

# GENERAL FEATURES

Since 1905, G&W has provided custom power solutions to utilities and electric power users around the world. G&W has a wide selection of reliable, quality switching and fault interrupting products to meet the most stringent customer requirements. Whether the application involves load switching, line sectionalizing, fault interruption or Smart Grid automation, G&W can provide a solution for distribution system switching and protection. When specifying switchgear, consider these features:

## MAXIMUM OPERATOR SAFETY

SF<sub>6</sub> gas is a nontoxic, nonflammable switching dielectric. Dead front switch construction eliminates any exposed live parts. Spring-assisted mechanisms assure quick-make, quick-break operation. Viewing windows permit visual verification of open or closed contacts. Tamper-resistant enclosures utilize pentahead bolts and padlocking provisions. Motor actuators are available permitting remote operation. The result is maximum operator safety.

## MINIMAL MAINTENANCE

G&W SF<sub>6</sub> switches are corrosion-resistant, totally sealed and factory filled. No more field adjustments of critical contact areas or concerns with environmental contamination or intrusions. A periodic check of the pressure gauge is all that is required.

## APPLICATION VERSATILITY

**Multi-way Configurations** — Switches are available for either two-position or three-position (incorporating an integral ground, tie or test position) switching. Single or multiple sources can feed multiple loads. Bus tie configurations are available permitting multiple sources to feed different loads within the same switch.

**Mounting Flexibility** — Horizontal and vertical configurations are available with operating apparatus accessible from the front, top or side compartments.

**Bushing Variety** — Many bushing styles are available including an exclusive disconnectable style permitting field changeout. Cable entry can be bottom, front, back or side. Transformer throat designs are available.

**Visible Break** — Load break switches can incorporate a visible break of all three phases.

**Overcurrent Protection** — Fusing or electronically controlled, resettable vacuum interrupters are available.

**Smart Grid / Lazer Solutions** — Complete SCADA distribution automation and Smart Grid solutions are available including automatic transfer. G&W's Lazer distribution automation systems provide pre-engineered, time-proven solutions for automatic power restoration.



# TWO POSITION LOAD BREAK SWITCHES

## TWO POSITION LOAD BREAK, RECTANGULAR TANK STYLE, RAM SERIES

Available in 20kA (Rotary Puffer) and 40kA (Linear Puffer) designs.

**RAM** styles incorporate in-line bushing arrangements with a 5" phase spacing. Bushings can be top, bottom, front or side mounted.

**SRAM** styles provide the most compact construction due to diagonal bushing arrangements with a 6-1/2" phase spacing. These models can accommodate bushing mounted fuses

### Rotary Puffer (RP) ratings

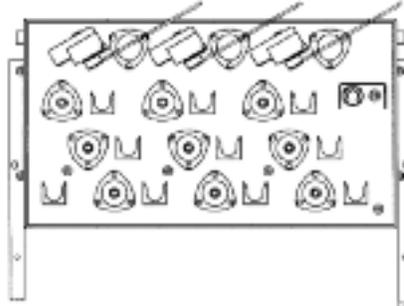
Maximum design voltage,	
kV .....	15.5 .....25
Voltage class,	
kV .....	15 .....25
Impulse level (BIL)	
kV .....	110 .....125
One minute withstand,	
AC kV .....	35 .....60
One minute withstand,	
Production test rating	
AC kV .....	34 .....40
15 minute withstand,	
DC kV .....	53 .....78
Continuous and load break current,	
Amps .....	630 .....630
Momentary current,	
kA asym.....	25.6 .....20
Fault-close current, (3 times)	
kA asym.....	25.6 .....20
One second current,	
kA sym.....	16 .....12.5
Operations load interrupting	
endurance	
at 600A .....	500 .....350
Mechanical endurance,	
operations .....	2000 .....2000

