



ABB - ELDS 2020

# Tableros de Distribución Primaria GIS

Familia ZX

Daniel Perez, Product Marketing Specialist

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# ZX Family

# Ratingen factory: Pioneers in GIS

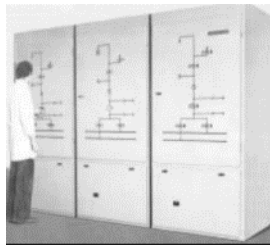
50 years of experience

1967



- ZF type up to 110 kV
- First 110 kV GIS
- First indoor Switchgear

1980



- ENK type up to 72.5 kV
- First GIS with vacuum circuit breaker
- First 3 phase encapsulated GIS

1983



- ZV type up to 52 kV
- First internal arc Phela tested switchgear



- ZR type up to 24 kV
- Compact ring main unit for secondary distribution

1995



- ZX family up to 42 kV
- 4 different MV product lines
- First GIS with no gas handling on site
- Actual product portfolio

2015



- AirPlus type up to 36 kV
- First GIS with eco-efficient gas instead of SF<sub>6</sub>

# ABB AG Calor Emag Medium Voltage Products

Key components under one roof

## Leader in GIS Technology

- Center of excellence for Vacuum Interrupters and MV GIS
- Testing laboratories and R&D center
- More than 1,200 employees
- Training and knowledge transfer
- Factory according Industry 4.0 A.K.A. “Smart Factory”
- ZX panels produced > 75,000



Ratingen factory, Germany



Vacuum Interrupter



Embedded Poles



Vacuum Circuit Breakers



Implementation of Protection and Control Units



Primary MV GIS



Service

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# MV Primary Gas-insulated Switchgear – ZX Family

Where is MV GIS technology used?

## Applications

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### Utilities

#### Electricity Distribution

- Substations
- Power Generation
  - Conventional
  - Renewables



### Industry

- Oil and Gas
- Mining and Minerals
- Pulp and Paper
- Petrochemicals
- Steel



### Transportation

- Rail
- Airports
- Marine
  - Offshore Applications
  - Vessels



### Building

- Data Center
- Hospitals
- Infrastructure



# MV Primary Gas-insulated Switchgear – ZX Family

## References

### Canada



Crosslinx Transit Solution Constructors  
122 x ZX2 Panels for Toronto Metro

### Brazil



Arena Fonte Nova  
18 x ZX0.2 Panels for the WM station

### Turkey



Istanbul Metropolitan Municipality  
198 x ZX0.2 panels for the Istanbul Metro

### South Africa



City of Cape town  
More than 100 x ZX0.2 Panels for The Cape Town



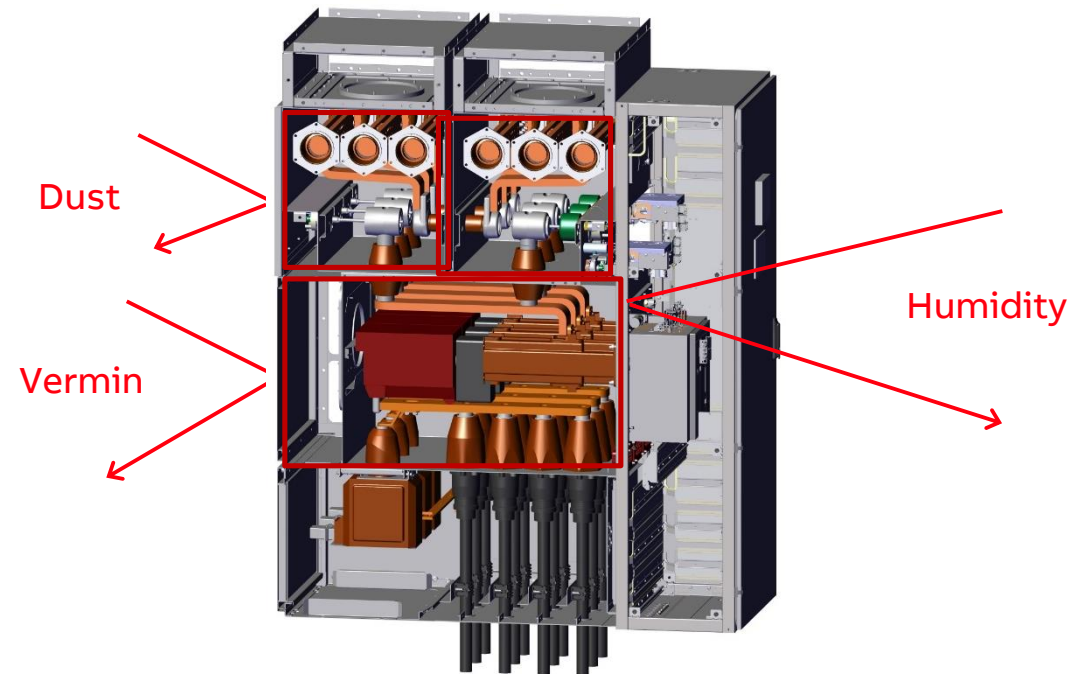
Over 75.000 panels installed in more than 100 countries!

# MV Primary Gas-insulated Switchgear – ZX Family

What is GIS technology?

## Gas-insulated Switchgear (GIS)

- Medium voltage parts are located inside hermetically sealed gas compartments, air is replaced by non-reactive insulating gas (SF<sub>6</sub>)
- Little/no fault probability
- Reduced maintenance requirements
- Smaller dimensions
- Long lifetime: 40 years
- Suitable for high altitude and underground applications



GIS offers increased safety, reliability and reduced footprint

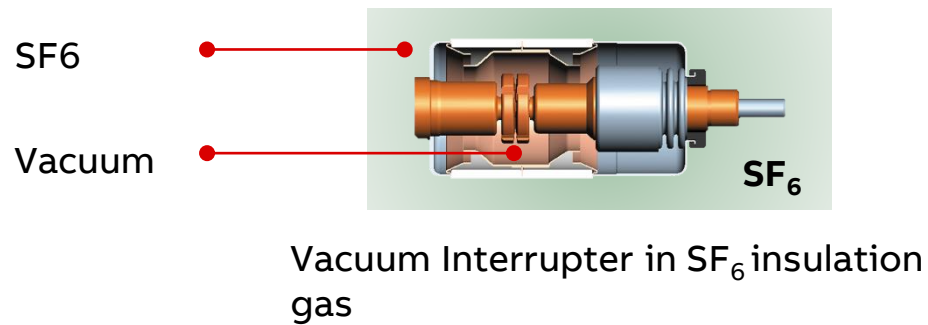
# MV Primary Gas-insulated Switchgear – ZX Family

GIS design: Gas tank and vacuum interrupters

## No maintenance - sealed gas tanks and vacuum interrupters

Maintenance-free MV parts

- Hermetically sealed gas tank
- SF<sub>6</sub> as insulation medium
- Vacuum interrupters for switching

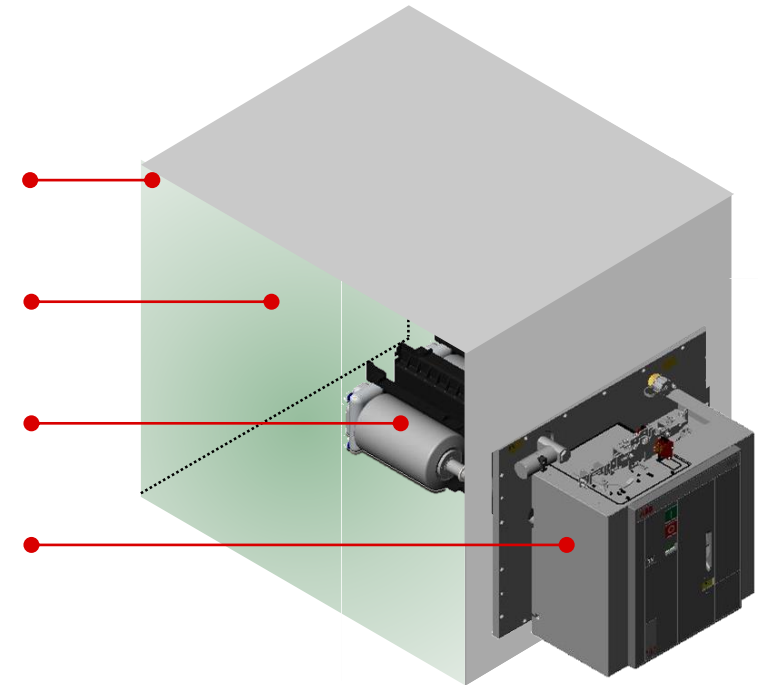


Gas tank

SF<sub>6</sub> insulation gas

Vacuum interrupter

Mechanism/drive  
(outside gas tank)





