01.4IB.30000
Powell GIS™ (Gas Insulated Switchgear)

G81 - 36kV / 1250A, 2000A, 2500A, & 3150A / 40kA
G82 - 38kV / 1200A, 2000A, 2500A / 40kA
Contact Information

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Signal Words

As stated in ANSI Z535.4-2007, the signal word is a word that calls attention to the safety sign and designates a degree or level of hazard seriousness. The signal words for product safety signs are “Danger”, “Warning”, “Caution” and “Notice”. These words are defined as:

⚠️ DANGER

_DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury._

⚠️ WARNING

_WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury._

⚠️ CAUTION

_CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury._

⚠️ CAUTION

_CAUTION, used without the safety alert symbol, is used to address practices not related to personal injury._

⚠️ NOTICE

_NOTICE is used to address practices not related to personal injury._

Qualified Person

For the purposes of this manual, a qualified person, as stated in NFPA 70E®, is one who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. In addition to the above qualifications, one must also be:

1. trained and authorized to energize, deenergize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
2. trained in the proper care and use of personal protective equipment (PPE) such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
3. trained in rendering first aid if necessary.
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Ch 1 General Information

⚠️ WARNING

The equipment described in this document may contain high voltages and currents which can cause death or serious injury.

The equipment is designed for use, installation, and maintenance by knowledgeable users of such equipment having experience and training in the field of high voltage electricity. This document and all other documentation shall be fully read, understood, and all warnings and cautions shall be abided by. If there are any discrepancies or questions, the user shall contact Powell immediately at 1.800.480.7273.

⚠️ WARNING

Prior to adjustments, servicing, maintenance, or any act requiring the operator to make physical contact with the equipment, the power source must be disconnected and the equipment grounded. Failure to do so may result in death or serious injury.

NOTICE

The information in this instruction bulletin is not intended to explain all details or variations of the Powell equipment, nor to provide for every possible contingency or hazard to be met in connection with installation, testing, operation, and maintenance of the equipment. For additional information and instructions for particular problems, which are not presented sufficiently for the user’s purposes, contact Powell at 1.800.480.7273.

NOTICE

Powell reserves the right to discontinue and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.
A. Scope

The information in this instruction bulletin covers the technical data in respect to the 36kV/38kV, 40kA SF₆ Powell GIS™ (Gas Insulated Switchgear).

B. Purpose

The information in this instruction bulletin is intended to provide information required to properly operate and maintain the Gas Insulated Switchgear described in Ch 1 General Information, A. Scope.

This instruction bulletin provides:

1. Safety guidelines
2. General descriptions of the operation and maintenance of the gas insulated switchgear
3. Instructions for installation and placing the switchgear into service
4. Instructions for part replacement
5. Information for ordering renewal parts
6. Procedure for critical adjustments
7. Illustrations, photographs, and description of the switchgear

The illustrations contained in this document may not represent the exact construction details of each particular type of gas insulated switchgear. The illustrations in this document are provided as general information to aid in showing component locations only.

All illustrations and photos are shown using deenergized equipment.

Be sure to follow the appropriate safety precaution while handling any of the equipment. Failure to do so may result in serious injury or death.

To the extent required, the products described herein meet the applicable ANSI, IEEE, NEMA, and IEC Standards; however, no such assurance is given with respect to local codes and ordinances which may vary greatly.

C. Instruction Bulletins Available Electronically

Changes to the instruction bulletin may be implemented at any time and without notice. Go to powellind.com to ensure use of the current instruction bulletin for the Powell equipment.

For more information visit powellind.com. To contact the Powell Service Division call 1.800.480.7273 or 713.944.6900, or email info@powellservice.com.

For specific questions or comments pertaining to this instruction bulletin email documents@powellind.com with the IB number in the subject line.
Ch 2  Safety

A. Safe Work Condition

The information in Section A is quoted from NFPA 70E 2012 - Article 120, 120.1 Establishing an Electrically Safe Work Condition.

120.1 Process of Achieving an Electrically Safe Work Condition

1. Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.

2. After properly interrupting the load current, OPEN the disconnecting device(s) for each source.

3. Wherever possible, visually verify that all blades of the disconnecting devices are fully OPEN or that drawout type circuit breakers are withdrawn to the fully disconnected position.

4. Apply lockout/tagout devices in accordance with a documented and established policy.

5. Use an adequately rated voltage detector to test each phase conductor or circuit part to verify they are deenergized. Test each phase conductor or circuit part both phase-to-phase, and phase-to-ground. Before and after each test, determine that the voltage detector is operating satisfactorily.

Informational Note: See ANSI/ISA-61010-1 (82.02.01)/UL 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 V and below.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being deenergized could contact other exposed energized conductors or circuit parts, apply ground connecting devices rated for the available fault duty.

B. Safety Guidelines

Study this instruction bulletin and all other associated documentation before uncrating the switchgear.

Each user has the responsibility to instruct and supervise all personnel associated with usage, installation, operation, and maintenance of this equipment on all safety procedures. Furthermore, each user has the responsibility of establishing a safety program for each type of equipment encountered.

