

Gas Insulated Switchgear **XD**

145, 252, 363kV-Advanced Technology in a Modular, Flexible, and Compact Design



with Primary Plus™

Pre-engineered solution set that digitizes primary equipment and provides factory installed and configured protection, monitoring, diagnostics and communications.



PDM is the preferred supplier of Gas Insulated Switchgears for North America transmission and distribution networks.

Contact your **PDM Senior Account Manager** for more information.

info@pdmlc.net
pdmlc.net



420kV Gas Insulated Switchgear

One of the Largest GIS Vendors in the World **XD**

For over a century, utilities around the world have relied on GE to deliver products and services to increase power system, and improve grid resiliency and responsiveness. As a global leader in providing grid infrastructure products and services, GE supports a broad set of utility applications ranging from transmission and substation automation to distribution networks and smart metering, enabling greater safety, connectivity and increased security.

Through an alliance with XD Electric®, GE has extended its portfolio to include all high, extra-high, and ultra high-voltage power equipment supporting the highest transmission voltage levels in the world. XD Electric is one of China's largest primary equipment manufacturers dedicated to the research, application and development of high and ultra high-voltage power transmission solutions. XD Electric has a broad range of products to transform and direct the flow of power for industrial, commercial and residential users.

PDM is the preferred supplier of XD|GE Gas Insulated Switchgears for North America transmission and distribution networks and are sold under the PDM name.

Performance Quality in a Compact, Flexible Design

PDM's Gas Insulated Switchgear (GIS) solutions are for high to ultra high-voltage power transmission and distribution networks.

PDM offers a highly reliable, compact GIS that lowers installation space and reduces maintenance requirements. Designed with light-weight, durable aluminum enclosures, total load on the foundation and building floors is significantly reduced. The PDM GIS requires a low level of maintenance throughout the life of the product. The main components, including circuit breakers, disconnectors, earthing switches, and operating mechanisms, are designed for a normal operation of more than 30 years.

Key Features & Benefits

Designed for Reliability and Safety

Our design features a minimum number of moving parts and live parts have been enclosed to protect the insulation system against the external environment.

Durability

To ensure durability, we employ the latest digital machinery technology including the cold flanging and welding of high-strength aluminum enclosures, epoxy resin casting of insulators, and high-strength aluminum alloy casting.

Lower Cost of Ownership

High-grade materials and components provide a maximum life cycle of greater than 30 years and reduced maintenance over the life of the product. Our designs utilize light-weight aluminum which reduces the costs of civil work and foundation preparation, and provides easy bay access resulting in less scheduled downtime for maintenance and repair.

Compact and Flexible

Our design optimizes the space available for installation and allows for customizable electrical setups that permit new adaptations and upgrades at any time.



XD|GE has delivered more than 20,000 bays including 631 bays of 363kV and above and 24 bays of 800kV and above.

XD|GE is one of the most reliable Gas Insulated Switchgear suppliers with one of the lowest average fault rates in the world according to a SGCC Service Report.

The quality of these gas insulated switchgear is the result of a rigorous standard quality management system, which has been certified in accordance with ISO® 9001.

With more than 40 years of experience in the development, engineering, manufacturing and project delivery of gas insulated switchgear, XD|GE has the proven experience to successfully implement these critical assets, even in the most challenging environments and applications around the world.

Primary Plus



Primary Plus is a pre-engineered solution set that provides utilities with a means to reduce the time and labor associated with substation construction and expansion, while at the same time utilizing technologies and methodologies familiar to existing resources.

This factory installed and configured solutions include:

- Digitizing primary equipment by replacing labor-intensive, individually terminated copper wires with standardized physical interfaces and open digital communications
- Electrical protection systems optimized for the equipment and application to monitor and react to fault conditions
- Monitoring and diagnostics of critical primary assets to predict problems and proactively manage performance
- Highly secure and ruggedized communication network equipment including industrial strength wireless, fiber optic multiplexers and Ethernet switches

Product Porfolio

PDM's portfolio for gas insulated high-voltage switchgear in North America includes several flexible and modular models from 145kV, 252kV and 363kV.

	Unit	ZF7A-145	ZF9-252	ZF9-363
Rated voltage	kV	145	252	363
Rated current	A	3150	4000	4000
Rated frequency	Hz	50/60	50/60	50/60
Rated power frequency withstand voltage, 1 min (*)	kV	275	460	520
Rated lightning impulse withstand voltage (*)	kV	650	1050	1175
Rated short circuit breaking current	kA	40	50/63	50/63

(*) Phase to earth

GIS with Voltage 145kV

Overview

Model Number: ZF7A-145/T3150-40

This 145kV/3150A/40kA spring operated GIS is very similar to the 72.5kV design. It was also type tested by both KEMA of Holland and CESI of Italy. The product is characterized by a three phase common design, spring/spring operated mechanism, superior insulating and breaking capabilities. For this design type, over 14,000 bays of GIS have been put into service in power stations and transmission networks worldwide.

Key Features

- 3 Phase common single and double bus bar arrangements
- Compact GIS with reduced dimensions:
L x W x H: 6600mm x 800mm x 3150mm
- Circuit breaker with spring operating mechanism, type CT20
- 3 position Disconnecter and Earthing Switch (DES)
- DES is equipped with a motor mechanism
- Fast Earthing Switch (FES) is equipped with a spring mechanism
- 20 year maintenance cycle time • Built-in grounding switches
- Exclusive sealing technology (less than 0.5% leakage rate per year)
- Suitable for Indoor substations up to 145kV, 40kA, 3150A
- Complete, assembled bay fits within one standard shipping container
- Built-in grounding switches

Benefits

Large insulating margin: Electrical field intensity of the surfaces of insulating parts and conductors is designed to be kept at a low, reliable level through optimization of electrode profiles, material used and manufacturing techniques.

Excellent interrupting property: The interrupter adopts the advanced arc extinguishing technology by utilizing both the arc energy and spring mechanism energy, so that it can reliably break fault current and load current at all levels up to its rated values.