# MV Primary Gas-insulated Switchgear – ZX Family

Comparing air-insulated and gas-insulated switchgear

## Air-insulated switchgear (AIS)

### General design

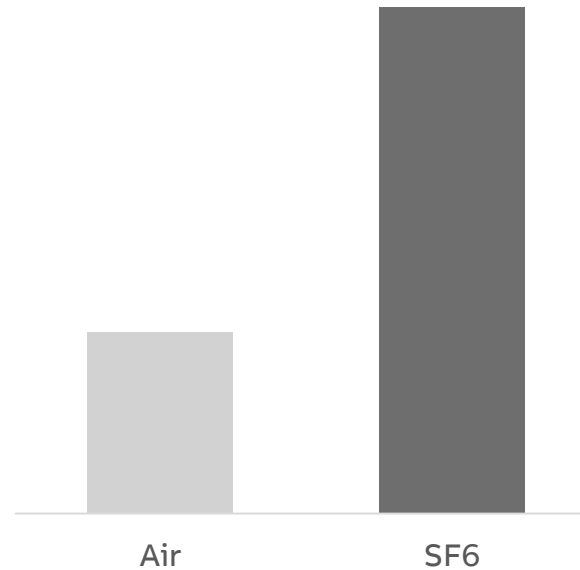
- Structure: Sheet metal compartments
- Insulation medium: Surrounding air



### Benefits

- Structure: Sheet
- High flexibility for different requirements
- Well-known and proven technology
- Lower initial investment
- High local experience to install, operate and perform service works

### Electric insulation performance



## Gas-insulated switchgear (GIS)

### General design

- Structure: Gas-tight steel compartments
- Insulation medium: Sulfur hexafluoride (SF<sub>6</sub>)



### Benefits

- Smaller footprint up to 70%
- Reliable performance, independent from ambient conditions
- Maintenance free MV part
- Maximized safety, arc-resistant, no access to MV parts

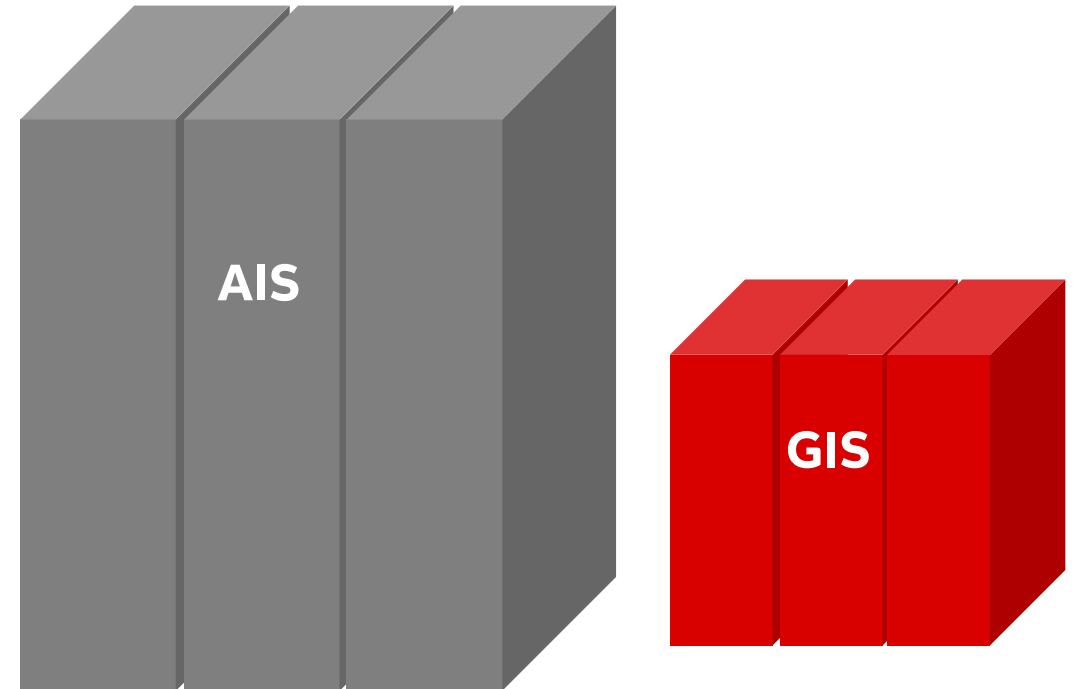
# MV Primary Gas-insulated Switchgear – ZX Family

What about life cycle cost ?

## Life Cycle Cost

- Up to 70 % footprint reduction can be achieved by choosing GIS over AIS
- Cost efficient solution with respect to life cycle cost
  - Cost saving for real estate
  - Long maintenance intervals
  - Less civil works
  - Fewer outages

The right choice today will pay off tomorrow!



# Internal arc test

Operator safety

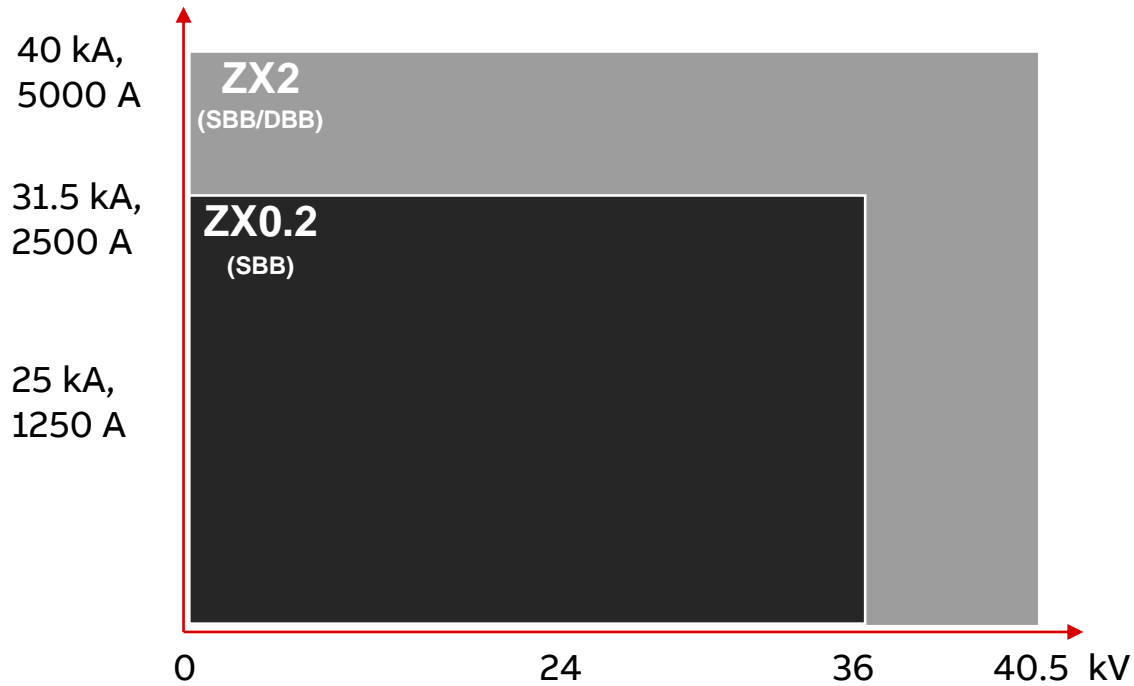
## IEC 62271-200

- IAC Internal arc classification
- AFLR — Accessibility from the rear (R-rear)
  - Accessibility from the sides (L-lateral)
  - Accessibility from the front (F-front)
- Switchgear installed in closed rooms with access restricted to authorized personnel only



