (including breaker close time) after energization of the close circuit.

4.2.15 The compressor or pump motor for pneumatic or hydraulic mechanism furnished with the breaker shall be 230 volt or 115 volt single phase 60 Hz. See Specification Data Sheets for specific bid requirements.

4.3 Auxiliary Power Supply

The Owner will furnish one auxiliary power supply to each circuit breaker at the voltage specified on the Specification and Data Sheets. If the Supplier chooses to furnish motors or other auxiliary equipment designed to operate at a different voltage from the specified auxiliary power supply, he shall furnish all equipment required to transform the voltage of auxiliary power to the design voltage of the equipment furnished. The Supplier shall provide suitable branch circuit protection.

4.4 Auxiliary Power and Control Power Disconnects

Two power supply disconnects and four knife switches per breaker shall be provided. The close circuit and auxiliary power supply shall be fed from individual disconnects. One knife switch shall be wired in series with each of the disconnects feeding the auxiliary power supply and close coil. The type of disconnect device (molded case circuit breaker or fuse blocks) shall be as indicated on the Specification Data Sheets.

4.5 SF6 Gas System (As Applicable)

4.5.1 Temperature compensated pressure switches or gas density switches shall be provided to monitor the SF6 gas density.

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GUAM
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AUTHORITY
AGANA, GUAM

Specification No. E-039

Page 10 of 25
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

4.5.2 A drop in SF6 gas density shall initiate a low SF6 gas density alarm. A further drop in density shall initiate a trip or block any further breaker operation as specified on the Specification and Data Sheets.

4.5.3 The breaker shall be furnished with sufficient SF6 gas to fill, test, and energize each breaker. The SF6 gas shall be free of moisture and impurities. SF6/nitrogen gas mixtures shall not be supplied.

4.5.4 The SF6 to air seals and gaskets shall prevent SF6 gas leakage in excess of 1 percent per year of gas weight, through the duration of the guarantee period. Corrosive arc products due to moisture infiltration shall be prevented to the maximum extent possible through the use of desiccant moisture absorbing chambers and an arc product filter.

4.6 Arc Containment Chamber

The arc containment chamber shall be designed to prevent mechanical failure and withstand pressure buildup if the breaker fails to interrupt full rated fault current. The use of a pressure relief device is acceptable and shall be so stated in the Proposal Data Section.

4.7 Dual Monitoring and Control System

The circuit breaker shall be furnished with dual alarm and control schemes which monitor the pneumatic or hydraulic operating system and the SF6 gas system (as applicable). The dual alarm and control schemes shall be mechanically and electrically independent with each alarm and control scheme wired into a separate trip coil circuit.

4.8 Space Heaters

4.8.1 Each enclosure furnished shall be provided with space heaters to prevent condensation of moisture within the enclosure. Space heater capacity shall be as required to maintain the enclosure internal temperature above the dew point. The heaters shall be spaced away and thermally insulated from any devices or painted surfaces.

4.8.2 Space heaters shall be sized to provide adequate heating when energized at the applied voltage indicated on the Specification Data Sheets. The

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GUAM
POWER
AUTHORITY
AGANA, GUAM

Specification No. E-039

Page 11 of 25
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

Supplier shall provide all space heater wiring integral to the breaker and suitable branch circuit protection.

4.8.3 Space heaters shall be controlled by an adjustable thermostat, factory set to close (ON) at 29° C (85° F) and open (OFF) at 35° C (95° F).

4.9 Current Transformers

4.9.1 Breaker shall be furnished with at least two multi-ratio relay-service CT's per phase as specified in the Specification Data Sheets. Current transformers shall be bushing type with fully distributed windings for relaying service. They shall be five lead multi-ratio type unless indicated otherwise on the Specification Data Sheets.

4.9.2 Each CT shall have a continuous current rating suitable for the breaker being furnished and shall be provided with polarity, secondary lead designations and diagrammatic nameplates.

4.9.3 Secondary and tap leads of each CT shall be brought out through conduits or ducts to suitable shorting type terminal blocks located in the circuit breaker control cabinet. Each set of secondary winding taps shall terminate on a 6-pole shorting block with the sixth pole permanently connected to the shorting bar and to ground.