The switchgear described in this instruction bulletin are operated by a high-energy, high-speed mechanism that is interlocked to provide specific operating sequences. It is mandatory that the following rules be observed to ensure the safety of personnel associated with usage, installation, operation, and maintenance of these circuit breakers.

The safety rules in this instruction bulletin are not intended to be a complete safety program. The rules are intended to cover only some of the important aspects of personnel safety related to gas insulated switchgear.
C. General

1. Only supervised and qualified personnel trained in the usage, installation, operation, and maintenance of gas insulated switchgear shall be allowed to work on this equipment. It is mandatory that this instruction bulletin, any supplements, and service advisories be studied, understood, and followed.

2. Maintenance programs must be consistent with both customer experience and manufacturer's recommendations, including service advisories and instruction bulletin(s). A well planned and executed routine maintenance program is essential for circuit breaker's reliability and safety.

3. Service conditions and circuit breaker applications shall also be considered in the development of safety programs. Variables include ambient temperature; humidity; actual continuous current; thermal cycling; number of operations; interrupting duty; and any adverse local conditions including excessive dust, ash, corrosive atmosphere, vermin and insect infestations.

D. Specific

1. Do not work on an energized circuit breaker.

2. Do not work on a circuit breaker with the control circuit energized.

3. Extreme care must be exercised to keep all personnel, tools, and other objects clear of mechanisms which are to be operated, discharged, or released. These circuit breakers utilize stored energy mechanisms. These mechanisms must be serviced only by skilled and knowledgeable personnel capable of releasing each spring load in a controlled manner. Detailed information regarding these mechanisms is found in this instruction bulletin.

4. Do not attempt to close the circuit breaker manually on an energized circuit.

5. Do not use an open circuit breaker as the sole means of isolating a high voltage circuit. For complete isolation, the circuit breaker shall be in the open position and disconnector open, and circuit earthed.

6. All components shall be disconnected by means of a visible break and securely grounded for safety of personnel performing maintenance operations on the circuit breakers.

7. Interlocks are provided to ensure the proper operating sequences of the circuit breakers and for the safety of the user. If for any reason an interlock does not function as described, do not make any adjustments, modification, or deform the parts. Do not force the parts into position. Contact Powell for instructions.
E. X-Rays

When high voltage is applied across the contacts of a vacuum interrupter, there is the possibility of generation of X-rays. The intensity of the X-radiation is dependent on the peak voltage and the contact gap. At the normal operating voltage for this type of equipment, the radiation levels are negligible. At the voltages specified for testing, test personnel shall be in front of the circuit breaker such that the two layers of steel used in the frame and front cover construction are between the test personnel and the vacuum interrupters, and that the test personnel be no closer than one meter (3') from the front of the circuit breaker. The circuit breaker shall be either fully open, or fully closed when making high potential tests. Do not test with contacts partially open.

F. Safety Labels

The equipment described in this document has DANGER, WARNING, CAUTION, and instruction labels attached to various locations. All equipment DANGER, WARNING, CAUTION, and instruction labels shall be observed when the circuit breaker is handled, operated, or maintained.

**NOTICE**

Warning and Caution labels are located in various places in and on the switchgear and on the circuit breaker removable element. Always observe these warnings and caution labels. Do NOT remove or deface any of these warning/caution labels.
Ch 3  General Powell GIS™

A. DESCRIPTION

Powell's cubical type gas-insulated switchgear is an integrated assembly of a vacuum circuit breaker, the 3-position switch/disconnector, bus connecting system and control devices coordinated electrically and mechanically for a medium voltage power system.

1) Safety and Maintenance

• The 3-position switch is interlocked with circuit breaker mechanically
• Circuit breaker function accompanied by earthing function in combination with the 3-position switch
• Operating mechanism is accessed from outside of enclosure

2) Four Completely Segregated Areas

• Bus compartment(s)
• Circuit breaker compartment
• Cable compartment
• Low voltage compartment
Ch 4 General Specification

A. Applied Standard

1. Powell GIS™ if manufactured in accordance with the IEC standards.
   • IEC 62271-100: High-Voltage alternating current circuit breakers
   • IEC 62271-200: AC Metal-Enclosed Switchgear and control gear for rated voltages above 1kV and up to and including 52kV.
   • IEC 62271-102: High-Voltage alternating current disconnector and earthing.
   • IEC 60376: Specification of technical grade sulfur hexafluoride (SF₆) for use in electrical equipment.
   • IEC 60480: Diagnosis guide of SF₆ gas for electric device.

B. Service Condition

1. Location: Indoor
2. Ambient Temperature: -5 ~ +40°C
3. Altitude: Not exceeding 1,000m above sea level
4. Atmospheric Condition: Not notably polluted

C. Structure

1) General

The gas tank has been designed for its entire life. It is made of stainless-steel (SUS 304L), contains a 3-position switch/disconnector switch, bus bar and vacuum interrupter.

The tank is permanently sealed. No maintenance or refilling of the tank required. In the event of an internal arc, each tank has a rupture disc which direct gases to an arc duct assembly.