### Linear Puffer (PI) ratings

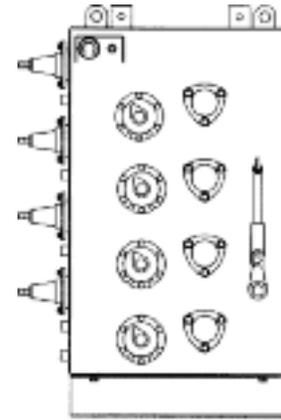
Maximum design voltage,	
kV .....	15.5 .....27 .....38
Voltage class,	
kV .....	15 .....25 .....35
Impulse level (BIL),	
kV .....	110 .....125 .....150
One minute withstand,	
AC kV .....	35 .....60 .....70

### Variety of styles available.

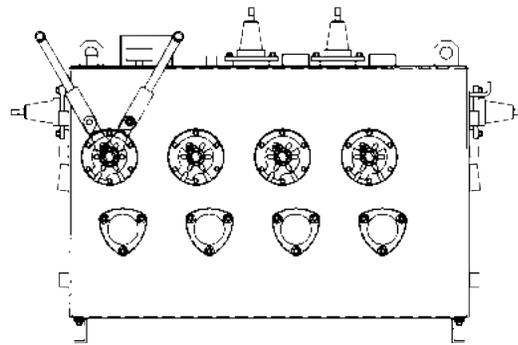
*Bushings can be front, top, bottom or side mounted.*



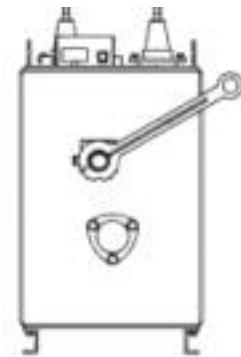
*RAM 33 with front mounted bushings and operators.*



*Vertical mount VRAM44 with side mounted bushings and front operators.*



*RAM44 with top mounted bushings and operators.*



*RAM21 with top mounted bushings and front operator.*

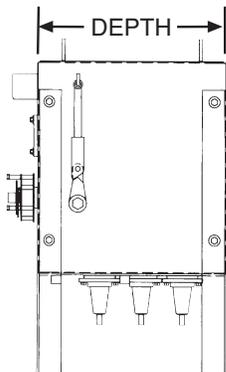
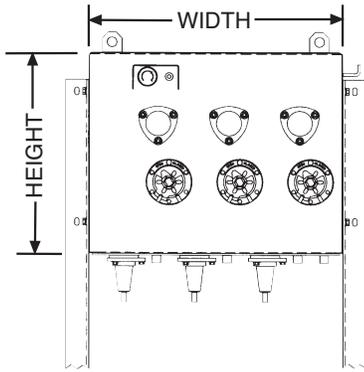
One minute withstand,	
Production test rating	
AC kV .....	34 .....40 .....50
15 minute withstand,	
DC kV .....	53 .....78 .....103
Continuous and load break current,	
Amps* .....	630 .....630 .....630
Momentary current,	
kA asym .....	40 .....40 .....40
Fault-close current, (3 times)	
kA asym .....	40 .....40 .....40
One second current,	
kA sym .....	25 .....25 .....25
Open gap withstand,	
kV .....	200 .....200 .....200

10 operation overload interrupting	
capability,	
A .....	3000 .....3000 ..3000
Operations load interrupting	
at 600A .....	1200 .....1200 ..1200
Mechanical endurance,	
operations.....	2000 .....2000 ..2000

*\*900A available*

# TWO POSITION LOAD BREAK SWITCHES

## TWO POSITION LOAD BREAK, RECTANGULAR TANK STYLE RAM SERIES CONTINUED



RAM catalog numbers with bottom bushings shown.

For typical specifications, go to [www.gwelec.com](http://www.gwelec.com). For contact principles, see pages 32 and 33.