4.10 Line Terminals

Breaker shall be provided with either pad or stud mount drilled in accordance with NEMA Standards. The terminal pad shall be of copper and shall be tinned for use with aluminum conductors.

4.11 Accessories

Breaker shall be equipped with the following accessories:

- a. Any special tools required for installation or maintenance. This shall include a tank lifter.
- b. An operation counter to record the number of breaker operations.
- c. A selector-switch for "local" or "remote" operation.

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GUAM
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AUTHORITY
AGANA, GUAM

Specification No. E-039

Page 12 of 23
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

4.12 Bushings

4.12.1 All bushings shall be rated in accordance with ANSI and NEMA standards and as specified on the Specification and Data Sheets. For SF6 gas breakers, all bushings shall be SF6 gas filled porcelain.

4.12.2 Any damage to porcelain, such as chips or cracks, shall result in the damaged item being replaced, not repaired.

4.13 Porcelain Color and Paint

4.13.1 All external porcelain shall be ANSI 255.1 No. 70 gray.

4.13.2 Except for electrical connection surfaces, all exterior circuit breaker metallic parts, including galvanized steel surfaces, support steel, raceway, etc., shall be painted. Breaker shall have finish paint color ANSI 45 or Berkshire green.

4.14 Auxiliary Power and Control Circuits

Breaker auxiliary power, control and alarm circuits shall be provided with terminal blocks for connection to external circuits. The terminal blocks shall have circuit identification and shall be located in the control cabinet to provide external circuit connections from a common raceway entrance.

4.15 Assembly and Configuration

4.16.1 The circuit breakers shall be factory assembled into integral shipping sections as complete as possible to minimize assembly requirements at the site. A structural steel frame, common to all breaker components shall be furnished. The frame furnished shall maintain a 9'-0" minimum height from bottom of porcelain to top of foundation.

4.16.2 The assembly shall be complete including bushings, if shipping clearances will permit. Anchor bolts, nuts, and washers for the circuit breaker shall be provided and shall be ASTM A36/A36M threaded bars or ASTM A307 Grade B, heavy hexagon nuts conforming to ASTM A563 Grade A; flat or beveled washers.

Effective date: 01-27-09

Issued:

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GUAM
POWER
AUTHORITY
AGANA, GUAM

Specification No. E-039

Page 13 of 23
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

4.17 Spare Parts

4.17.1 The Proposal shall include a list of spare parts included in the lump sum prices for each circuit breaker and an itemized list of spare parts that are recommended, but not included for each circuit breaker. The second list shall indicate the quantity recommended per circuit breaker, and the unit price each.

4.17.2 For SF6 gas breakers: one complete set of spare gaskets, O-rings, Dow Corning 111 (grease) and molecular sieve filters shall be furnished. The set shall contain all gaskets, O-rings, Dow Corning 111 and molecular sieve filters needed for one complete breaker including operating mechanism seals and SF6 gas-to-air seals.

4.17.3 For SF6 gas breakers: one gas tank full of SF6 gas, hoses, fittings and filter dryer shall also be furnished. Provide one Leak-Tec leak tester for every five breakers purchased.

5.0 TESTS

5.1 Certified test reports shall be conducted in accordance with ANSI C37.09.

5.2 The Supplier shall furnish two (2) certified copies of test reports of all the tests covered to the GPA Manager of Engineering within two weeks of breaker delivery.

5.3 Owner witness testing of breakers shall be required and included in the bid for order quantities of 4 or more power circuit breakers. Per diem rates will be provided by GPA at the time of the prebid.

5.4 Copies of the test reports shall be included in the instruction manuals for the breaker. Test reports for each circuit breaker shall be submitted and identified by serial number.

6.0 QUALITY CONTROL

The Supplier shall have a quality control program to assure compliance with the requirements of this specification. The program shall be documented and available for

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AGANA, GUAM

Specification No. E-039

Page 14 of 23
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

GPA's review if requested. Documentation of the quality control program shall indicate where in the products and manufacturing process the quality checks are taken, describe the purpose of the checks and describe the nature of the check (e.g. if check is visual only or if electrical or mechanical testing is used).