2) Circuit Breaker

The circuit breaker is rated up to 36kV/38kV, 40kA. The circuit breaker consists of a vacuum interrupter, insulator frame and operating mechanism. The circuit breaker poles are installed horizontally in the circuit breaker compartment. The vacuum interrupter is supported by the insulator frame located in the circuit breaker compartment. The circuit breaker is operated by a stored energy mechanism normally charged by a small universal motor, but it can be also charged by a manual handle for emergency manual to close and open. The circuit breaker has three independent vacuum interrupters.

3) 3-Position Switch

The 3-position switch is rated up to 36kV/38kV, 40kA and is a motor operating rod-type switch. Live switch components (bus bar, insulated spindle with moving contact) are in the gas compartment and the operating mechanism components (drive motor, position indicator and emergency manual operation) outside of the gas compartment.

4) Bus

• Single and double bus system
• Transfer Bus System
5) **Current Transformer**
   - The current transformer is an individual cast-resin insulated product available to be installed inside a SF₆ gas compartment.

6) **Potential Transformer**
   - The potential transformer is a plug-in and epoxy molding type.

7) **Lightning Arrester**
   - The lightning arrester is a plug-in type.

8) **Painting**
   - The gas tanks are stainless steel and do not require painting. All other external metal surfaces are cleaned, rust proofed and painted in accordance with Powell’s paint thickness.
### Ch 5  Technical Specification

#### A. Ratings

<table>
<thead>
<tr>
<th>Table A Cubicle Type Gas Insulated Switchgear Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Switchgear Type</strong></td>
</tr>
<tr>
<td>Rated Voltage (kV)</td>
</tr>
<tr>
<td>Power Frequency Withstand Voltage (kV)</td>
</tr>
<tr>
<td>Lightning Impulse Withstand Voltage (kV)</td>
</tr>
<tr>
<td>Rated Frequency (Hz)</td>
</tr>
<tr>
<td>Normal Current (Amperes)</td>
</tr>
<tr>
<td><strong>Main Bus</strong></td>
</tr>
<tr>
<td>≤ 3150</td>
</tr>
<tr>
<td><strong>Feeder</strong></td>
</tr>
<tr>
<td>1250 / 2000 / 2500 / 3150</td>
</tr>
<tr>
<td>Rated Short Time Withstand Current, 3s (kA)</td>
</tr>
<tr>
<td>Rated Peak Withstand Current (kA, peak)</td>
</tr>
<tr>
<td>Rated Short Circuit Breaking Current (kA)</td>
</tr>
<tr>
<td>Rated Short Circuit Making Current (kA)</td>
</tr>
<tr>
<td>Rated Operating Sequence</td>
</tr>
<tr>
<td>Closing Time (ms)</td>
</tr>
<tr>
<td>Opening Time (ms)</td>
</tr>
<tr>
<td>Breaking Time (cycle)</td>
</tr>
<tr>
<td>Auxiliary Voltage (V)</td>
</tr>
<tr>
<td>Insulation Gas</td>
</tr>
<tr>
<td>Rated Pressure at 20°C (bar)</td>
</tr>
<tr>
<td>Minimum Operating Pressure at 20°C</td>
</tr>
<tr>
<td>Arc Classification (62271-200)</td>
</tr>
<tr>
<td><strong>Bus Bar System</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>≤ 1250A</td>
</tr>
<tr>
<td>≥ 2000A</td>
</tr>
</tbody>
</table>

**Notes:**

1. The value in “[ ]” is for the system according to the GOST 1516.3, GB 3906 or relevant standard on request.
2. The auxiliary voltage can be changed on request.
3. The size of actual panel can be different according to the rating, quantity and arrangement of components.
4. Width of the panel in [ ] is when voltage transformer is installed.
5. Depth of the panel can increase according to the numbers and size of components in low voltage compartment.
## B. 3-Position Switch

<table>
<thead>
<tr>
<th><strong>Table B. 3-Position Switch</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td><strong>Rated Voltage</strong></td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
</tr>
<tr>
<td><strong>Rated Current</strong></td>
</tr>
</tbody>
</table>

### Power Frequency withstand Voltage

<table>
<thead>
<tr>
<th></th>
<th>Phase to earth and between phases</th>
<th>Across the isolating distance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage</strong></td>
<td>70(80)kV</td>
<td>80(88)kV</td>
</tr>
</tbody>
</table>

### Lightning impulse withstand voltage (1.2/50)

<table>
<thead>
<tr>
<th></th>
<th>Phase to earth and between phases</th>
<th>Across the isolating distance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage</strong></td>
<td>170kV</td>
<td>195kV</td>
</tr>
</tbody>
</table>

### Short-time withstand current frequency

<table>
<thead>
<tr>
<th></th>
<th>Peak withstand current</th>
<th>Duration of short-circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current</strong></td>
<td>40kA</td>
<td>3s</td>
</tr>
<tr>
<td><strong>Voltage</strong></td>
<td>104kA</td>
<td></td>
</tr>
</tbody>
</table>

### Disconnector class of mechanical endurance

- **M1**

### Operation method

- Motor & Handle

### Control Voltage

- **DC110 / 125VDC**

### Control Voltage change range

- 85 ~ 110%
Ch 6  Structure

A. General

Powell GIS™ is a metal enclosure 3-phase conductor that is symmetrically arranged with a compact structure.