Excellent seismic-withstand capability: The overall design has the features of simple structure, light-weight, low gravity, which provide excellent seismic withstand capability.

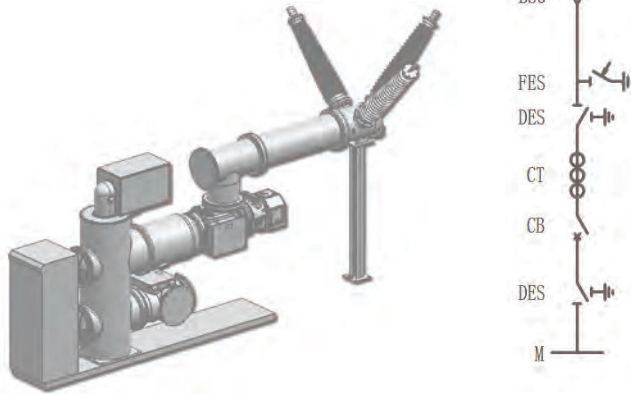


145kV Gas Insulated Switchgear in Hong Kong

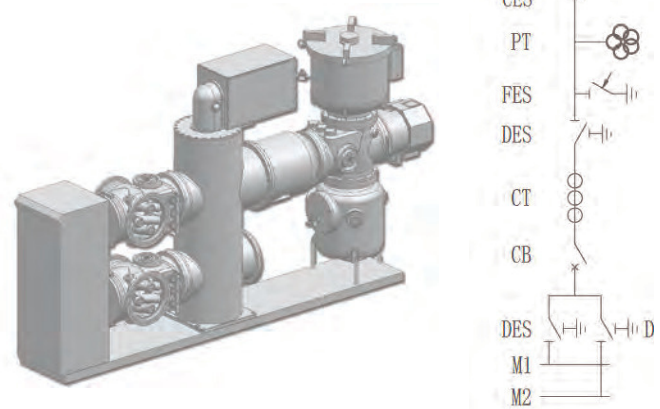
GIS with Voltage up to 145kV

Applications & Bay Configurations

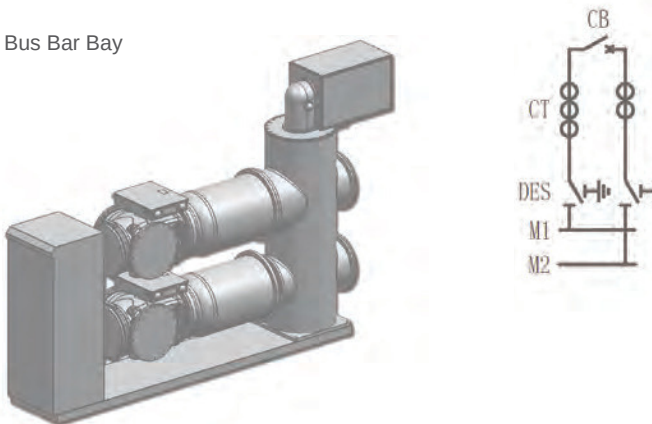
Single Bus Bar



Double Bus Bar



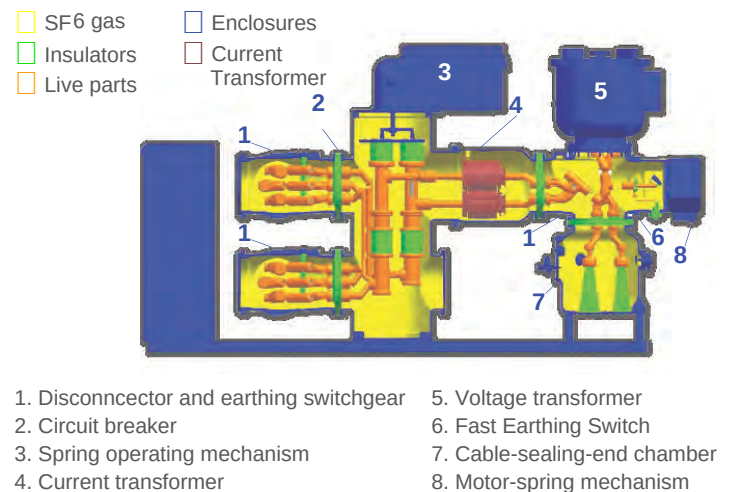
Bus Bar Bay



Specifications of 145kV GIS

	Unit	ZF7A-145	
Rated voltage	kV	145	
Rated current	A	3150	
Rated frequency	Hz	50/60	
Rated power frequency withstand voltage, 1 min (*)	kV	275	
Rated lightning impulse withstand voltage (*)	kV	650	
Rated short circuit breaking current	kA	40	
Breaker mechanism type		Spring	

Cross Sectional View



GIS with Voltage up to 252kV

Overview

Model Numbers: ZF9-252/T4000-50 and ZF9-252/Y4000-63

The 252kV class, indoor GIS solutions have been sold for over 10 years within substations around the world. Since its introduction, over 4,500 bays have been installed and are in service today.

Purposefully designed with operating components contained within a sealed metal container that is filled with insulating gas, this GIS class reduces installation space requirements, is more resistant to weather impacts, and is easier to maintain.

With future expansion in mind, the 252kV GIS is able to grow with your system and still adhere to wiring requirements and standards. For greater application flexibility, the 252kV GIS can be constructed as individual phase or three phase common busbar.

Key Features

- Innovative design that offers a three phase common busbar and single phase circuit breaker enclosure
- Compact GIS with reduced dimensions:
L x W x H: 6600mm x 1800mm x 3150mm
- Circuit breaker operating mechanism with either spring (50kA) or hydro-mechanical (63kA) device
- For horizontal circuit breaker configurations, an electrical control bay operates all three phases at the same time
- Built-in grounding switches
- 3 position Disconnect and Earthing Switch (DES)
- Exclusive sealing technology (less than 0.5% leakage rate per year)
- 20 year maintenance cycle time

Benefits

Smaller footprint: With a bay designed to fit on a standard transport vehicle transportation and installation costs are reduced and the need for specialized transportation equipment is eliminated.