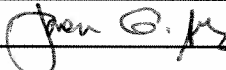
7.0 PACKING AND SHIPPING

- 7.1 The breaker shall be placed and crated with suitable material to prevent damage and injury during shipment and handling operations. Breaker shall be securely blocked to prevent shifting during transit.
- 7.2 Circuit breaker components shall be clean, dry, and sealed when shipped from the factory. Each component not shipped with SF6 gas shall contain a packaged moisture absorbing chemical as required to keep it moisture free during shipment. Tanks, interrupters, support insulators, or other SF6 containers which are found to contain moisture when received at the jobsite shall be dried, and moisture damage shall be repaired at the Supplier's expense.
- 7.3 Complete instructions outlining the Supplier's recommended procedures for inspection upon receipt at the construction site, moisture free maintenance during storage, and preparation for SF6 filling shall accompany each breaker. These instructions shall be shipped inside the breaker control cabinet.

8.0 WARRANTY

The Supplier shall provide a warranty of at least one year for all parts and workmanship. The Supplier shall warrant that all equipment is free from defects.

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GUAM
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AGANA, GUAM

Specification No. E-039

Page 15 of 23
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

9.0 SPECIFICATION DATA SHEETS

High voltage SF6 circuit breakers shall comply with the Technical Specifications and shall be furnished in accordance with the following requirements:

LOCATION AND QUANTITY

Each circuit breaker shall be designed and constructed for operation on a 3-phase, 60 hertz, solidly grounded system, at an ambient temperature range from +40° C to -30° C at an altitude below 3,300 feet.

Description and Use	Rated Continuous Current (Amps)	Quantity
115 kV Gas Circuit Breaker, (General)	1200	As required
115 kV Gas Circuit Breaker, Bus Tie	2000	As required

RATINGS

Description	Rating
Nominal Voltage	115 kV
Maximum Voltage	121 kV rms
Voltage Range Factor, K	1.0
Full Wave Impulse Withstand Voltage	550 kV peak
Continuous Current	As required from above:
Interrupting Current Rating (Symmetrical)	40 kA
Short-time Current Carrying Capability (3 seconds)	40 kA
Close and Latch Current Capability	64 kA
Interrupting Time	3 cycles
Rated Closing Time	0.1 seconds

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GUAM
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AUTHORITY
AGANA, GUAM

Specification No. E-039

Page 16 of 23
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

Description	Rating/Scheme
Operator motor voltage	120 Vac
Control Voltage	125 Vdc
Breaker Closing	125 Vdc
Breaker Tripping	125 Vdc
Housing Heaters Voltage	120 Vac
Auxiliary Power	120/240 Vac, 60 hertz, 1-phase
Tripping Logic for low SF6 gas operating pressure	Block Trip and Close
Bushing BIL	500 kV
Bushing Ampere Capability	Match Line Breaker Rating
Bushing Creepage Distance	1 inch/kV
Control Power Disconnects	Fuse Blocks
Seismic Risk	Zone 4
Out-of-Phase Switching Capability	180°

Current Transformer Data

Type	Breaker Rating (A)	Ampere Ratio (A)	Quantity		Accuracy Relaying Class	Thermal Rating
			Per Bushing	Total		
Breaker (General)	1200	1200/5 MR	2	12	C800	1.5
Bus Tie (General) Or Line (Piti/Agana/Harmon/Tam)	2000	2000/5 MR	2	12	C800	1.5

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GUAM
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AUTHORITY
AGANA, GUAM

Specification No. E-039

Page 17 of 25
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

ACCESSORIES

Standard accessories shall be provided with each breaker. Accessories shall include, but not necessarily limited to, the following as indicated.

Description
An auxiliary switch with 16 "a" and 16 "b" contacts in addition to those required for control of breaker mechanism. All contacts shall be wired to terminal blocks. Contact surfaces shall be silver-plated. Contacts shall be rated to break 6 amperes at 135 volts dc.
Four spare contacts from each Breaker 52X close relay, if relay is necessary for type of breaker supplied.
Cutoff and latch checking switches.
One local-remote control switch wired for local-remote operation and annunciation.
One trip-close push button station wired for local breaker test operation. One push button for each trip coil.
Pressure switch for annunciation of low operating pressure if pneumatically or hydraulically operated breaker is furnished.
One maintenance closing and opening device shall be furnished for use with all breakers at each substation site.
Position indicator visible from the outside of the control cabinet.
Loss of voltage alarm relay on each auxiliary power and control power feed to the breaker, one for the auxiliary power, one for close control power, and one for each of the trip coil circuits.
Operation counter to count trip operations.
One elapsed time meter for the stored energy mechanism motor.
120 volt ac lamp with door operated switch in the control cabinet.
Nameplates to identify switches, relays, and other auxiliary devices.
One 120 volt, single-phase receptacle, Hubbell Cat. No. 5251, and one 240 volt, 60 ampere, single-phase receptacle, NEMA Type 14-60R, shall be installed in each control and mechanism cabinet, and shall be accessible from outside the cabinet.