# MV Primary Gas-insulated Switchgear – ZX Family

## ZX Family



ZX0.2



ZX2

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**ZX2**

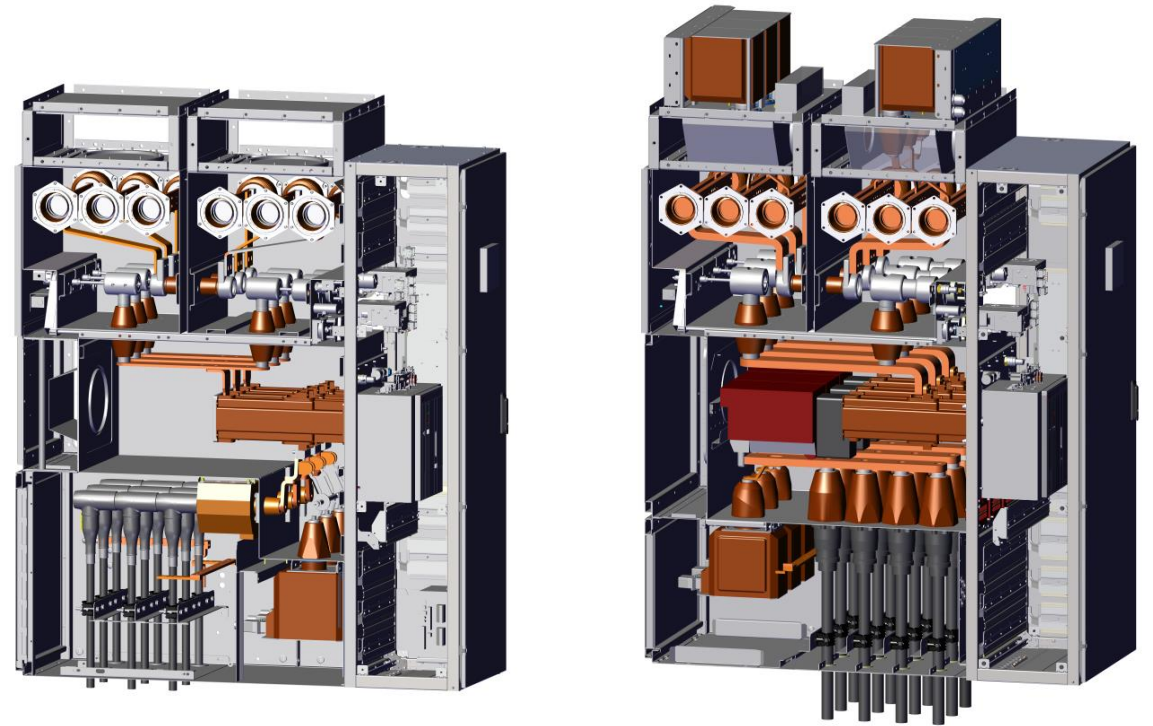


# MV Primary Gas-insulated Switchgear – ZX2

Are you looking for a safe, reliable and compact switchgear design?

## Main Characteristics

Max rated Voltage	<b>40.5 kV</b>
Mas short circuit current	<b>40 kA</b>
Max BB Current	<b>Single busbar: 5000 A Double busbar: 4000 A</b>
Max CB current	<b>3000 A</b>
Panel width	<b>≤ 1200 A: 600 mm &gt; 1200 A: 800 mm &gt; 2000 A: 840 mm</b>
BIL	<b>800/840 mm: 200 kV 600 mm: 170 kV</b>
Factory-assembled, -filled, –tested panels as per IEC 62271-200	
3-phaseen capsulated <b>arc-resistant bays</b>	
Stainless steel <b>segregated gas compartments</b> for live parts	

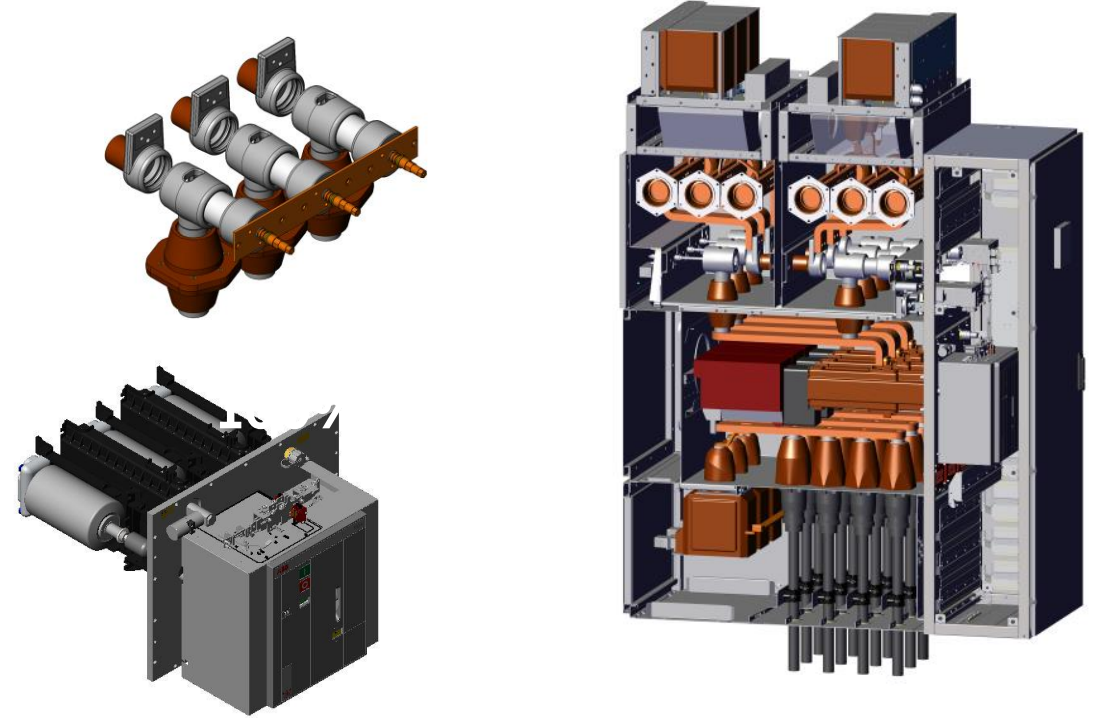


# MV Primary Gas-insulated Switchgear – ZX2

## Key components

### Operation

- Motorized operating mechanisms for switching devices located easily accessible inside LVC
- Manual emergency operation possible
- Advantages of **earthing via circuit breaker and three position switch** in series:
  - Circuit breaker is of higher quality than any earthing switch
  - Higher number of make-proof earthing operations
  - No contamination of SF6 through switching operations
- Optional view ports for visual verification
- High performance CB

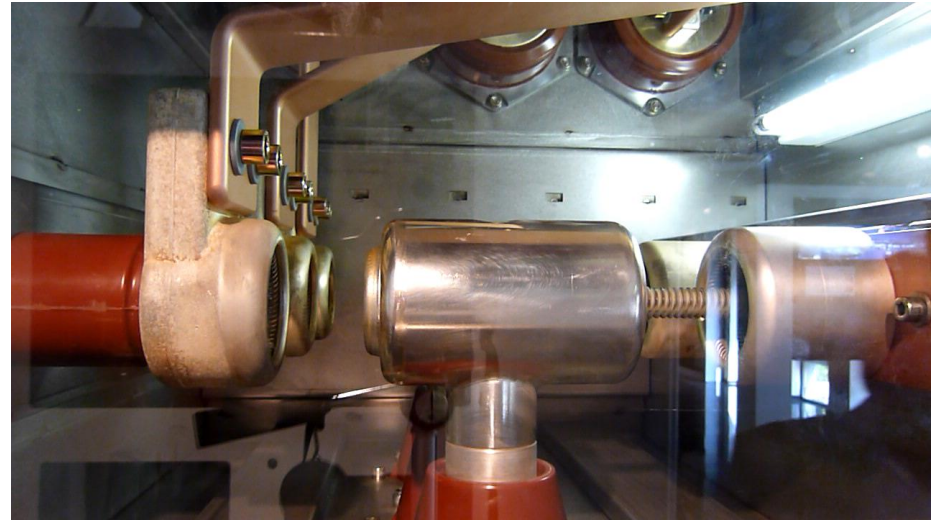


# ZX2 Type Switchgear

What is a three-position disconnect?