Ease of installation: The integration of the local control panel and GIS results in a compact design coupled with secondary wiring arrangements completed in the factory, on-site installation and commissioning work is reduced, saving project time and money.

High reliability: For the Disconnect Switch, Earthing Switch, and Fast Earthing Switch components, the mechanisms for all three phases are directly connected, delivering a compact structure with greater reliability.

Ease of transportation: As the mechanical assemblies are a compact three phase common enclosure that contains just a few moving parts, adjustments between phases is reduced. The equipment's compact design also considerably reduces transportation costs and on-site installation time.



252kV Gas Insulated Switchgear



252kV Gas Insulated Switchgear

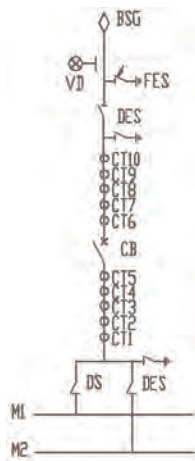
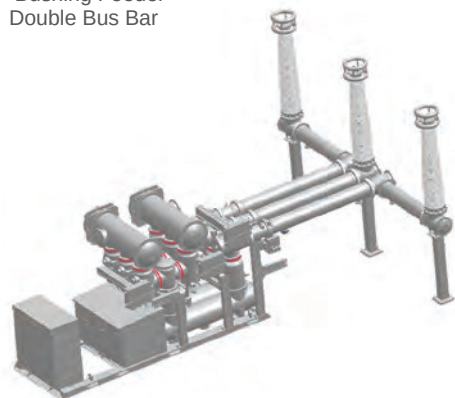


252kV Gas Insulated Switchgear

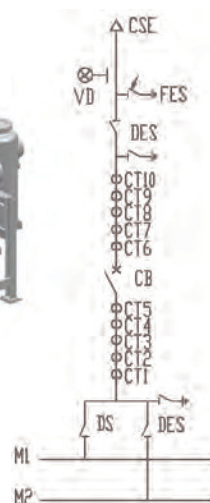
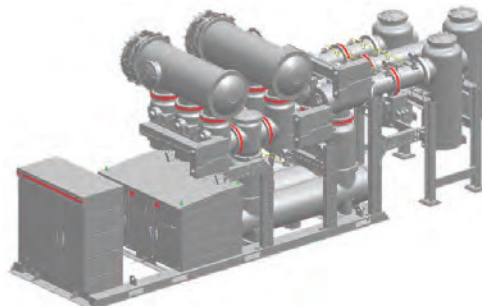
GIS with Voltage up to 252kV

Applications & Bay Configurations

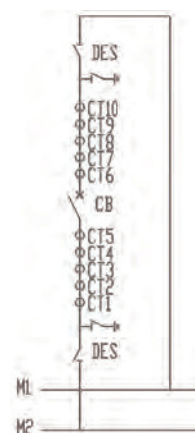
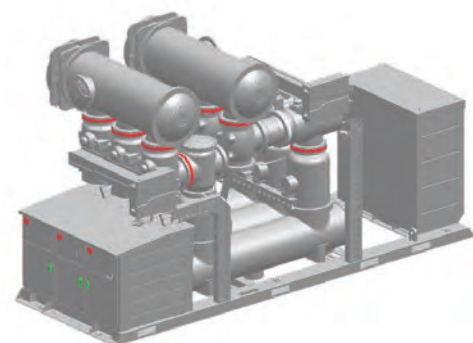
Bushing Feeder
Double Bus Bar



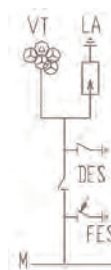
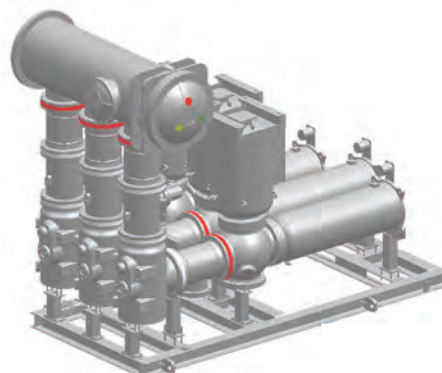
Cable Feeder
Double Bus Bar



Bus Bar
Coupling Bay



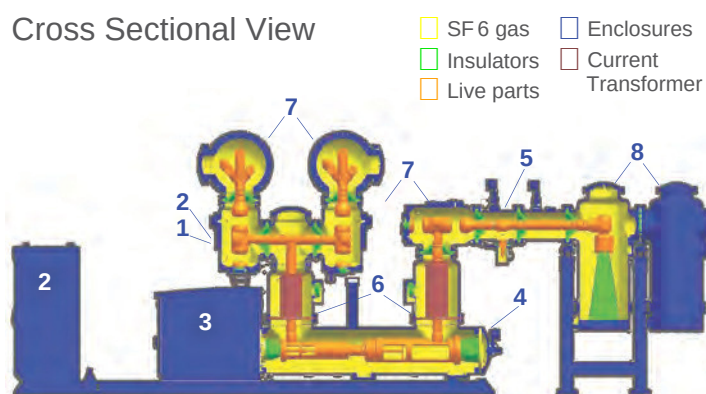
Measurement &
Protection Bay



Specifications of 252kV GIS

	Unit	ZF9-252
Rated voltage	kV	252
Rated current	A	4000
Rated frequency	Hz	50/60
Rated power frequency withstand voltage, 1 min (*)	kV	460
Rated lightning impulse withstand voltage (*)	kV	1050
Rated short circuit breaking current	kA	50
Breaker mechanism type		Spring /Hydro-mechanical

Cross Sectional View



1. Disconnect Switch
2. Earthing Switch
3. Motor operating mechanism
4. Circuit breaker
5. Hydro-mechanical mechanism
6. Current transformer
7. Main bus
8. Current Transformer

GIS with Voltage up to 363kV

Overview

Model Numbers: ZF9-363/Y4000-50 & ZF9-363/Y4000-63

The 363kV Gas Insulated Switchgear product continues to be an industry leader when it comes to the design, manufacturing, management, and testing of this high voltage primary equipment. With more than 550 bays installed and in operation, the ZF9-363 family of GIS is designed to both IEC® and ANSI®/IEEE® standards. Utility customers have come to rely on this product to provide advanced parameters, reliable function, simplified operation, and reduced maintenance.