B. Circuit Breaker

The circuit breaker compartment contains a vacuum interrupter assembly that is connected to a mechanism for open and close operation. The 3-position switch can connect and disconnect the main bus. The switch can also ground the circuit breaker and connected line or load terminals.

Figure 1  Drawing of G81

a. Main Bus
b. 3-Position Switch Mechanism
c. 3-Position Switch
d. Main 3-Pole Bushing (Contact Conductor)
e. Vacuum Interrupter
f. Rupture Disc
g. Vacuum Interrupter Housing
h. Circuit Breaker Mechanism
i. Arc Gas Duct
j. Current Transformer (Block Type)
k. Cable Socket (Structure)
l. Instrument Compartment
C. MECHANISMS

1) Circuit Breaker Mechanism

- Motor: ~125 VDC, for close spring charging
- Auxiliary switch: 5 Poles or 10 poles
- Close coil: 86 Ohm
- Trip coil: 86 Ohm for 5 cycles or (42 Ohm for 3 cycles)

2) 3-Position Switch Mechanism

- Motor: ~125 VDC
- Auxiliary switch (DS, Open, ES): Up-to 10 Poles
- Motor & hand operation

**Figure 2  Circuit Breaker Mechanism**

**Figure 3  3-Position Switch Mechanism**

a. Close/Open Indicator
b. Breaker Shaft
c. Dash Pot
d. Operating Counter
e. Opening Button
f. Closing Mechanism
g. Open Solenoid
h. Close Spring
i. Closing Button
j. Manual Charging Operating Hole
k. Trip Spring
l. Closing Solenoid
m. Spring Charge Indicator
n. Motor
o. Auxiliary Switch

a. Indicator
b. Handle Insert Hole
c. Motor
d. Interlock Rod
e. Limit Switch for Motor Control
f. Auxiliary Switch
g. Drive Gear
h. Clutch for Motor Control
D. **Bus Compartment**

Bus bar compartment contains a main bus bar, feeder bus bar including the 3-position switch (3PS), filled with SF₆ gas with safety rupture discs activated by overpressure.

E. **Cable Compartment**

Cable compartments contain the incoming or outgoing cable supports and earthing bus. The cable compartment is sealed by metal walls.

Under the Arc Fault condition, the rupture disc may rupture and should be checked visually by opening the arc gas duct panel.
Ch 7 Operation

A. Construction of Each Feeder

Figure 4 G81 Single Bus System

Circuit Diagram for Typical Unit

- Arc Way
- Outgoing Feeder
- Incoming Feeder
- Bus - VT
- Bus - Coupler
- Arc Way

CB Panel/Outgoing Feeder

a. Main Bus
b. 3-Position Switch
c. 3-Position Switch Mechanism
d. Bushing
e. Vacuum Interrupter
f. Rupture Disc
g. Circuit Breaker Mechanism
h. Current Transformer (Block Type)
i. Inner Cone Socket
j. Surge Arrestor
k. Zero Sequence Current Transformer

Note:
1. Width of panel can be increasing according to the specification or quantity of current transformers.
2. An arc way is needed at each side of the end panel
**Figure 5  G82 Transfer Bus System**

**Circuit Diagram for Typical Unit**

<table>
<thead>
<tr>
<th>Arc Way</th>
<th>Incoming Feeder</th>
<th>Outgoing Feeder</th>
<th>Bus PT</th>
<th>Bus-Coupler</th>
<th>Arc Way</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3PS</td>
<td>CT</td>
<td></td>
<td>CB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DS</td>
<td>3PS</td>
<td></td>
<td>PF</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3PS</td>
<td></td>
<td>PT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CB Panel/Outgoing Feeder with Plug-in Circuit**

- **a. Main Bus**
- **b. 3-Position Switch**
- **c. 3-Position Switch**
- **d. Bushing**
- **e. Vacuum Interrupter**
- **f. Circuit Breaker Mechanism**
- **g. Rupture Disc**
- **h. 3-Position Switch**
- **i. 3-Position Switch Mechanism**
- **j. Current Transformer**
- **k. Inner Cone Socket**
- **l. Arc Gas Duct**

**Note:**
1. An arc way is needed at each side of the end panel
B. Operation Circuit Breaker

Figure 6  Circuit Breaker Schematic

- S21 & S22: Limit Switch for Driving Springs
- S3: Limit Switch Close
- ASO: Auxiliary Switch
- K1: Anti Pumping Relay
- M: Motor for Spring Charging
- Y1: Trip Coil
Figure 7  Flowchart for Circuit Breakers

Motor Motion

Closing Spring Charging

Limit Switch S3 Close

CB Closing Signal Input

Energizing Trip Coil

CB Close

Release Closing Spring

CB Open Signal (Protection Relay CS S/W)

CB Open by Manual (by button)

Limit Switch S21, S22 Open

Motor Stop

CB Close by Manual (by button)

Limit Switch S21, S22 Close

Charging Closing Spring by Handle

Energizing Trip Coil

CB Open

Electric Operation

Manual Operation

Operation

Powered by Safety®
Figure 8  Available position for 3-Position Switch and Circuit Breaker

DISCONNECT / OPEN

CONNECT / CLOSE

READY FOR EARTHING

CABLE SIDE EARTHING

3PS

CB

3PS

CB

3PS

CB

3PS

CB
C. Operation of 3-Position Switch

Figure 9 3-Position Switch Schematic

D1CX : Disconnector Close Command Contact
D1OX : Disconnector Open Command Contact
E1CX : Earthed Close Command Contact
E1OX : Earthed Open Command Contact
M : Motor
CH : Motor Clutch
1) **Electric Operation**

Refer to Figure 9 during electric operation.