One-line Diagram (Horizontal)	Voltage Class (kV)	Mom. (kA) asym.	Catalog Number	Approximate	
				Width in. (mm)*	Wt. w/ SF <sub>6</sub> lbs (kgs)

### RAM SERIES (TYPICAL CONFIGURATIONS)

	15	40	RAM21-376M-40P	18(458)	300 (136)
	25	40	RAM21-386M-40PI	18 (458)	300 (136)
	35	40	RAM21-396M-40PI	18 (458)	300 (136)
	15	40	RAM33-376M-40PI	33 (838)	725 (330)
	25	40	RAM33-386M-40PI	33 (838)	725 (330)
	35	40	RAM33-396M-40PI	33 (838)	725 (330)
	15	40	RAM44-376M-40PI	42 (1067)	875 (398)
	25	40	RAM44-386M-40PI	42 (1067)	875 (398)
	35	40	RAM44-396M-40PI	42 (1067)	875 (398)
	15	40	RAM55-376M-40PI	51 (1295)	1025 (466)
	25	40	RAM55-386M-40PI	51 (1295)	1025 (466)
	35	40	RAM55-396M-40PI	51 (1295)	1025 (466)
	15	40	RAM66-376M-40PI	60 (1524)	1175 (534)
	25	40	RAM66-386M-40PI	60 (1524)	1175 (534)
	35	40	RAM66-396M-40PI	60 (1524)	1175 (534)
	15	40	RAM45-376M-40PI-BT	51 (1295)	1025 (466)
	25	40	RAM45-386M-40PI-BT	51 (1295)	1025 (466)
	35	40	RAM45-396M-40PI-BT	51 (1295)	1025 (466)

\* For PI, RAM designs: depth = 30" (762), height = 26" (660mm).

# CONTACT PRINCIPLES

## TWO POSITION, LINEAR PUFFER STYLE

G&W's patented Linear Puffer (LP) style, two-position switches are ideal for heavy duty manual load break switching, automatic transfer or automated sectionalizing applications rated through 35kV, 900A continuous and 40kA asymmetrical short circuit. Switches are tested to 1200 loadbreak and 2000 mechanical operations. Current limiting fuses or electronically controlled vacuum interrupters can be added for overcurrent protection. G&W's LP style contact system provides extremely efficient, high speed arc extinction for maximum service life.

### Stored Energy Mechanism

Linear puffer switches can be supplied with internal stored energy (cock and trip) mechanisms for both the open and close operators permitting high speed local or remote operation. A separate external trip handle is provided. An optional internal solenoid permits remote operation.

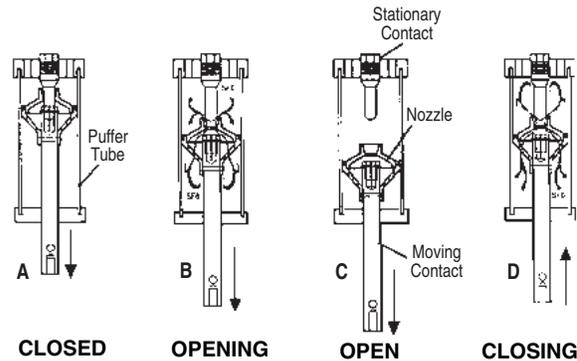


▲ Three phase visible position of contacts.



▲ Three phase linear puffer mechanism.

## TWO POSITION, LINEAR PUFFER CONTACT PRINCIPLE



**A.** The stationary contact and piston assembly (containing the moving contact and nozzle) are housed in clear cylindrical tubes. These are mounted in a modular three-phase assembly which is independent of the switch tank. The stationary contacts are supported independent of the cable entrance bushings, eliminating possible misalignment resulting from tank deflections. Tank deflections are caused by normal tank pressure variance due to ambient temperature fluctuations. This construction eliminates contact alignment difficulties caused by deflections of the switch tank walls. The modular construction also allows testing of the module during assembly and complete flexibility in switch design and configuration. The nozzle which directs the flow of SF<sub>6</sub> has a converging/diverging geometry (see photo) which improves the arc interruption capability over designs using straight throated nozzles. The converging portion of the nozzle has a constantly decreasing flow area up to the nozzle throat minimizing velocity changes in the flow of SF<sub>6</sub> gas, while improving arc interruption and dielectric recovery.