## Characteristics

- Three Position: **No load switch**
  - Connected
  - Disconnected
  - Grounding
- **Motorized operating mechanism**, manual emergency operation possible
- **Maintenance-free**
- **Actual view ports** to meet NEC-requirement
- Optional **portable camera** system available



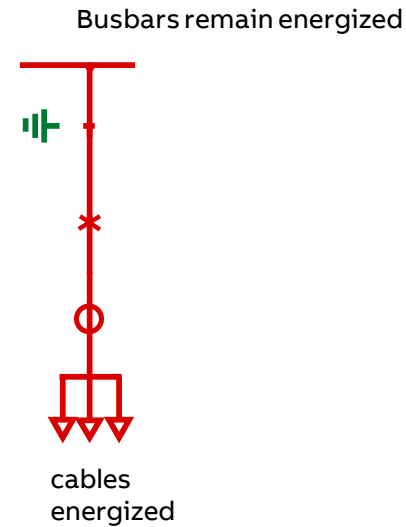
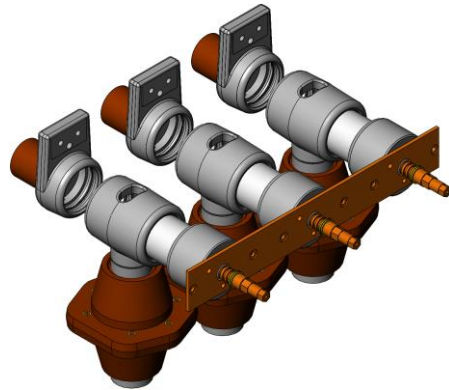
# MV Primary Gas-insulated Switchgear – ZX Family

GIS design: 3-position switch

## Safe cable works - disconnect and cable earthing

- In GIS, withdrawable CB not reasonable due to gas loss
- No-load operation: Pre-select and open/close over CB
- 3-position switch in series with CB

- Connect to busbars
- Disconnect/isolate
- Cable-earthing





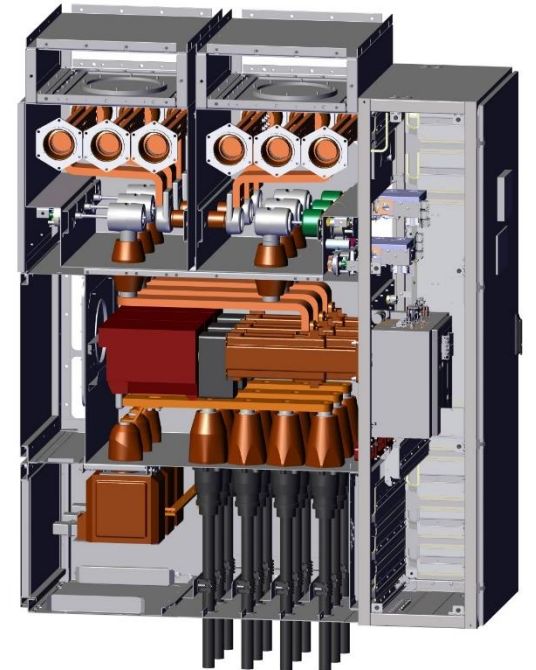
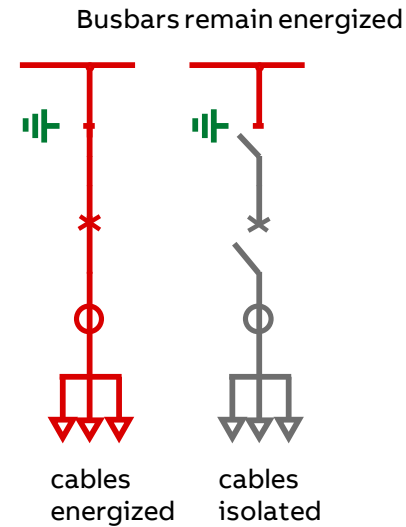
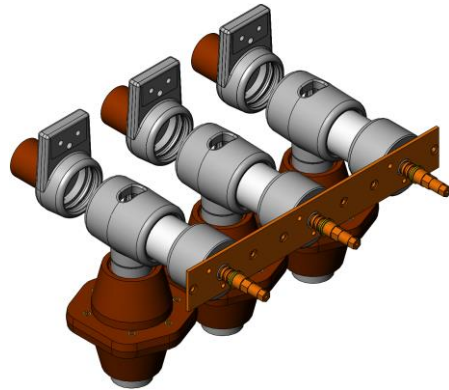
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# MV Primary Gas-insulated Switchgear – ZX Family

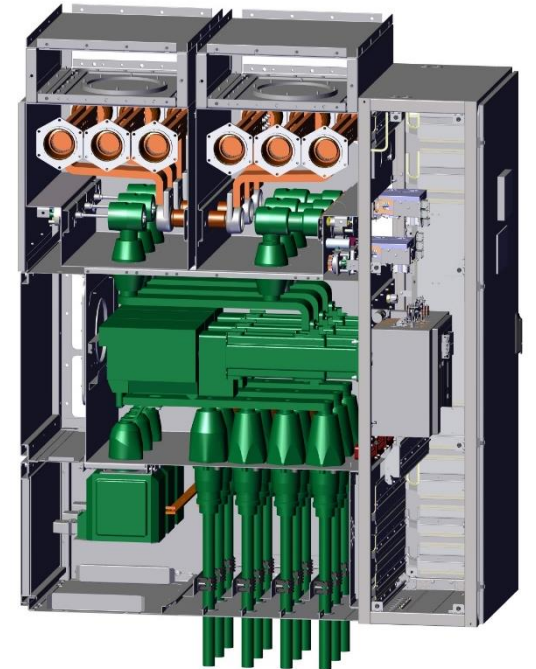
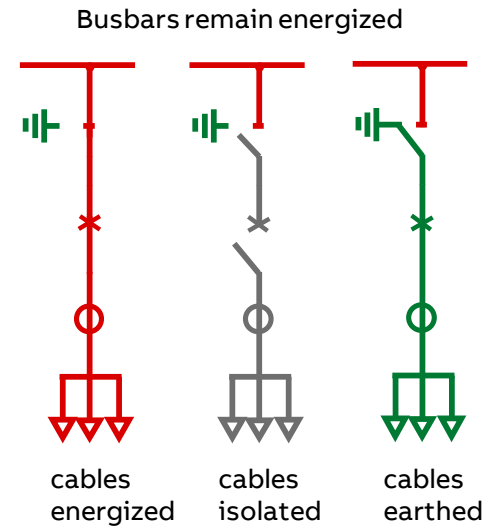
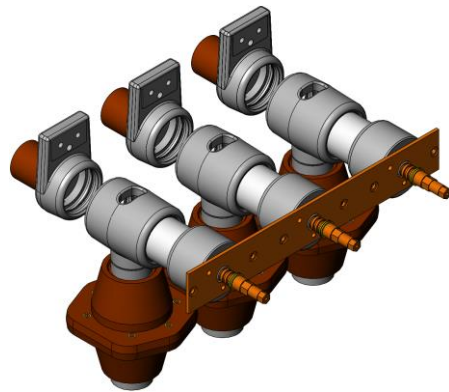
GIS design: 3-position switch

## Safe cable works - disconnect and cable earthing

### 3-position switch instead of withdrawable CB

- In GIS, withdrawable CB not reasonable due to gas loss
- No-load operation: Pre-select and open/close over CB
- 3-position switch in series with CB