A clutched motor is used for the electrical operation of the 3-Position disconnector. The motor can be operated forward or reversed direction and the motor clutch makes the operation of the motor stop to prohibit over operating of the disconnector as follows:

a. **Disconnector : Off → On**
   When the command contact “D1CX” is closed, the motor is rotated clockwise so that the position of the disconnector is connected.

b. **Disconnector : On → Off**
   If the command contact “D1OX” is closed, the motor is rotated counterclockwise so that the position of this disconnector is disconnected.

c. **Earthing : Off → On**
   If the command contact “E1CX” is closed, the motor is rotated counterclockwise so that the position of this disconnector is placed “earth”.

d. **Earthing : On → Off**
   When command contact “E1OX” is closed, the motor is rotated clockwise so that the position of this disconnector is placed “disconnected”.

2) **Manual Operation**

Refer to Figure 10 during manual operation.

Carefully follow the instructions on the face of the selector switch mechanism.

The 3-position switch can only be operated when the circuit breaker is in the open position. If the circuit breaker is closed, the 3-position switch cannot be operated mechanically as the circuit breaker interlock prohibits insertion of the manual handle into the access port.

The circuit breaker can only be operated when the 3-position switch is fully in the connected, disconnected, or earthed position. The manual handle can not be removed until switching operation has been completed.

The 3-position switch contains a moving contact that moves in a longitudinal direction by an internal trapezoid threaded screw among fixed and earthing contacts. The alternating movement provides for the switching of the disconnecting switch contact, open position or switching of the earthing contact of the 3-position switch.

As the switch is rotated clockwise from the “OFF” position, it is placed in the “connected” (service on) position. From the “connected” position, counter-clockwise rotation returns the switch to the “open” position.

As the switch is rotated counterclockwise from the “open” position, the switch is now in the “earthed” position. From the “earthed” position, clockwise rotation returns the switch to the “open” position.
Figure 10  Operation Device & Switch Position

- **Connected Position**
- **Disconnected Position**
- **Earthed Position**

**DANGER**

**CAUTION**

DISCONNECTING

OFF

OFF

ON

ON

EARTHING
Ch 8 Components

A. Circuit Breaker (HHF)

Figure 11  Circuit Breaker and Mechanism

- Contact Spring
- Circuit Breaker Mechanism
- Pole with VI

B. Vacuum Interrupter Construction

Figure 12  Vacuum Interrupter for HVS-03644

- Contact Tip
- Contact Base
- Bellows
- Fixed Stem
- Arc Chamber
- Movable Stem
C. 3-Position Switch (3PS)

Figure 13 Structure of 3-Position Switch

a. Manual Handle Insert hole
b. Operating Screw Rod
c. 3PS Pole

D. Bus Bar Connector (Single Phase)

Figure 14 Structure of Bus bar Connector

a. Bus Bar Connector for 1250A
b. Bus Bar Connector for 2500A

E. 3-Position Switch Bushing (Connects Bus Bar Compartment and Circuit Breaker Compartment)

Figure 15 Structure of 3PS Bushing

F. Cable Socket

Figure 16 Structure of Cable Socket
G. Rupture Disc

Figure 17 Rupture Disc

Normal

Ruptured
**Ch 9 Assembly & Carry**

It is recommended that the equipment be moved by crane but if one is not available a forklift or hand push vehicle is sufficient.

When using a crane to lift, make sure to keep the same angles of the chain on both sides of the equipment. Always keep the equipment in an upright, horizontal position during movement.

*Figure 18 Equipment Lifting*
**Ch 10 Installation**

**A. INSTALLATION**

<table>
<thead>
<tr>
<th>Table C Installation Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step #1</strong></td>
</tr>
<tr>
<td><strong>Step #2</strong></td>
</tr>
<tr>
<td><strong>Step #3</strong></td>
</tr>
<tr>
<td><strong>Step #4</strong></td>
</tr>
<tr>
<td><strong>Step #5</strong></td>
</tr>
<tr>
<td><strong>Step #6</strong></td>
</tr>
<tr>
<td><strong>Step #7</strong></td>
</tr>
<tr>
<td><strong>Step #8</strong></td>
</tr>
<tr>
<td><strong>Step #9</strong></td>
</tr>
</tbody>
</table>

**Figure 19 Installation**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Base Frame</td>
</tr>
<tr>
<td>2</td>
<td>Bottom frame of the panel</td>
</tr>
<tr>
<td>3</td>
<td>Panel height adjusting screw</td>
</tr>
<tr>
<td>4</td>
<td>Shim</td>
</tr>
<tr>
<td>5</td>
<td>Base Frame fixing bolt</td>
</tr>
<tr>
<td>6</td>
<td>Panel fixing bolt</td>
</tr>
<tr>
<td>7</td>
<td>Base Frame height adjusting screw (option)</td>
</tr>
</tbody>
</table>
B. ERECTION OF POWELL GIS™