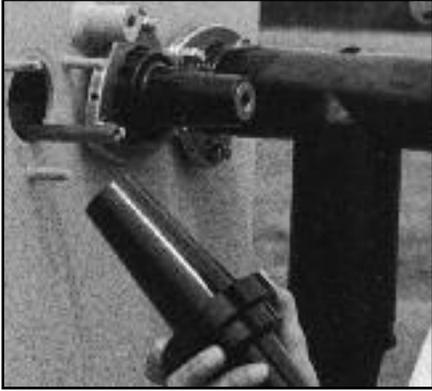


**B.** As the contacts separate, the SF<sub>6</sub> is compressed by the piston assembly and directed into the arc zone by the nozzle. The compressed SF<sub>6</sub> flows (is puffed) across the contacts and around the arc established by the separating puffed contacts. The cooling action of the gas is increased by the higher pressure (due to compression) and the flow which constantly provides a supply of cool SF<sub>6</sub> into the arc zone.

**C.** At current zero the temperature of the arc is reduced to the point of deionization, ceasing the flow of current. The SF<sub>6</sub> rapidly recovers dielectric strength withstanding the system recovery voltage across the contacts.

**D.** As the contacts are closing, the piston assembly compresses the SF<sub>6</sub> between the contacts. This increases the dielectric strength of the gap, minimizing prestrike. The contacts are designed using a tulip bayonet construction (see photo). The sliding action of the contacts on engagement provides a self cleaning action of the main current carrying surfaces. The contact fingers are designed for increasing contact pressure with increasing current for proper operation during momentary or close-into-fault conditions. The contacts have arc resistant copper tungsten tips to minimize erosion of material during load switching and prevent damage to the main current transfer area of the contacts.

# ACCESSORIES AND OPTIONS



## 3-1/C, 600A QUIK-CHANGE APPARATUS BUSHINGS

Cable entrance bushings can be damaged at any time due to improper handling, accidental shifting during shipment, elbow failure or even normal wear and tear. In the case of SF<sub>6</sub> gas insulated switches where the tank is totally welded, conventional bushing replacement means sending the switch back to the factory for repair. G&W's exclusive Quik-Change Disconnectable Bushing permits quick, easy field replacement without having to open the switch tank.

Bushings are designed to IEEE 386 standards with standard interface accepting conventional elbow style connectors and include an aluminum conductor with 5/8"-11 aluminum threaded stud and aluminum single hole pad (**elbows must be ordered separately**). Copper studs are available. For bottom entry switches, recommended switch frame height is 42" for all voltages.



## 3-1/C, 600A VOLTAGE SENSING BUSHINGS

G&W's Voltage Sensing Bushing (VSB) system is a temperature compensated, built-in, voltage measuring system that eliminates the need for PTs when three phase analog voltage monitoring is required. Compared to potential transformers, the VS bushing system offers these benefits:

- Significant cost savings
- Cleaner, less cumbersome installation
- Less space required
- Fewer add-on components which could potentially fail
- Installed and tested prior to shipment
- Can be field calibrated
- One digital output per way for threshold voltage detection



The VS bushing system utilizes a capacitively coupled screen which is embedded within the epoxy bushing. The low energy output of the screen is amplified by integral circuitry, resulting in a 0-120 VAC analog output suitable for direct connection to any relay, IED or RTU. The circuitry incorporates built-in calibration and temperature compensation which improve accuracy.

Bushings are designed to IEEE 386 standards with standard interface accepting conventional elbow style connectors and include an aluminum conductor with 5/8"-11 aluminum threaded stud and aluminum single hole pad (**elbows must be ordered separately**). Bushings are bolt-on style. Copper studs are available. For bottom entry switches, recommended switch frame height is 42" for all voltages.