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GUAM
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AUTHORITY
AGANA, GUAM

Specification No. E-039

Page 18 of 25
Revision No. 0
Date: 01/27/09

PREPARED BY ENGINEERING DEPARTMENT

A suitable nameplate showing all ratios, accuracy classes, and thermal ratings of the current transformers shall be mounted inside the control cabinet.

One SF6 gas sampling valve for use in moisture testing.

SF6 gas system pressure gauge.

Density switch for annunciation of low SF6 gas density.

Density switch with 3 independent contacts for annunciation of low SF6 gas density cutoff.

Bushing terminals, NEMA 4 hole spade type, tinned bronze or silver plated aluminum, both sides of terminal suitable for electrical connections.

Two NEMA 2 hole grounding pads with tinned bronze, bolted type terminals for attachment to the Owner's 4/0 AWG stranded copper ground cables. The grounding pads shall be on diagonally opposite locations on the frame.

Interposing relays for remote trip and close of breaker if inrush current of trip and close coils is greater than 0.5 amps dc.

RECOMMENDED MANUFACTURERS

- A. Siemens
- B. Alstom
- C. Areva/AEG

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Specification No. E-039

Page 19 of 25
Revision No. 0
Date: 01/27/09

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10.0 115 KV GAS CIRCUIT BREAKER BID TECHNICAL FORM

Description	Rating
Manufacturer	
Catalog No. and Type	
Nominal Voltage	
Maximum Voltage	
Voltage Range Factor, K	
Full Wave Impulse Withstand Voltage	
Continuous Current	
Interrupting Current Rating (Symmetrical)	
Short-time Current Carrying Capability (3 seconds)	
Close and Latch Current Capability	
Interrupting Time	
Description	
Rated Closing Time	
Operator motor voltage	
Control Voltage	
Breaker Closing	
Breaker Tripping	
Housing Heaters Voltage	
Auxiliary Power	
Tripping Logic for low SF6 gas operating pressure	
Bushing BIL	

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Specification No. E-039

Page 20 of 25
Revision No. 0
Date: 01/27/09

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Description	Rating
Bushing Ampere Capability	
Bushing Creepage Distance	
Control Power Disconnects	
Seismic Risk	
Out-of-Phase Switching Capability	

Current Transformer Data

Breaker Usage	Breaker Rating (A)	Ampere Ratio (A)	Quantity		Accuracy Relaying Class	Thermal Rating
			Per Bushing	Total		
Line Breaker (General)	1200	1200/5 MR				
Bus Tie (General)	2000	2000/5 MR				

SF6 Gas System

Description	Rating
Normal SF6 gas operating pressure, psig	
Minimum SF6 gas operating pressure for full interrupting capability, psig	
Minimum SF6 gas operating pressure for load current interrupting capability, psig	

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Specification No. E-039

Page 21 of 25
Revision No. 0
Date: 01/27/09

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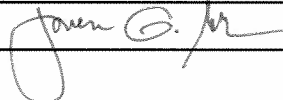
Operating Mechanism

Description	Rating
Type	
Rated Duty Cycle	
Number of close-open operations that can be performed starting with a fully charged operating mechanism with no auxiliary electric power available	
If spring charged mechanisms are proposed, dc power requirement to recharge mechanism at dc voltage specified, amperes	
Time required to fully recharge operating mechanism to normal operating pressure or condition	
After one close-operation	
From zero operating pressure	
After one close-open operation and loss of auxiliary power (spring charged only)	
Maximum line to ground voltage breaker can withstand with one atmosphere SF6 gas pressure, kV	

Dimensions

Description	Response
Length	
Width	
Height	
Distance between lowest live part and top of foundation	
Total weight of circuit breaker with SF6 gas, lbs.	
Weight of largest piece for handling during erection, lbs.	