Key Features

- Single or three phase enclosure design
- Dimensions:
 - L x W x H: 7190mmX2700mmX7285mm (bushing height)
- Vertical and single break circuit breaker design
- Circuit breaker with hydro-mechanical operating mechanism
- Disconnect and Earthing switches with motor operating mechanism
- Fast Earthing Switch with motor driven spring mechanism
- Exclusive sealing technology (less than 0.5% leakage rate per year)
- Built-in grounding switches

Benefits

Ease of installation: The integration of the local control panel and GIS results in a compact design coupled with secondary wiring arrangements completed in the factory, on-site installation and commissioning work is reduced, saving project time and money.

Standardized modular design: A standardized and modular design serves as the basis for various configurations allowing for maximum application flexibility with the fewest number of components.

Online monitoring: This product meets all the requirements of an intelligent power station. With integrated electronic current transformers (ECT) and electronic voltage measurement, utilities are provided with the ability to monitor SF₆ gas partial discharge, and mechanical behaviors online.



363kV Gas Insulated Switchgear at Golmud Substation



363kV Gas Insulated Switchgear

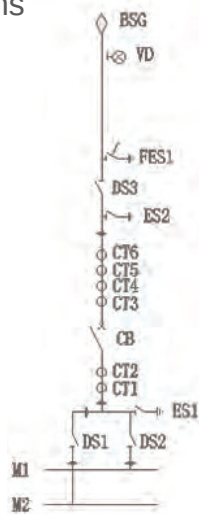
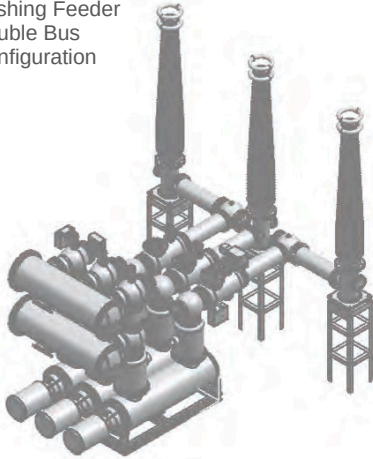


363kV Gas Insulated Switchgear in Weenan, Shaanxi

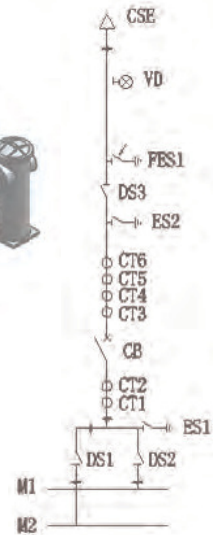
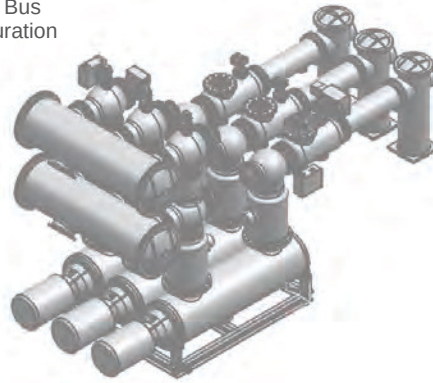
GIS with Voltage up to 363kV

Applications & Bay Configurations

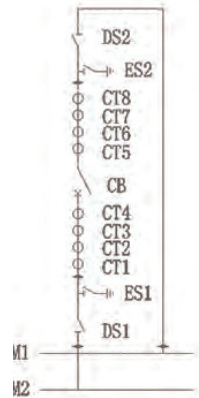
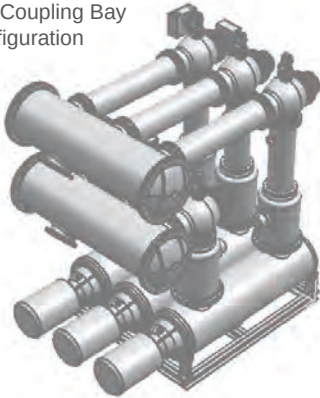
Bushing Feeder
Double Bus
Configuration



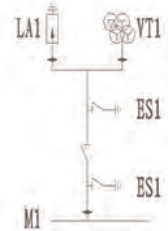
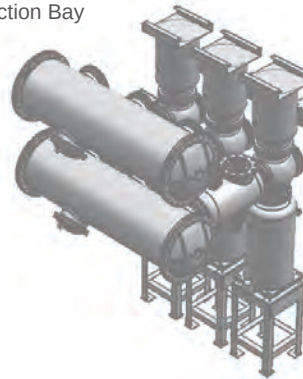
Cable Feeder
Double Bus
Configuration