SPECIFICATIONS		
Operating temperature: -40°C to +65°C	Analog voltage outputs: 3 or 6	Maximum burden (per output): 0.06VA
Input voltage range (phase-to-phase): 10.7kV - 38kV	Number of digital outputs: 1 or 2	Voltage accuracy: +/- 2% from 0°C to 65°C and +/- 5% from -40°C to 0°C.
Nominal output voltage: 120 VAC	Digital pick-up voltage: 90% of Vnom (on all phases)	Voltage signal delay: 1/2 cycle max
	Digital drop-off voltage: 75% of Vnom (on any phase)	



## 3-1/C, 600A / 900A APPARATUS BUSHINGS

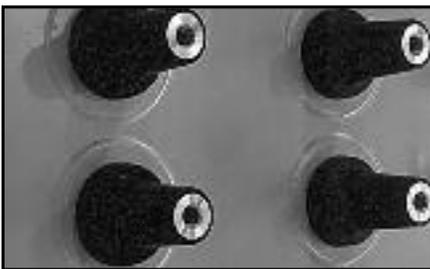
Bushings are designed to IEEE 386 standards with standard interface accepting conventional elbow style connectors and include an aluminum conductor with 5/8"-11 aluminum threaded stud and aluminum single hole pad for a 600A rating (**elbows must be ordered separately**). A copper conductor is available which extends the continuous current rating to 900A. For bottom entry switches, recommended switch frame height is 42" for all voltages. Welded flange bushings are available.

# ACCESSORIES AND OPTIONS



## 3-1/C, 200A DEEPWELL BUSHINGS

Bushings are designed to IEEE 386 standards with standard interface accepting deadbreak or loadbreak inserts and conventional elbow connectors (**inserts and elbows must be ordered separately**). A copper conductor is standard. For bottom entry switches, recommended switch frame height is 42" for all voltages. Welded flange bushings are available.



## 3-1/C, 600A APPARATUS BUSHINGS WELDED FLANGE STYLE

Bushings are designed to IEEE 386 standards with standard interface accepting conventional elbow style connectors. Bushings include a stainless steel flange and an aluminum conductor with 5/8"-11 aluminum threaded stud. (**Elbows must be ordered separately**). 200A deepwell welded flange bushings are also available.



## 3-1/C, 600A UNIVERSAL BUSHINGS

The combination Universal Cable End and Universal bushing provides an extremely versatile interface between cable and equipment for easy connecting, disconnecting, and isolating of distribution cable circuits. End caps for both bushing and splice module permit dead-ending of the cable and equipment for fast cable sectionalizing if required.

Universal bushings are designed to accept G&W universal bushing cable ends (**G&W Universal bushing cable ends must be ordered separately. See chart below**). An aluminum conductor and aluminum single hole pad is standard. For bottom entry switches, recommended switch frame height is 36" for all voltages. Hi-pot test kits are available.

**NOTE:** Universal bushings can accept up to two G&W Universal bushing cable ends per phase. For applications requiring this feature, consult factory.

## UNIVERSAL BUSHING CABLE ENDS (PER PHASE)

Complete cable data required before order can be processed.

Configuration	Catalog Number	
	15.5kV	27kV
Terminate 1 cable per phase	15CE	27CE
Terminate 2 cables per phase	15CE-CE	27CE-CE
Dead End Kit	15DCE	27DCE
Change 1 cable per phase to 2 cables per phase*	151V2	271V2

\* Kit includes second cable end (CE) and hardware necessary for connection.

# ACCESSORIES AND OPTIONS



## 3-1/C, 600A OPEN STUD BUSHINGS

Open stud bushings are furnished standard with 3/4"-16 threaded copper stud connectors and require G&W air termination kits (G&W air termination kits must be ordered separately. See below). For bottom entry switches, recommended switch frame height is 42" for all voltages where this bushing is used. If other than G&W termination kits are used, a NEMA 2-hole pad must be specified. See note below.