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Specification No. E-039

Page 22 of 25
Revision No. 0
Date: 01/27/09

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Description	Response
Maximum noise level during operation at 100 feet, dBA	
Will circuit breakers be fully assembled at factory for production tests?	
Will circuit breakers be shipped completely assembled except for filling with SF6 gas?	
If not shipped completely assembled, describe required field assembly.	
Method of shipment	
Maintenance interval (number of close-open operations) as defined by ANSI C37.06-1987 Table 8	

Spare Parts

List of spare parts and maintenance tools furnished with each circuit breaker, and included in the Proposal Price	
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Specification No. E-039

Page 23 of 25
Revision No. 0
Date: 01/27/09

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Accessories:

Description	Included
An auxiliary switch with 16 "a" and 16 "b" contacts in addition to those required for control of breaker mechanism. All contacts shall be wired to terminal blocks. Contact surfaces shall be silver-plated. Contacts shall be rated to break 6 amperes at 135 volts dc.	<input type="checkbox"/>
Four spare contacts from each Breaker 52X close relay, if relay is necessary for type of breaker supplied.	<input type="checkbox"/>
Cutoff and latch checking switches.	<input type="checkbox"/>
One local-remote control switch wired for local-remote operation and annunciation.	<input type="checkbox"/>
One trip-close push button station wired for local breaker test operation. One push button for each trip coil.	<input type="checkbox"/>
Pressure switch for annunciation of low operating pressure if pneumatically or hydraulically operated breaker is furnished.	<input type="checkbox"/>
One maintenance closing and opening device shall be furnished for use with all breakers at each substation site.	<input type="checkbox"/>
Position indicator visible from the outside of the control cabinet.	<input type="checkbox"/>
Loss of voltage alarm relay on each auxiliary power and control power feed to the breaker, one for the auxiliary power, one for close control power, and one for each of the trip coil circuits.	<input type="checkbox"/>
Operation counter to count trip operations.	<input type="checkbox"/>
One elapsed time meter for the stored energy mechanism motor.	<input type="checkbox"/>
120 volt ac lamp with door operated switch in the control cabinet.	<input type="checkbox"/>
Nameplates to identify switches, relays, and other auxiliary devices.	<input type="checkbox"/>
One 120 volt, single-phase receptacle, Hubbell Cat. No. 5251, and one 240 volt, 60 ampere, single-phase receptacle, NEMA Type 14-60R, shall be installed in each control and mechanism cabinet, and shall be accessible from outside the cabinet.	<input type="checkbox"/>
A suitable nameplate showing all ratios, accuracy classes, and thermal ratings of the current transformers shall be mounted inside the control cabinet.	<input type="checkbox"/>

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Specification No. E-039

Page 24 of 25
Revision No. 0
Date: 01/27/09

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Description	Included
One SF6 gas sampling valve for use in moisture testing.	<input type="checkbox"/>
SF6 gas system pressure gauge.	<input type="checkbox"/>
Density switch for annunciation of low SF6 gas density.	<input type="checkbox"/>
Density switch with 3 independent contacts for annunciation of low SF6 gas density cutoff.	<input type="checkbox"/>
Bushing terminals, NEMA 4 hole spade type, tinned bronze or silver plated aluminum, both sides of terminal suitable for electrical connections.	<input type="checkbox"/>
Two NEMA 2 hole grounding pads with tinned bronze, bolted type terminals for attachment to the Owner's 4/0 AWG stranded copper ground cables. The grounding pads shall be on diagonally opposite locations on the frame.	<input type="checkbox"/>
Interposing relays for remote trip and close of breaker if inrush current of trip and close coils is greater than 0.5 amps dc.	<input type="checkbox"/>

Miscellaneous

Description	Response
Allowable forces on bushing terminals, lbs:	
Horizontal (in-line)	
Horizontal (lateral)	
Vertical	
Foundation loading, lbs:	
Downward load (sum of breaker weight plus impact)	
Uplift load	
Is pressure relief device necessary? If yes, state the pressure at which the device will operate.	

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Specification No. E-039

Page 25 of 25
Revision No. 0
Date: 01/27/09

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Witness Testing for Order Quantities of 4 or More

Testing schedule, and included in the
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