Bus Coupling Bay
Configuration



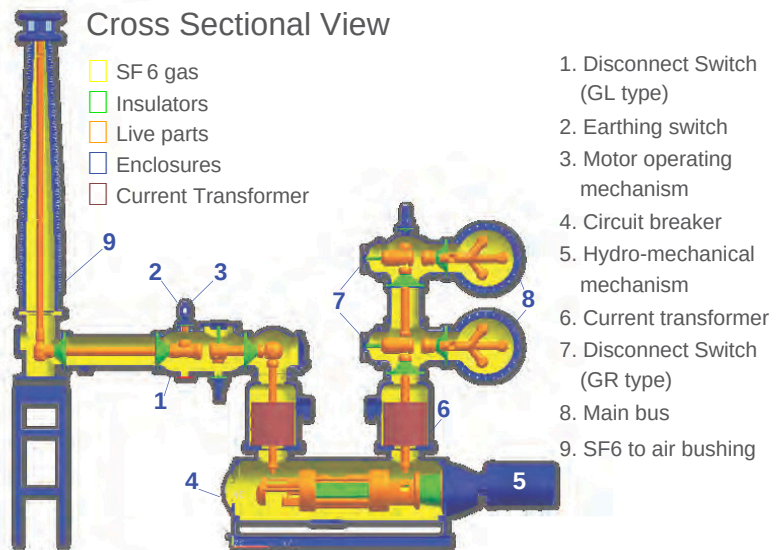
Measurement and
Protection Bay



Specifications of 363kV GIS

	Unit	ZF9-363
Rated voltage	kV	363
Rated current	A	4000
Rated frequency	Hz	50/60
Rated power frequency withstand voltage, 1 min (*)	kV	520
Rated lightning impulse withstand voltage (*)	kV	1175
Rated short circuit breaking current	kA	63
Breaker mechanism type		Hydro-mechanical

Cross Sectional View



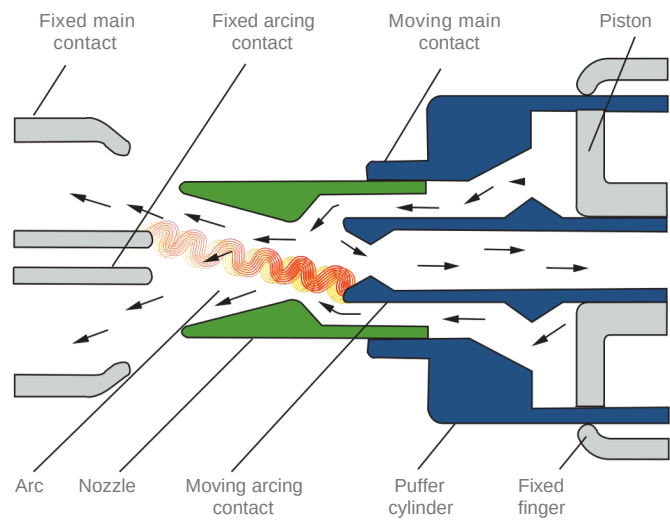
Technology

For voltage ratings below 420kV, the circuit breaker is in a single break arrangement. Above 420kV, the circuit breaker is a double-break in the horizontal arrangement, with parallel capacitors. Adopting SF6 gas as an arc extinguishing medium, the interrupter is designed as a puffer type. The contact nozzle structure allows for a short circuit current rating of 67kA and meets all required breaking abilities, including out of phase and short line fault.

Interrupter

The figure to the right shows the principle construction of the interrupter. The pressure of the gas in the puffer cylinder goes up when the gas is heated by the arc and then compressed by the opening movement of the puffer cylinder. The pressurized and compressed gas then goes to the arc between the stationary contact and the moving contact. The nozzle concentrates the gas flow to the arc for efficient cooling.

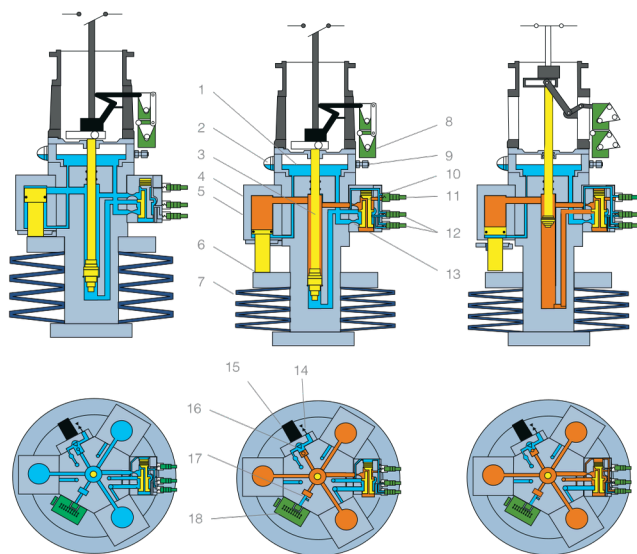
Construction and Key Components of the GIS Interrupter Module



Hydromechanical Operating Mechanism

The hydromechanical mechanism has a modular design that allows for easy maintenance. Disc springs are used to store the energy for operating the breaker. The mechanism has two independent control valves for opening to ensure reliable operation. The direct connection to the interrupter provides

a one to one travel distance between the interrupter and the mechanism. This mechanism can be operated either in single phase or in three phase electrically, and can be gang-operated in three phase mechanically.



a. Uncharged, open position b. Charged, open position c. Charged, closed position

1. Low pressure oil tank
2. Oil lever indicator
3. Operating piston rod
4. High pressure oil tank
5. Piston for charge
6. Support ring
7. Disk spring
8. Auxiliary switch
9. Oil-filling hole
10. Throttle of close
11. Electro-magnetic valve for close
12. Electro-magnetic valve for open
13. Throttle of open
14. Oil drainage valve
15. Energy-store motor
16. Oil pump
17. Pressure release valve
18. Spring position switch



Spring Operating Mechanism

The design of the spring operated mechanism provides the high performance required for reliable operation. The lever engaged with the locking device, which is released when the trip coil is energized, is rotated counterclockwise by the trip spring (Fig.1).