- Connect to busbars
- Disconnect/isolate
- Cable-earthing



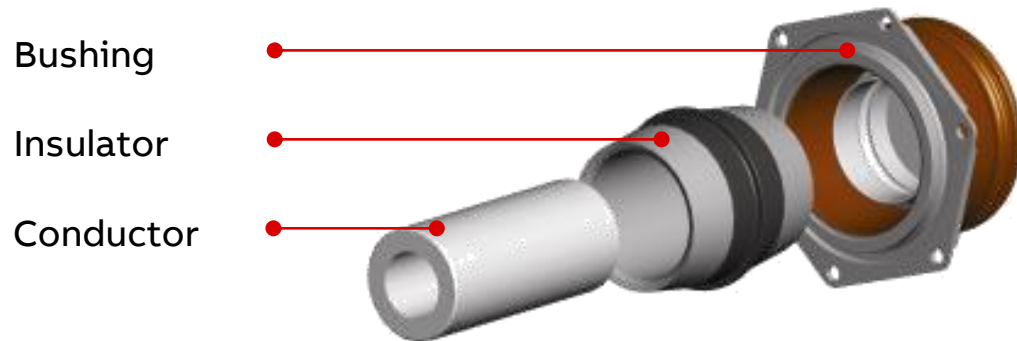
# MV Primary Gas-insulated Switchgear – ZX Family

GIS design: Plug-in busbar connection

**Easy installation - no gas works, no screws**

## Plug-in busbar connection

- Separate panel partitioning, panels gas-filled and tested in factory
- Plug-in connection with 2 parts only (conductor, insulation)
- No gas handling on sites, no screws/torques to worry about



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# MV Primary Gas-insulated Switchgear – ZX2

How easy can a switchgear installation be?

## Busbar connection

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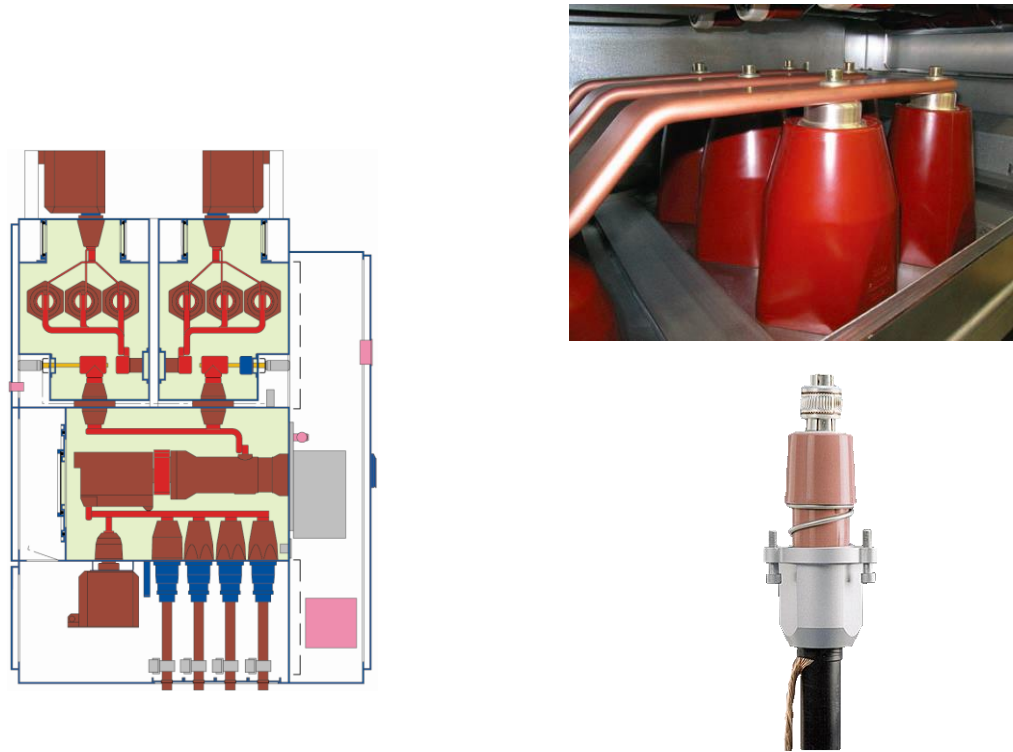
Safe, fast and easy installation, no gas works at site, no special tools required !



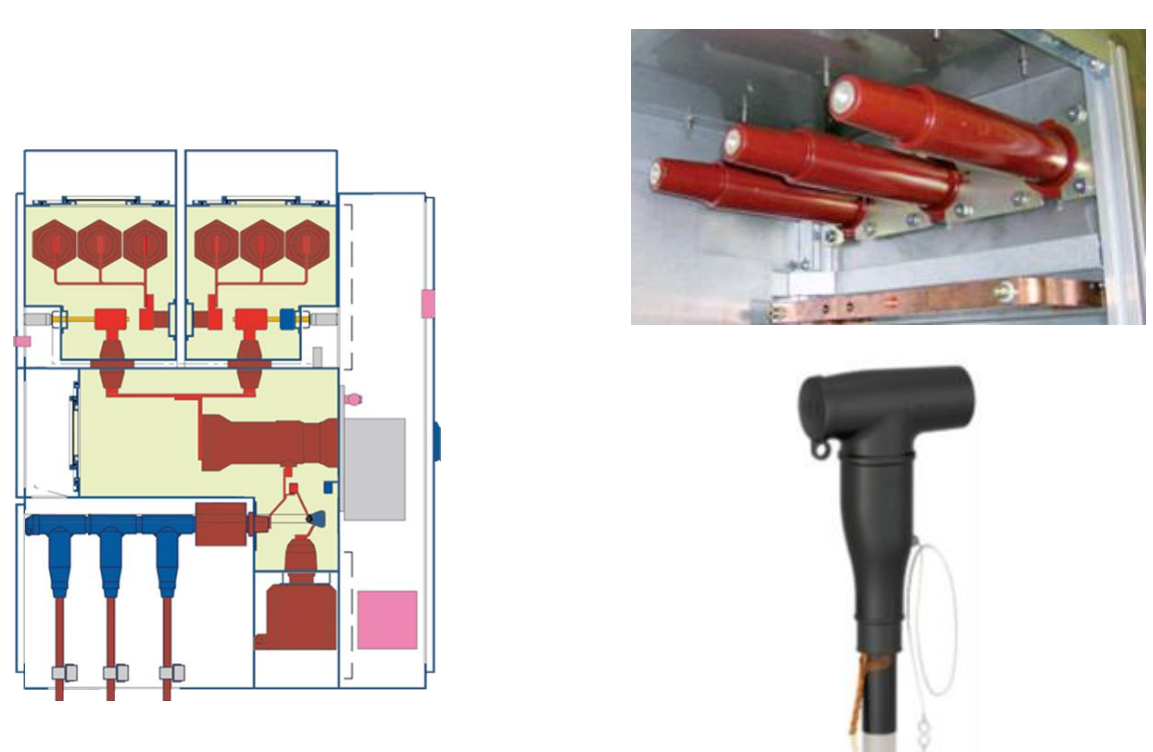
# MV Primary Gas-insulated Switchgear – ZX2

How would you like to make your cable connection?

## Inner cone termination



## Outer cone termination





# MV Primary Gas-insulated Switchgear – ZX2

Technology: safe, fast and easy installation

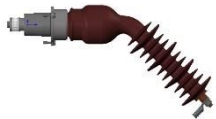
Voltage transformer / Sensor



Surge arrestor



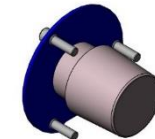
Test plug



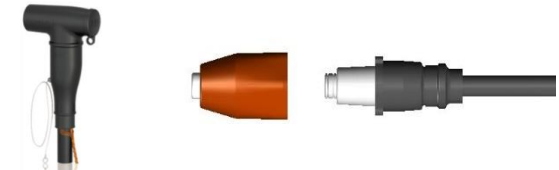
Busbar (plug-in)



Dummy plug



Cable plug





# MV Primary Gas-insulated Switchgear – ZX2

What is your control and protection philosophy?