1) End Panel

<table>
<thead>
<tr>
<th>Table D Erection of Powell GIS™ Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step #1</td>
</tr>
<tr>
<td>Step #2</td>
</tr>
<tr>
<td>Step #3</td>
</tr>
<tr>
<td>Step #4</td>
</tr>
<tr>
<td>Step #5</td>
</tr>
<tr>
<td>Step #6</td>
</tr>
</tbody>
</table>

2) Next Panel

<table>
<thead>
<tr>
<th>Table E Next Panel Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step #1</td>
</tr>
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<td>Step #2</td>
</tr>
<tr>
<td>Step #3</td>
</tr>
<tr>
<td>Step #4</td>
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<tr>
<td>Step #5</td>
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<tr>
<td>Step #6</td>
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<tr>
<td>Step #7</td>
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<tr>
<td>Step #8</td>
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<tr>
<td>Step #9</td>
</tr>
<tr>
<td>Step #10</td>
</tr>
<tr>
<td>Step #11</td>
</tr>
<tr>
<td>Step #12</td>
</tr>
<tr>
<td>Step #13</td>
</tr>
</tbody>
</table>

Figure 20  End Panel Installation
Figure 21  Bolting of Guide Pin

a. Guide Pin
b. Guide Nut
c. Connecting Piece
**Figure 22  Installing Bolts and Guide Pins**

- Installing the guide pins
- Install the connecting bolts

**Figure 23  Connecting to Bus Bar Socket**

- Epoxy Mold
- Connecting Conductor & Silicone Tube
Figure 24  Panel and Bus Bar Connection
Figure 25  

*Figure of Installation Site*

Put the first panel

Place new panel and install busbar connector

Place in busbar closing caps and fix gas duct closing plate

Connect all panels
3) **Installation of End Panel**

<table>
<thead>
<tr>
<th>Table F Installation of End Plate Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step #1</strong></td>
</tr>
<tr>
<td><strong>Step #2</strong></td>
</tr>
<tr>
<td><strong>Step #3</strong></td>
</tr>
<tr>
<td><strong>Step #4</strong></td>
</tr>
</tbody>
</table>

**Figure 26  Bus Bar Closing Caps**

4) **Connecting Primary and Secondary Cables**

Primary cables shall be connected to the switchgear before assembling the rear arc gas ducts. Connect secondary wiring system to the panels.

5) **Pressure Relief Arc Gas Ducts**

After erecting all panels top pressure relief ducts, rear arc gas ducts and side arc gas ducts shall be assembled onto the panels and joining to each other according to the installation plan.

6) **Special Accessories for G81 & G82 Installation**

<table>
<thead>
<tr>
<th>Table G Special Accessory for G81 &amp; G82 Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No.</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
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<tr>
<td>5</td>
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<tr>
<td>6</td>
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<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
</tbody>
</table>
C. Extension of Panels on Site

Powell Powell GIS™ can be extended on site either on the left side or the right size after commissioning. The factory assembled and SF₆ gas filled panels don't need any gas handling on installation site.

**CAUTION**

If future extension is expected the necessary space requirement shall be considered in foundation layout.

**CAUTION**

Do not work on energized equipment. Working on energized equipment may cause personal injury or even death.

<table>
<thead>
<tr>
<th>Table H Extension of Panels on Site Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step #1</strong></td>
</tr>
<tr>
<td><strong>Step #2</strong></td>
</tr>
<tr>
<td><strong>Step #3</strong></td>
</tr>
<tr>
<td><strong>Step #4</strong></td>
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<tr>
<td><strong>Step #5</strong></td>
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<tr>
<td><strong>Step #6</strong></td>
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<tr>
<td><strong>Step #7</strong></td>
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<tr>
<td><strong>Step #8</strong></td>
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<tr>
<td><strong>Step #9</strong></td>
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<tr>
<td><strong>Step #10</strong></td>
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<tr>
<td><strong>Step #11</strong></td>
</tr>
<tr>
<td><strong>Step #12</strong></td>
</tr>
<tr>
<td><strong>Step #13</strong></td>
</tr>
<tr>
<td><strong>Step #14</strong></td>
</tr>
<tr>
<td><strong>Step #15</strong></td>
</tr>
<tr>
<td><strong>Step #16</strong></td>
</tr>
<tr>
<td><strong>Step #17</strong></td>
</tr>
<tr>
<td><strong>Step #18</strong></td>
</tr>
<tr>
<td><strong>Step #19</strong></td>
</tr>
<tr>
<td><strong>Step #20</strong></td>
</tr>
<tr>
<td><strong>Step #21</strong></td>
</tr>
<tr>
<td><strong>Step #22</strong></td>
</tr>
</tbody>
</table>
Figure 27  Future of Extension Site

1. Remove lateral side covers and closing caps.
2. Place new panel and install busbar connector.
3. Place in busbar closing caps and fix gas duct closing plate on the new panel.
4. Extension of panels.
D. HV CABLE CONNECTION

Cables are connected to Powell GIS™ utilizing a plug in “inner sealing cone” assembly.