The cam and the ratchet wheel engaged with the locking device, which

is released when the closing coil is energized, are rotated counterclockwise by

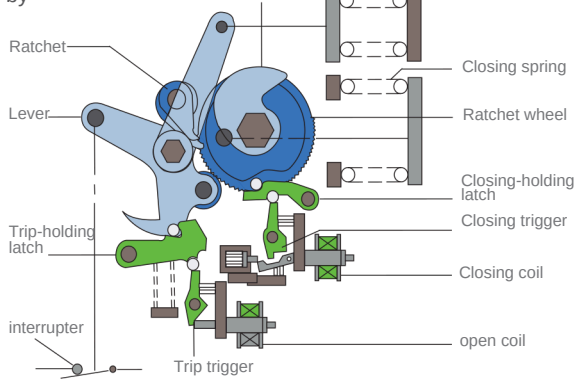


Fig1. Closed position (closing spring charged)

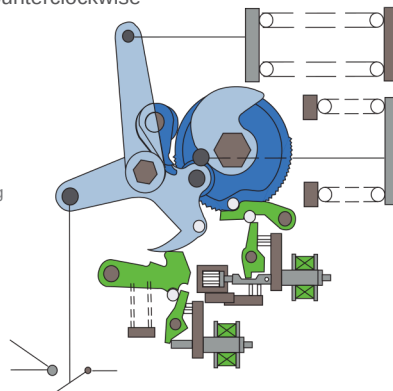


Fig2. Open position (closing spring charged)

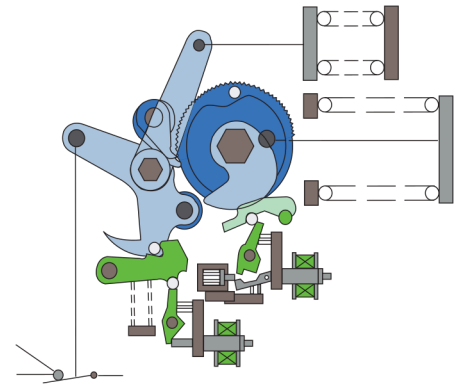


Fig3. Closed position (closing spring discharged)

the closing spring. The lever is rotated clockwise, compressing the trip spring by torque from the cam (Fig.2).

As soon as the closing sequence is completed, the closing spring is charged by the ratchet linked to the motor (Fig.3).

Current Transformer

The current transformer is an epoxy resin coated casting. The bus conductor functions as the primary coil and the secondary coil is a fixed ring core. The measurement and protection coil of the CT are at earth potential, with high precision 0.2 class. Special accuracy ratings are available upon request.

Disconnecter

There are two types of disconnectors in the GIS; types GR and GL. For GR, the configuration is at 90 degrees and GL is configured in-line. One or two earthing switches may be installed in each of these two disconnector types, making a more compact and flexible structure. Based on application and customer requirements, the disconnectors may be used to switch small capacitive, inductive current and/or busbar transfer currents.

Earthing Switch (ES) and Fault Earthing Switch (FES)

Earthing and fault earthing switches are installed on each disconnector. One or two ES/FES can be installed on each. Insulation spacers are included between the enclosure of the earthing switch and breaker compartments. After disassembly of the earthing bar, measurement of the main circuit resistance and inspection of the mechanical characteristics of the circuit breaker may be carried out. FES has the capability of making short circuit current and switching inductive currents. The ES/FES can be provided with either motor/spring or pneumatic mechanisms.

Main Busbar and Branch Busbar

Depending on voltage level and configuration, the main busbar and branch are either single phase or three phase encapsulated. The enclosure material is aluminum tube or casting, which eliminates eddy current heating.

Surge Arrestor, Voltage Transformer and SF6 Bushing

The surge arrestors and voltage transformers are all enclosure type structures, using SF6 gas as the insulation medium in the vertical arrangement. SF6 entrance bushings have pollution withstand capability up to class 5 with an advanced inner shield design. The bushings are small in diameter and light in weight with high earthquake resistance. Both composite and porcelain bushing can be provided.

Innovative Facilities and Rigorous Quality Processes

This technology portfolio is built in advanced manufacturing and testing facilities that follow robust quality processes, to provide customers with products that meet the critical and demanding reliability and environmental requirements of power transmission and distribution applications.

Manufacturing Excellence

We design a broad range of switchgear in five, vertically integrated and specialized production facilities including machining, surface treatment, insulating, housing and casting.

Additionally, there are two specialized facilities that produce both the spring and hydromechanical operating mechanisms.

Final production is completed in three workshop assembly lines that total more than 50,000 square meters. Components such as aluminum enclosures, cast resin insulators, current and voltage transformers, and operating mechanisms are manufactured through this completely integrated manufacturing model.

The switchgear facilities are ISO 9001 certified, ISO 14001 certified for environmental management systems, as well as OSHA® 18001 certified for health and safety management systems.

Exceptional Quality

Delivering high quality, reliable products and solutions is a primary directive and that is evident throughout the manufacturing facilities. The quality process begins with an incoming inspection of all materials to ensure the best possible inputs before manufacturing begins.

Throughout the production and assembly process, there are multiple checkpoints, including both visual inspections as well as stopped flow inspections all performed to documented test plans. The production facilities follow strict non-conforming procedures to identify, control and avoid the use and delivery of non-conforming products. Each production facility has developed strict environmental standards, including controls of cleanliness, temperature and humidity, and has controls in place to monitor and manage to established standards.

In addition, we have a dedicated measurement and inspection department with a certified full time inspector in each of its manufacturing sites. The measurement and inspection department provides a secondary cross-inspection for all work in process, as well as finished products, ensuring a high level of quality is achieved throughout the manufacturing process. First Pass Yield and Cost of Quality data is maintained and analyzed, per product family, in order to drive continual product and process improvements and higher product reliability.

From raw materials acquisition and inspection to finished product, our GIS is designed to meet rigid quality processes so the installed product provides the highest level of reliability while focusing on lowering the total cost of ownership.

Advanced Test Facilities

XIHARI®, the Xi'an High Voltage Apparatus Research Institute, is an integral part of the XD|GE alliance. XIHARI has extensive testing capabilities at its facilities, which include a: High Power Laboratory, High Voltage Laboratory, Artificial Climate Laboratory, EMC Laboratory and an Operational Test Circuit for HVDC Thyristor Valves. At the switchgear facilities, once final assembly is completed, the switchgear modules/bays are tested at the High Voltage Laboratory. The testing facility allows for the testing of a single breaker module, a single bay or a complete substation according to the international standards.