## Protection, metering and control



PCU



REX 640

# MV Primary Gas-insulated Switchgear – ZX2

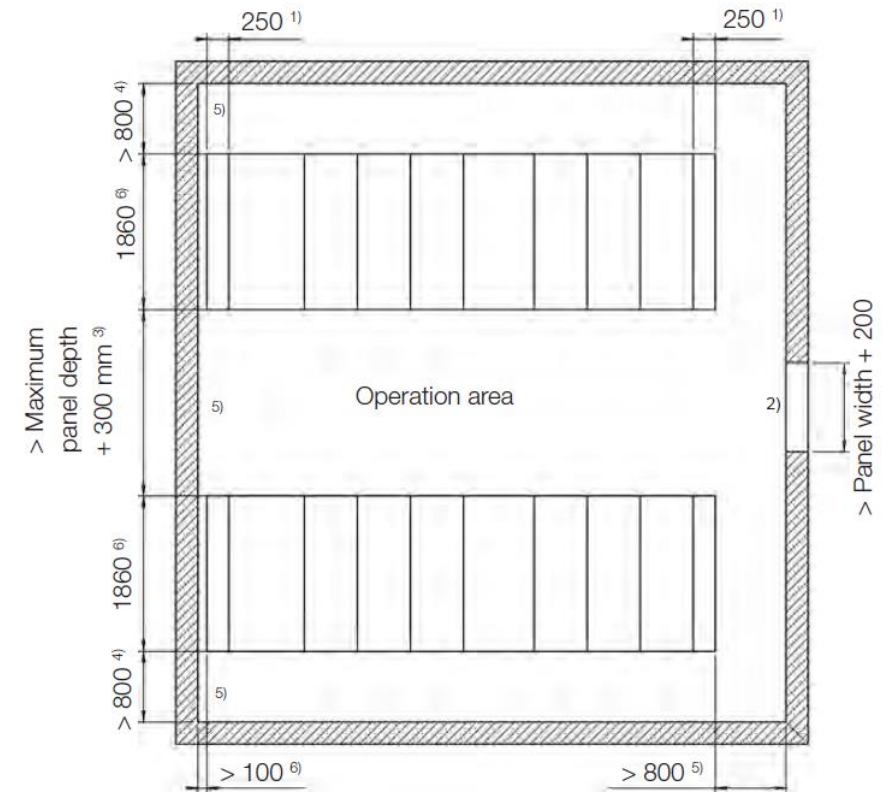
Saving space helps to reduce cost

## Installation

- Delivery of **factory filled and tested panels**
- Installation without gas works at site
- Transverse installation is possible
- Installation on standard floor frames embedded in concrete floor, on intermediate frame or on raised false floor
- Installation and commissioning shall be done by **trained and certified service personnel**

### Panel weights

Panel type	Panel width [mm]	Weight, max. [kg]
Single busbar	2x400	1500
	600	1400
	800	2000
Double busbar	2 x 400	1800
	600	1600
	800	2400
Side pressure relief duct (increase in weight of the relevant end panel)		250



# MV Primary Gas-insulated Switchgear – ZX2

## Installation

**Standard floor frame embedded in concrete**



**Raised false floor**



# MV Primary Gas-insulated Switchgear – ZX2

Are you concerned about gas handling?

## Gas compartments

- Each **feeder consists of 2 (SBB) or 3 (DBB) gas compartments** made from laser-cut **stainless steel**
- Each gas compartment is equipped with a on-return filling valve (with protective cap) and **repair openings**
- Operation at slight overpressure - rated **operating pressure 130kPa** (alarm level 120kPa) for rated voltage > 36kV
- **Low amount of SF6** used per panel: 5 - 10 kg
- **Gas leakage < 0,1% per year**
- **No checks on the insulating gas are necessary and maintenance-free**



No gas handling during 40-year lifetime of the switchgear required

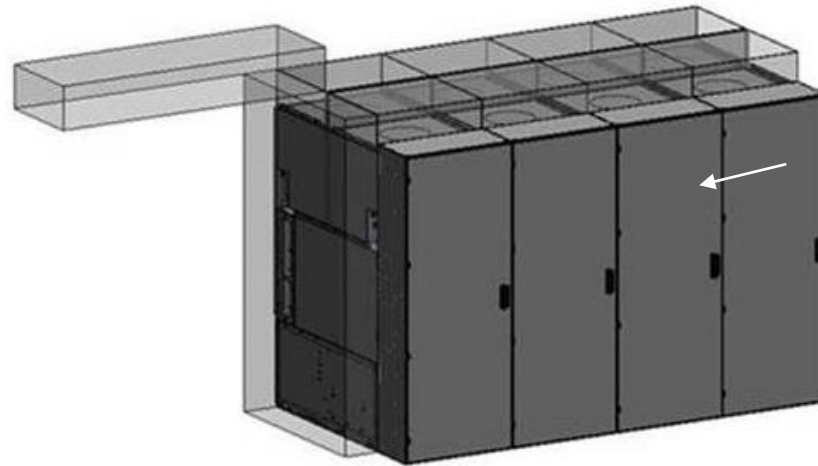
# MV Primary Gas-insulated Switchgear – ZX2

Are you concerned about safety?

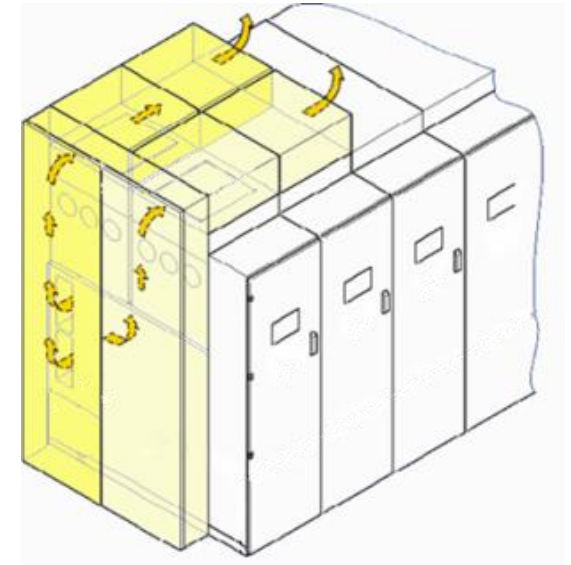
## Operator safety

- **Probability of internal arc is greatly reduced due** to stainless steel sealed (for life) design
- Each panel is divided into two (SBB) or three (DBB) **segregated gas compartments**
- Metallic partitions between the individual compartments and adjacent panels ensure that **internal arc fault damage does not propagate** (highly unlikely event)
- Integrated pressure relief ducts (plenum) are provided to **safely vent away hot gases** from operator personnel
- Plenums can also be designed to **relieve pressure to the outside of the switchgear room/building**

## Pressure relief to the outside



## Pressure relief into room via absorber



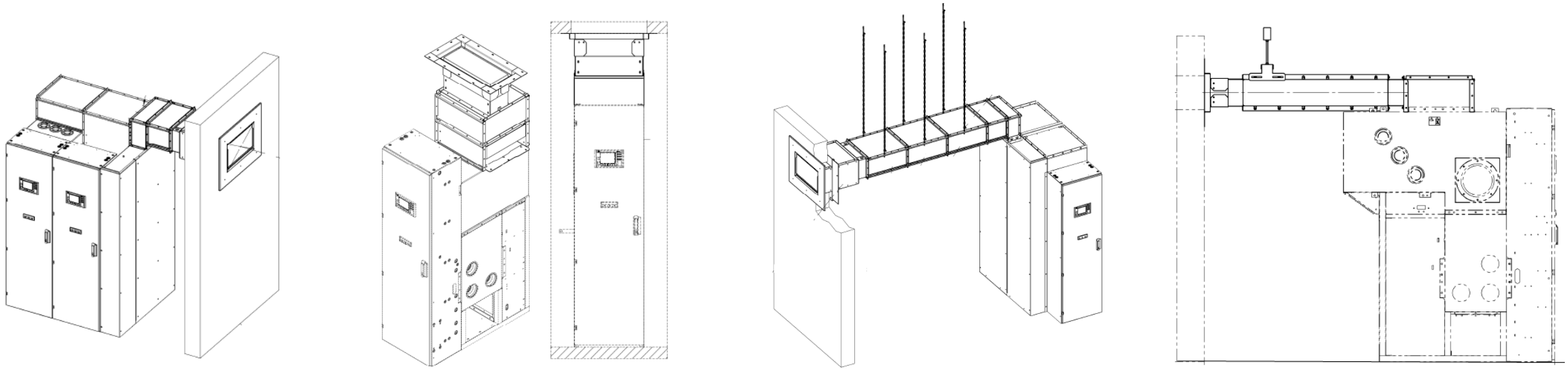
In case of an internal arc integrated plenums will safely vent away any hot gases or toxic byproducts.