1. When connecting the HV cable, it is recommended to treat ending part with termination kit in accordance with cable plug manufacturer’s recommendations.
2. Access the cable compartment, and then pull the cable plug up to the cable socket.
3. Fix the cable to the cable support by clamp.

Figure 28 Connection of the HV Cable Plug

E. FINAL EQUIPMENT CHECK

1. Tightening between Powell GIS and foundation
2. Main bus cover compartment bolts
3. Earth bus bar bolts
4. Control cable bolts
5. Check Auxiliary Circuit and Control Circuit
6. Check Current Transformer Circuit
7. Aux Circuit and Control Circuit Check
8. Check CT Circuit by CT Circuit Drawing

F. INSULATION GAS

Check input pressure by pressure meter.
Ch 11  Maintenance & Test Procedure

A. MAINTENANCE

1) Safety

Extreme care must be exercised to keep all personnel, tools, and other objects clear of mechanisms which are to be operated, discharged, or released. These circuit breakers utilize stored energy mechanisms. These mechanisms must be serviced only by skilled and knowledgeable personnel capable of releasing each spring load in a controlled manner.

2) Maintenance Terms

<table>
<thead>
<tr>
<th>Table I Maintenance Terms</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every 4 years</td>
<td>- Check SF₆ gas pressure, if need refilling</td>
</tr>
<tr>
<td>Every 12 years</td>
<td>- Check SF₆ gas pressure</td>
</tr>
<tr>
<td></td>
<td>- Grease driving device</td>
</tr>
<tr>
<td></td>
<td>- Test solenoid coil</td>
</tr>
<tr>
<td>After CB mechanism operation is 2,000 times</td>
<td>- CB mechanism operating test and grease driving device</td>
</tr>
<tr>
<td></td>
<td>- Test solenoid coil</td>
</tr>
<tr>
<td>After 3PS mechanism operation is 1,000 times</td>
<td>- 3PS mechanism operating test and grease driving device</td>
</tr>
</tbody>
</table>

3) Check of Insulation Gas

<table>
<thead>
<tr>
<th>Table J Inspection</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of gas sensor is in 1.2~1.5 bar (abs)</td>
<td>- Fill to recommended pressure range</td>
</tr>
<tr>
<td></td>
<td>- Relieve pressure if above range</td>
</tr>
</tbody>
</table>

4) Instruction for Lubrication Use

In general, the operating mechanism requires only moderate lubrication at regular intervals and all excess must be removed with a clean cloth to prevent any accumulation of dust or dirt. Avoid any lubricant on insulation or other electrical parts.

Lubricate the mechanism with Alvania #2 or equivalent. Moving parts should then be moved slightly to let the grease penetrate and become properly distributed. After lubrication, operate the breaker several times manually.

The points to be lubricated is shown in Figure 29.

Figure 29  Lubrication of Circuit Breaker Mechanism

- Outer surface of spring guide
- Outer surface of shaft and pin
- Latch for closing/opening
- Cam for closing
3) Cleaning

According to the result of the visual check cleaning may be necessary.

Note: Only isolated, earthed and/or securely isolated parts of Powell GIS™ should be subjected to cleaning. Keep in mind all safety regulation of relevant standards.

4) Check the Control Circuit Wiring

Check the connecting condition of wiring according to the drawing.

5) SF₆ Gas Leakage Test

If pressure is below recommended level, perform this test to confirm that leakage of SF₆ gas sealed in the Powell GIS has not occurred.

a. Leak Test Method
   i. Test all the compartments, o-ring and bolting connections for leaks using the SF₆ gas detector.
   ii. The SF₆ gas detector detects Freon gas. So, where a leak is detected smear the spot with soapy water to confirm the leakage. Wipe away the soapy water after confirmation.
   iii. Standard of judgment: No detection of gas leakages.

Figure 30 Lubrication of 3-Position Switch Mechanism

- Shaft and saw-tooth of all gears
- Guide pin and Driving shaft

B. Test Procedure

1) Visual Check

   a. General condition of cabinets and compartments
   b. All operating mechanisms (especially that of the circuit breaker, 3-position switch/disconnector switch, and mechanical interlocks.

2) Functional Test

   After performing the visual check, the circuit breaker or 3-position switch mechanical test should be performed on all related devices, including mechanical interlocks. During this test the device shall be operated with no (electrical) load. If the “visual check” raises doubts about the proper characteristics of a component, consult with Powell on what tests are to be performed.
6) **Control Circuit Wiring Test**

   a. **Test Method**
      Confirm electrical operations with an approved drawing. Validate proper operation of all functional electrical components and interlocks.

7) **Timing**

   At normal control voltage, operate the test source to the “close” position to close the circuit breaker and record the closing time. The closing time from energizing the closing coil to vacuum interrupter contact touch should not exceed the values in *Table K Timing*. Again, at normal control voltage, operate the test source to the “open” position to open the circuit breaker and record the opening time. The opening time from energizing the shunt trip coil to vacuum interrupter contact part should not exceed the values in *Table K Timing*.