The testing hall meets all of the requirements of ISO/IEC 17025 and

houses

some of the largest test equipment in the world, providing the capacity to test primary equipment as large as 1,100kV AC. The High Voltage

Apparatus

Laboratory in XIHARI is a government authorized national high-voltage apparatus quality supervision and inspection test center. It is an

independent

third-party laboratory for type tests, routine tests, performance tests and certificate tests for high-voltage apparatus. The testing facilities at

also include an extension environmental laboratory. Testing capabilities include high-altitude testing, high humidity testing, and temperature testing from -70°C up to +150°C.



Support and Service

Global Project Engineering Services

We are dedicated to helping its customers reach their system objectives and provides a suite of professional services to assist the successful deployment and maintenance of products and solutions globally. From design and implementation to post-sales support, a team of highly skilled technical and business experts are available to help customers effectively use the capabilities and product domain knowledge.

This support infrastructure covers the entire life cycle of the product. From the coordination of transportation logistics to the completion of site acceptance testing and warranty service, the highly qualified team is available throughout the implementation.

To ensure a high quality of service to meet the needs of each unique application, XD|GE offers a global field service team of highly experienced and dedicated individuals. Coupled with a vast network of high voltage power equipment domain experts, we are able to support a broad range of applications in various environments.

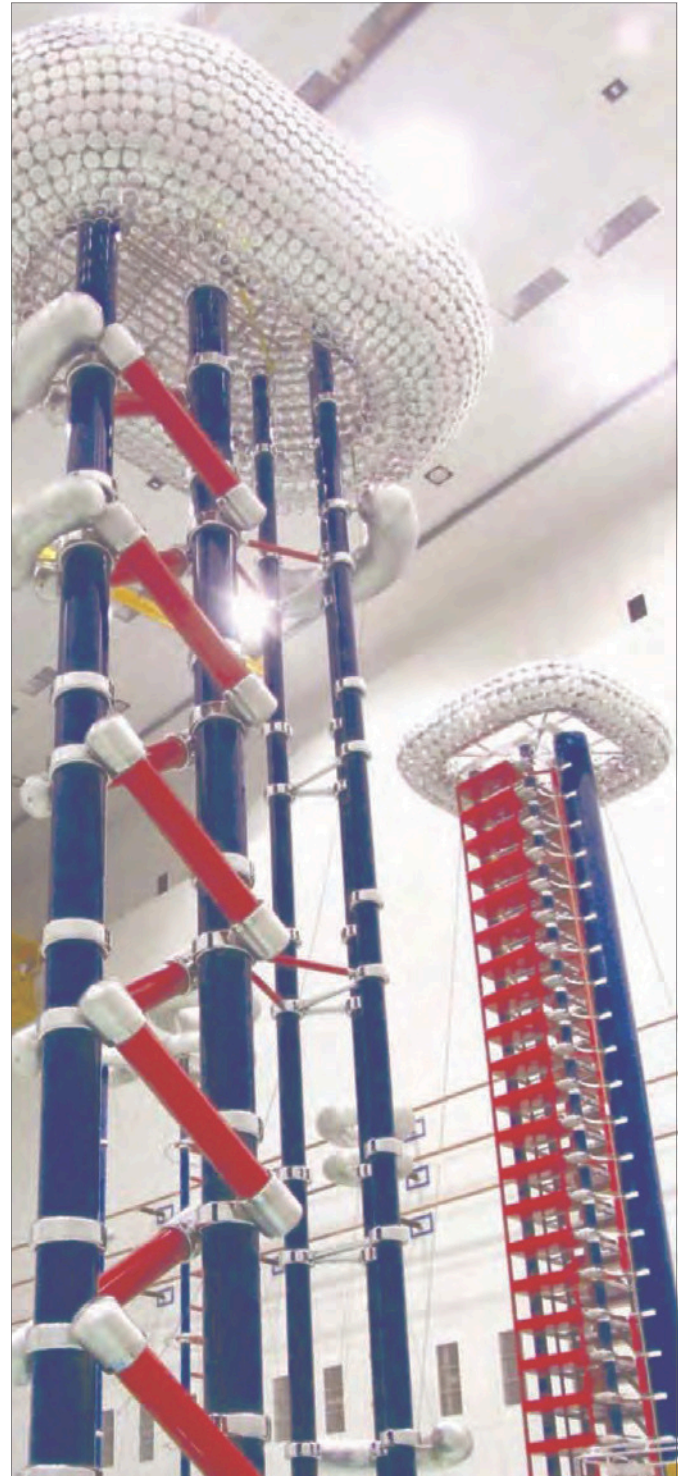
Finally, a 24x7 global support service is available to address and direct any customer application and field questions.

Specialized Installation and Commissioning

- Logistics and project management including coordination of ocean and inland transportation
- Installation services include receiving, rigging, unloading and labor (mechanical and electrical)
- Test commissioning
- Site acceptance testing

Post-Sales and Installation Support

- 24x7 global customer service
- Emergency response hotline
- Several customer support access points available to ensure timely support (telephone, e-mail, fax, or web)
- Global spare parts reserve
- A global network of maintenance and repair facilities



4800kV/720 kJ Impulse Voltage Generator &
±2000kV 30mA DC Voltage Generator

Primary Plus



Pre-Engineering Secondary Equipment

Primary Plus, a supplemental offering to its primary equipment, is a pre-engineered, factory installed solution set that allows utilities to reduce the time and labor associated with substation construction and expansion. Primary Plus uses technologies and methodologies familiar to existing resources and skill sets.

- Digitized primary equipment for replacing labor-intensive, individually terminated copper wires
- Electrical protection to monitor and react to fault conditions
- Advanced monitoring and diagnostics capabilities to predict problems and proactively manage asset performance
- Secure and ruggedized wireless devices, fiber optic multiplexers and Ethernet switches provide reliable communications infrastructure.