# MV Primary Gas-insulated Switchgear – ZX2

Pressure relief to the outside

## Plenum options



Our custom designed plenums will meet your site requirements

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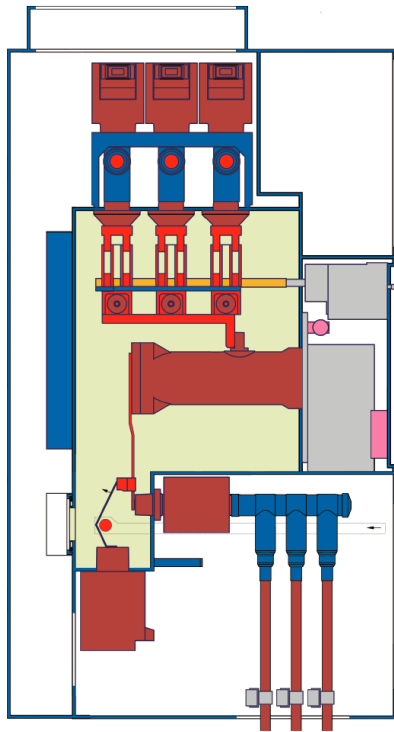
**ZX0.2**

# MV Primary Gas-insulated Switchgear – ZX0.2

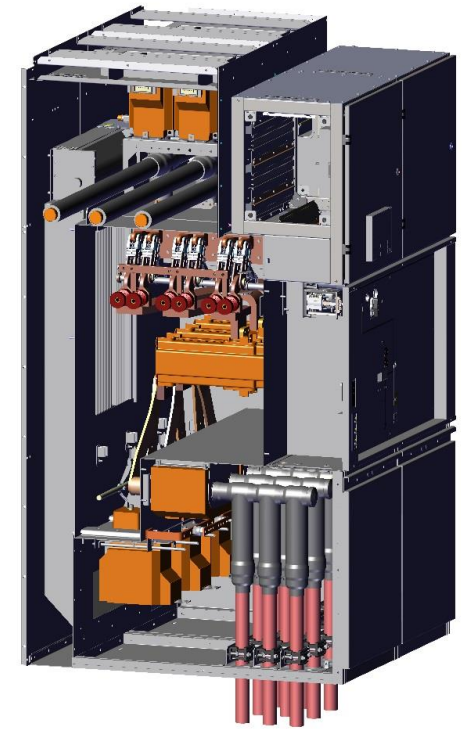
Are you looking for a safe, reliable and compact switchgear design?

## Main Characteristics

Max rated Voltage	<b>36 kV</b>
Mas short circuit current	<b>31.5 kA</b>
Max BB Current	<b>Single busbar: 2500 A</b>
Max CB current	<b>2500 A</b>
Panel width	<b>≤ 1200 A: 600 mm &gt; 1200 A: 900 mm</b>
BIL	<b>70/170 kV</b>
<b>3-phase encapsulated arc-resistant design</b>	
<b>Wall mounted design with mechanical operating area</b>	
<b>Solid insulated busbars: one gas compartment per panel</b>	



ZX0.2



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# ZX0.2 Type switchgear

## Low voltage compartment

### Low voltage compartment features

- Low voltage compartment is separate from operator area
- Custom designed
- Offers space for protection relays, meters, test plugs and secondary wiring
- **View ports** inside low voltage compartment for visual control of three position disconnect switch



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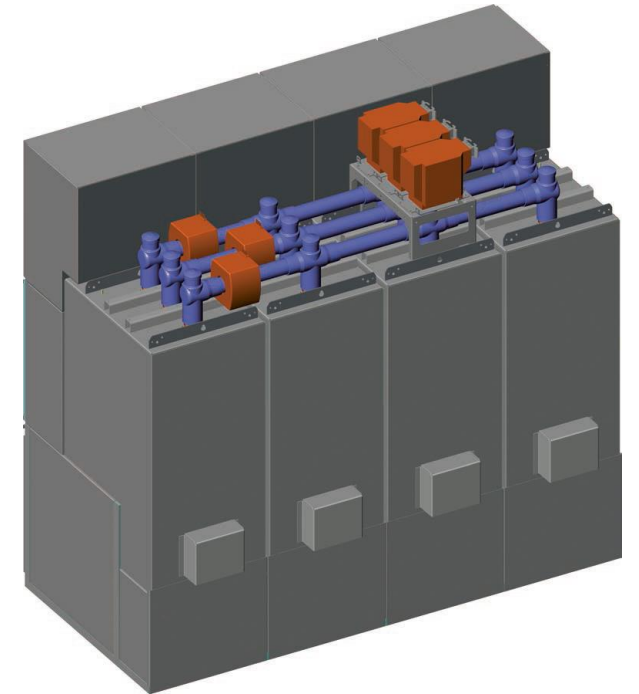
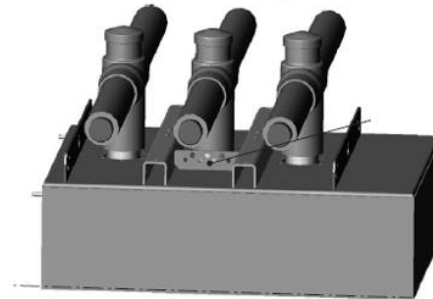
# ZX0.2 Type Switchgear

Are you looking for a compact and cost-effective switchgear?

## Busbar

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- Silicone insulated, shockproof busbar elements
- T-adapters to connect the bushing from the panel module with the busbar sections
- The busbar can be fitted with plug-in potential transformer and toroidal current transformers

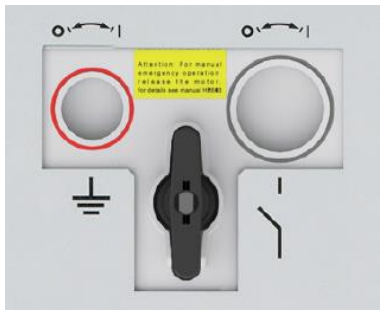




# ZX0.2 Type Switchgear

Do you like simple local operation?