<table>
<thead>
<tr>
<th>Table K Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closing Time</td>
</tr>
<tr>
<td>3 Cycle</td>
</tr>
<tr>
<td>5 Cycle</td>
</tr>
</tbody>
</table>

8) **3-Position Switch (disconnecter or earth) Operating Test**

   a. **Test Method**
      Purpose of this test is to check characteristics of ES and DS.
      Measuring open and close time
   b. **Control Voltage:** 80 - 110%
   c. **Standard of judgement:**
      Fully changes positions in 10 seconds

9) **Manual Close/Open Test**

   a. **Test Method**
      Repeat open & close operation by manual handle.
      Purpose of this test is checking DS and ES operation status.

10) **Potential Transformer Test**

   a. **Test Method**
      Use a 1000V megger for validating the main bus insulation. Use a 500V megger for validating control wire insulation.

   **Table L Insulation Resistance**

<table>
<thead>
<tr>
<th>Main circuit and earth</th>
<th>Control circuit and between control circuit and earth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Above 500 MΩ (DC 1000V Megger)</td>
</tr>
<tr>
<td></td>
<td>Above 2MΩ (DC 500V Megger)</td>
</tr>
</tbody>
</table>
Ch 12 Others

A. POST PROCESSING OF BOLT AND TORQUE VALVE

If the torque value of the gas compartment is above 8.8 and uses a whisker coated bolt, install using Loctite 222 or an anti reveling device. For outside installation a normal bolt is used. Torque values are represented in Table M Class 8.8 or 9.8 Bolt and Nut and Table N Class 10.9 Bolt and Nut.

<table>
<thead>
<tr>
<th>Table M Class 8.8 or 9.8 Bolt and Nut</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque (Nm)</td>
</tr>
<tr>
<td>Min</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>M6</td>
</tr>
<tr>
<td>M8</td>
</tr>
<tr>
<td>M10</td>
</tr>
<tr>
<td>M12</td>
</tr>
<tr>
<td>M16</td>
</tr>
<tr>
<td>M20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table N Class 10.9 Bolt and Nut</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque (Nm)</td>
</tr>
<tr>
<td>Min</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>M6</td>
</tr>
<tr>
<td>M8</td>
</tr>
<tr>
<td>M10</td>
</tr>
<tr>
<td>M12</td>
</tr>
<tr>
<td>M16</td>
</tr>
</tbody>
</table>

B. PROCESSING OF CONTACT SURFACE

Before fixing bolt, following operations are required:

- Surface must be cleaned
- Exposed surface bus must be grinded (without rust resistant part)
- Spread rust resistant grease

1) Cleaning

a. Use liquid detergent to clean a foreign substance on the surface
b. If the degree of pollution is high, use grinder to clean the foreign substance.

C. GAS MONITORING SYSTEM (HMD3)

Do not connect anything to the terminal marked “NC”.

1) Channel Scan

Channel Skip

The selected channel is skipped when “CHn” is OFF. Then the skipped channel LED and the relay operations all become “OFF” status.

2) Automatic Scan Mode

At the operating display, pressing the “SET” key for more than 1 second turns to the “Auto Scan” mode. While in the “Auto Scan” mode, it scans the channels that are “Chn = ON” and displays for approximately 2 seconds each. However, if a channel has a certain problem, the “Auto scan” is stopped and the problem status is displayed with the channel locked.
3) **Manual Scan Mode**

At the operating display, pressing the “SET” key turns to the “Manual Scan” mode. While in the manual scan mode, every time the “SET” is pressed once, the channels that have “CHn=ON” is scanned and displayed.

* $n = 1 \sim 3$ (Channel Number)

4) **Change the Parameter**

<table>
<thead>
<tr>
<th>Table 0: Change the Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter Name &lt;--&gt; Parameter Value</strong></td>
</tr>
<tr>
<td><strong>Parameter Value</strong></td>
</tr>
<tr>
<td><strong>Parameter Name &lt;--&gt; Changed Parameter Value</strong></td>
</tr>
</tbody>
</table>
Figure 31  HMD3

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OPERATING ZONE lamp of each P1, 2, &amp; 3 (Green)</td>
</tr>
<tr>
<td>2</td>
<td>LOW ZONE Lamp of each P1, 2, &amp; 3 (Yellow)</td>
</tr>
<tr>
<td>3</td>
<td>Low-Zone Lamp of each P1, 2, &amp; 3 (Red)</td>
</tr>
<tr>
<td>4</td>
<td>Channel indicating Lamp of each P1, 2, &amp; 3 (Green)</td>
</tr>
<tr>
<td>5</td>
<td>PV Indicator</td>
</tr>
<tr>
<td>6</td>
<td>DOT Indicator</td>
</tr>
</tbody>
</table>

SET: SET KEY

- Direction setting shift key
- Setting level reduction key
- Setting level increasing key
Figure 32  Wiring Connection Diagram

* Caution: Do not connect anything to “NC”
01.4IB.30000
Powell GIS™ (Gas Insulated Switchgear)

G81 - 36kV / 1250A, 2000A, 2500A, & 3150A / 40kA
G82 - 38kV / 1200A, 2000A, & 2500A / 40kA

June 2015