NOTE: 1. Bushings are also available with NEMA 2-hole pad. G&W air termination kits must be purchased separately. See below.

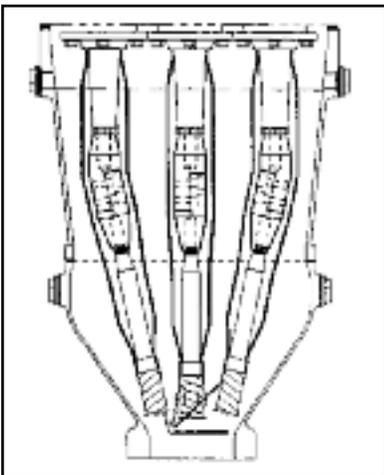
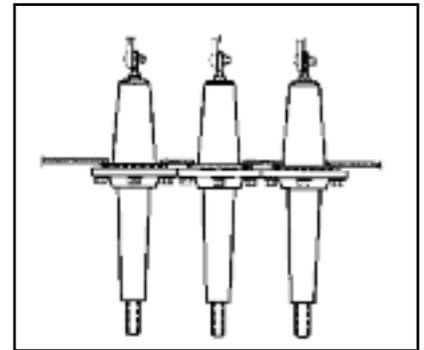
kV	Amp	kV BIL	Wt./3Ø set lbs (kgs)
15	600	110	35 (16)

## AIR TAPE TERMINATION KITS

Tape termination kits include all material required for fully shielded air terminations. Specify by completing the catalog number below:

AT X X X X MR - Y Y - Z Z

XXXX = Conductor size, i.e. #4AWG (0004), 4/0 (04/0), 1000kcm (1000), etc.  
 YY = Conductor type, i.e. Stranded Compressed (SC), Compact Round (CR).  
 ZZ = Connector style, i.e. Aluminum Crimp (AC), Copper Solder (CS), Copper Crimp (CC).



## 3/C, 600A STUD BUSHING COMPARTMENT

Stud bushing compartments include stud bushings with copper conductor, cast iron or non-magnetic cast aluminum mounting plate, shape C body and compartment, solder connector for copper conductors (aluminum conductors require compression style connectors), and WS, RS or DP entrances. Entrance style is dependent upon cable construction. Specify complete cable data when ordering. Accessory entrance fittings may also be required. Stud bushing compartments are designed for a maximum conductor size of 750KCM aluminum or 1000KCM copper. For bottom entry switches, recommended switch frame height is 60" for all voltages. **Stress cone kits and compound are required. Consult factory for proper compound selection.**

kV	Amp	Wt. lbs (kgs)	Comp'd Req'd gals (L)
15	600	140 (64)	5 (19)

## STRESS CONE KITS

Conductor Size AWG/KCM (mm <sup>2</sup> )	Catalog Number
4-4/0 (21-107)	T1MR
250-500 (127-253)	T2MR
600-1000 (304-507)	T3MR

Stress cone kits include all material required for fully shielded air terminations. Specify solder (copper) or compression (copper or aluminum) connector and complete cable data. Kits may differ depending upon cable insulation type.

# ACCESSORIES AND OPTIONS

For standard components, refer to typical specifications at [www.gwelec.com](http://www.gwelec.com) under Support.

## Gas Pressure Gauge and Fill Valve (Standard)

The pressure gauge is a “GO-NO-GO” style which is color coded to simplify verification of proper operating conditions. A Schraeder type fill valve permits refilling in the field. The gauge and fill valve are made of brass for corrosion resistance. Both are protected by a steel guard.



▲ Pressure gauge and fill valve

## Temperature Compensated Gas Density Gauge (Optional)

measures internal tank gas density for maximum precision of switch operating conditions. The gauge is colored coded to simplify reading.