Digitized Substation

Multilin™ HardFiber System

- Using the Multilin HardFiber system, we deliver primary equipment with digital communications. The Multilin HardFiber system provides a reduction in total life costs of protection and control through labor and resource optimization.
- This factory-installed solution reduces the amount of labor-intensive, individually terminated copper wire connections with pre-terminated copper and fiber optic cables that have standard physical interfaces and support open digital communications (IEC 61850 Communications standard).

Key Benefits

- Reduces up to 50% of labor costs for protection and control
- Replaces extensive copper wiring with pre-terminated copper and fiber cables
- Reduces specialized on-site labor by shifting spending to readily available materials
- Improves employee safety by leaving potentially dangerous high-energy signals in the switchyard
- Reduces the chances for operational mistakes made during isolation and restoration during routine maintenance
- Built on the Multilin Universal Relay (UR) family, allowing for fast transition into most protection and control applications
- Eliminates up to 90% of control building terminations



Electrical Protection & Control

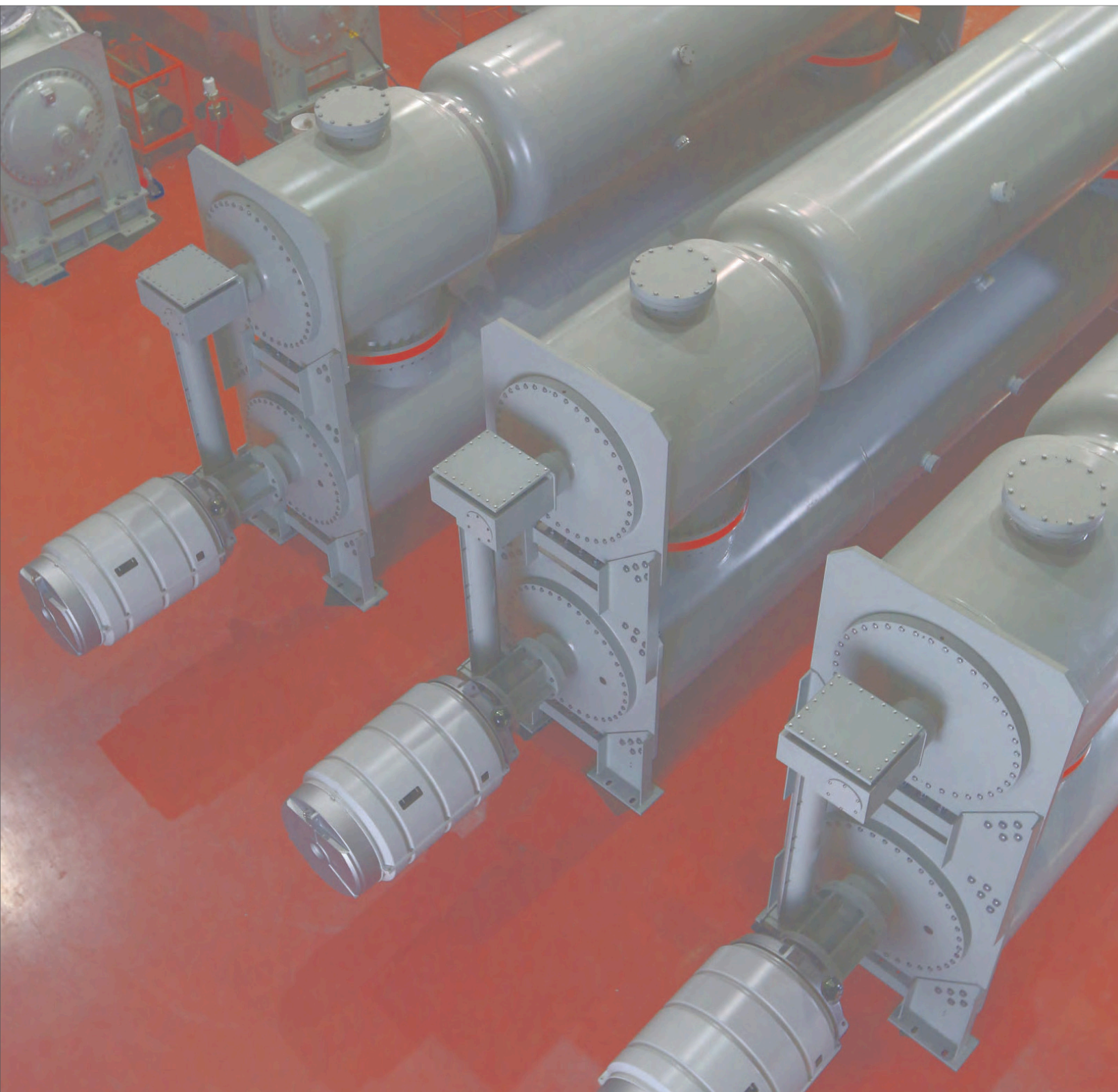
Advanced Relay's for Substation Equipment

Primary Plus uses Multilin protection & control relays to provide primary protection of this critical primary equipment. Depending on the type of power asset connected to the GIS and the specific application requirements, the most appropriate protective device can be deployed (i.e.: Feeder Protection, Transformer Protection, Line Differential Protection). Advanced protection algorithms, expandable I/O, extensive programming capabilities and automation, high accuracy metering, and the latest in communications technologies provide optimal primary asset management and maximum system availability.

Key Benefits

- Common, modular platform to meet unique application design requirements
- Advanced automation, I/O expandability, and programming logic for customized protection and control solutions
- High accuracy fault and disturbance recording for improved post event analysis
- High speed communications and inter-relay connectivity, including support for IEEE 1588 for reduced wiring and installation costs
- CyberSentry™ provides high-end cyber security (NERC® CIP, AAA, Radius, RBAC, Syslog)
- Integrated monitoring and metering for reliable asset management and maintenance optimization
- Embedded IEC 61850 protocol support, eliminating the need for external communications hardware
- Multi-language support to meet local application needs and requirement







Contact your PDM Senior Account Manager
for more information.

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