▲ Temperature compensated gauge

## Viewing Windows (Standard)

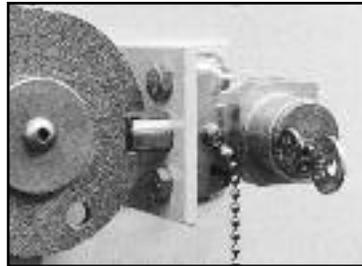
provide a means to visibly verify switch contact position. Single phase or three phase contact viewing is available.

## Frames (Optional)

are corrosion-resistant galvanized steel channels and supplied factory assembled to the switch. Open or panel style frames are available in various heights.



▲ Auxiliary switches



▲ Key interlocks



▲ Low pressure warning device

## Key Interlocks (Optional)

may be used as an added safety measure to prevent operation by unauthorized personnel or to assure safe coordination of energized equipment. Switches can be provided with provisions only (two maximum per operating mechanism) or with key interlocks factory installed. Specify locking scheme when ordering, i.e. lock in open, lock in closed or lock in both open and closed position. For key interlocks to be coordinated with other equipment, manufacturer's information must be provided.

## Ground Lugs (Optional)

are bronze, eyebolt style for 4/0 maximum conductor cable.

## Auxiliary Switches (Optional)

can be included to provide remote indication of contact position. One N.O. and one N.C. contact is supplied and can be wired by G&W or the customer. A maximum of two auxiliary switches can be installed per operating mechanism.

## Low SF<sub>6</sub> Remote Monitoring Devices:

**1) Low Pressure Warning Devices** are factory set at 5 psig and permit remote indication of internal tank pressure. It can also be used for low pressure control lockout. One Form C contact is provided for wiring by the customer.

**Recommended for installations where ambient temperature does not fall below 0°F (-15°C).**

## 2) SF<sub>6</sub> Density Switches

permit remote indication of internal tank gas density to assure proper pressure/temperature operating conditions. One Form C contact is provided for wiring by the customer.

**Recommended for installations where ambient temperatures fall below 0°F (-15°C).**



## Window Cover (Optional)

Available for Type 1, Type 2 or Type 3 interrupter controls.



▲ SF<sub>6</sub> density switch

# ACCESSORIES AND OPTIONS

## OPTIONS

Select from the following options and add to the appropriate switch specification:

- Stainless steel tank, type 304
- Temperature compensating pressure gauge
- Low pressure warning device
- SF<sub>6</sub> density switch
- 4/0 brass ground lug
- Key interlock provisions
- Key interlocks to lock in open position
- Current transformers for load break ways
- Potential transformers for voltage monitoring and/or control power
- Automatic transfer control type ATC451-4
- Motor actuators for remote switch operation
- Auxiliary switches for remote switch position indication
- Stationary switch controls for remote switch operation and SCADA integration
- Portable switch controls for remote switch operation
- Remote terminal units and communication packages for SCADA integration
- Operation counters
- Voltage sensors with 120VAC output or a contact to indicate presence of voltage
- Voltage indication panels
- 200A deepwell bushings
- 600A apparatus bushings
- 600A voltage sensing bushings
- 600A Quik-Change apparatus bushings
- 600A Universal bushings (through 25kV)
- 600A Open stud bushings
- 600A 3/C Stud bushing compartment
- Type 2 vacuum interrupter control including ground fault trip and time delay selector switches (three phase only)
- Type 3 vacuum interrupter control including ground fault trip, inrush restraint, programmable vacuum fluorescent display (VFD) and RS232/485 port
- Type 4 vacuum interrupter control (same as Type 3 with laptop programming only)
- Clear window cover for Type 1, Type 2 or Type 3 interrupter controls
- Submersible NEMA 6P enclosure for vacuum interrupter control
- SEL relays including 751A, 501, 551 and others
- External power / trip for vacuum interrupter control
- Refill kit consisting of regulator, hose and SF<sub>6</sub> bottle