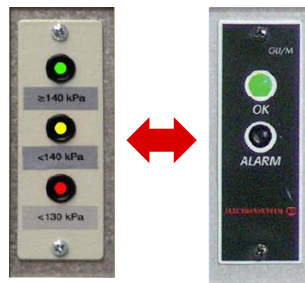
## Mechanical operator area



Mechanical operation for 3-position switch



Mechanical operation for CB, with Padlock



Indication system for gas density



Voltage indication system



# ZX0.2 Type Switchgear

## Outer cone cable termination

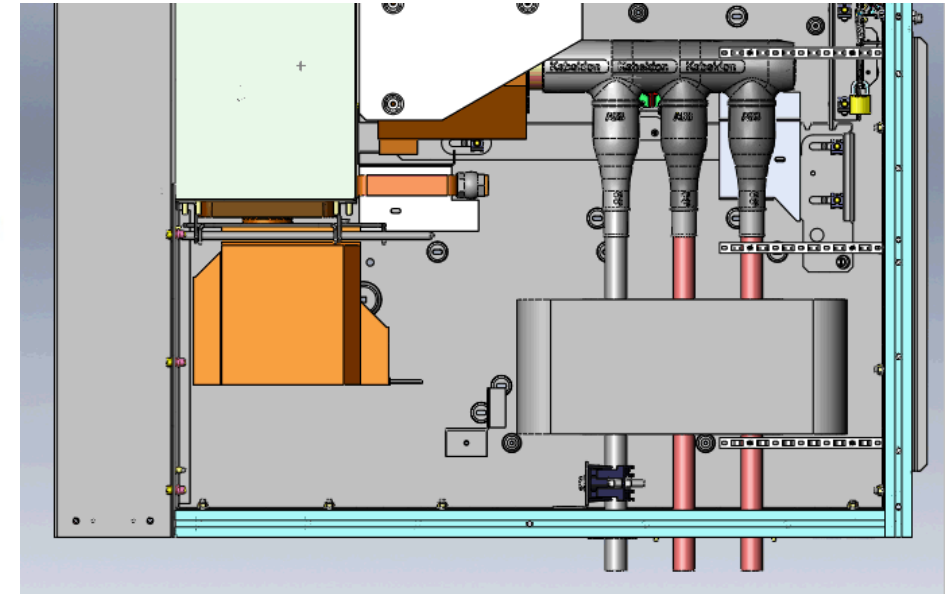
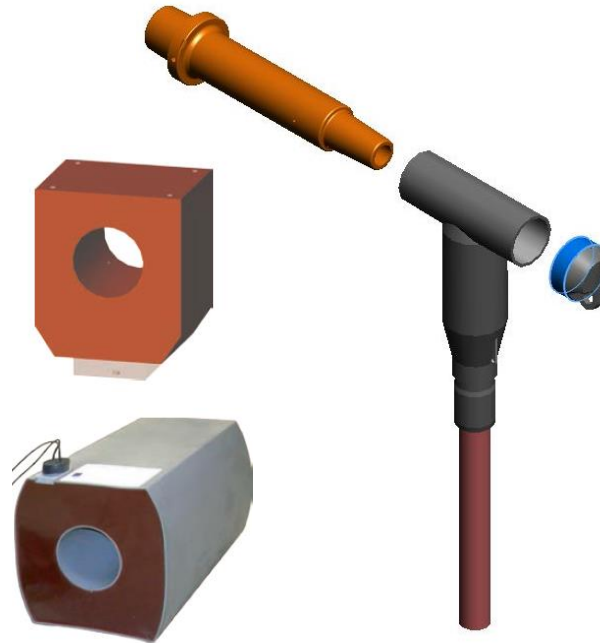
### Cable termination and current transformer

#### Outer cone cable termination system

- According to EN 50181
- One socket per phase
- **Maximum 3 cables plus 1 surge arrester per phase**

#### Current transformers are:

- **Toroidal type** and located on outer cone or busbar
- Designed per IEEE C57.13.
- Zero sequence current transformers can be installed inside the cable termination compartment (DTO)



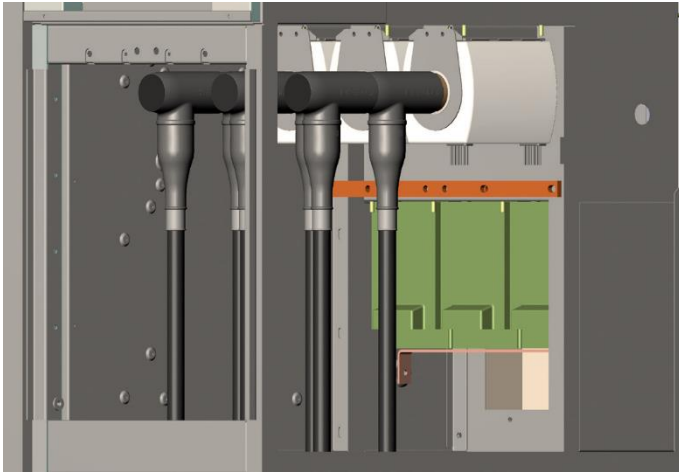
All auxiliary transformers are located outside gas compartment, thus replacement is easily possible.

# MV Primary Gas-insulated Switchgear – ZX0.2

How would you like to make your cable connection?

## Outer cone termination system

Cable termination compartment



Cable termination area

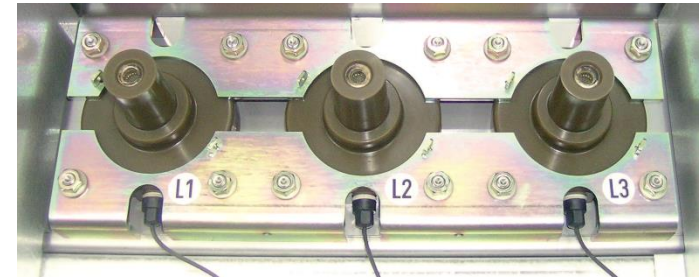


Connector



Cable termination

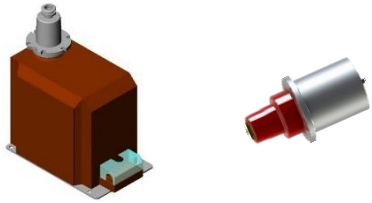
Panel with three position disconnecter and fuse



# MV Primary Gas-insulated Switchgear – ZX0.2

Technology: safe, fast and easy installation

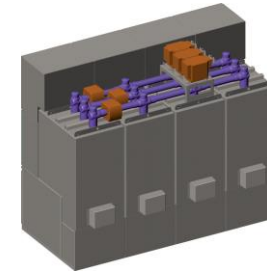
Voltage transformer / Sensor



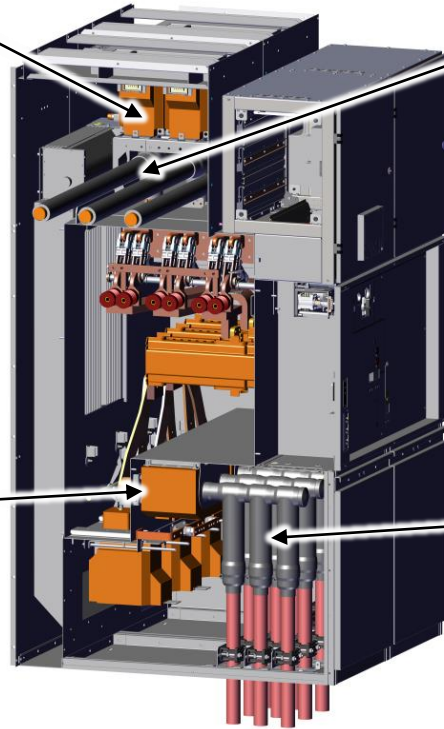
Ring core type / Sensor



Busbar



Cable plug

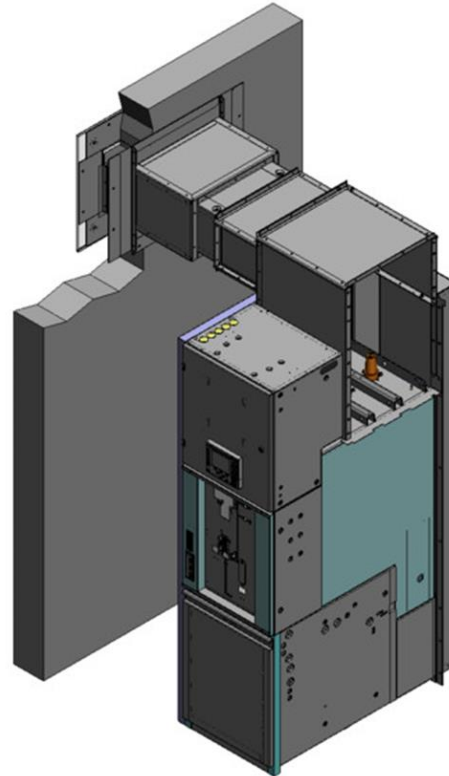


# MV Primary Gas-insulated Switchgear – ZX0.2

Do you care about the safety of your operating personnel?

## Pressure relief system

- Stainless steel gas compartment sealed for life
- Each gas compartment is equipped with a non-return filling valve and a temperature-compensated gas density sensor for permanent gas supervision
- Low gas alarm on protection relay and LED in operator area
- **Gas leakage < 0.1% per year**
- Pressure relief to outside of the building/PDC
- **Duct designed to fit customer needs** (to left/right, top, back..)





# MV Primary Gas-insulated Switchgear – ZX0.2

Are you concerned about gas handling?

## Gas compartments

- Gas compartments made from laser-cut stainless steel
- Gas compartment is equipped with a on-return filling valve (with protective cap) and repair openings
- Rated operating pressure 130kPa up to 24kV, 150kPa @36kV
- **Low amount of SF6** used per panel: 5 - 10kg
- **Gas leakage < 0,1% per year**
- **No checks on the insulating gas are necessary and maintenance-free**

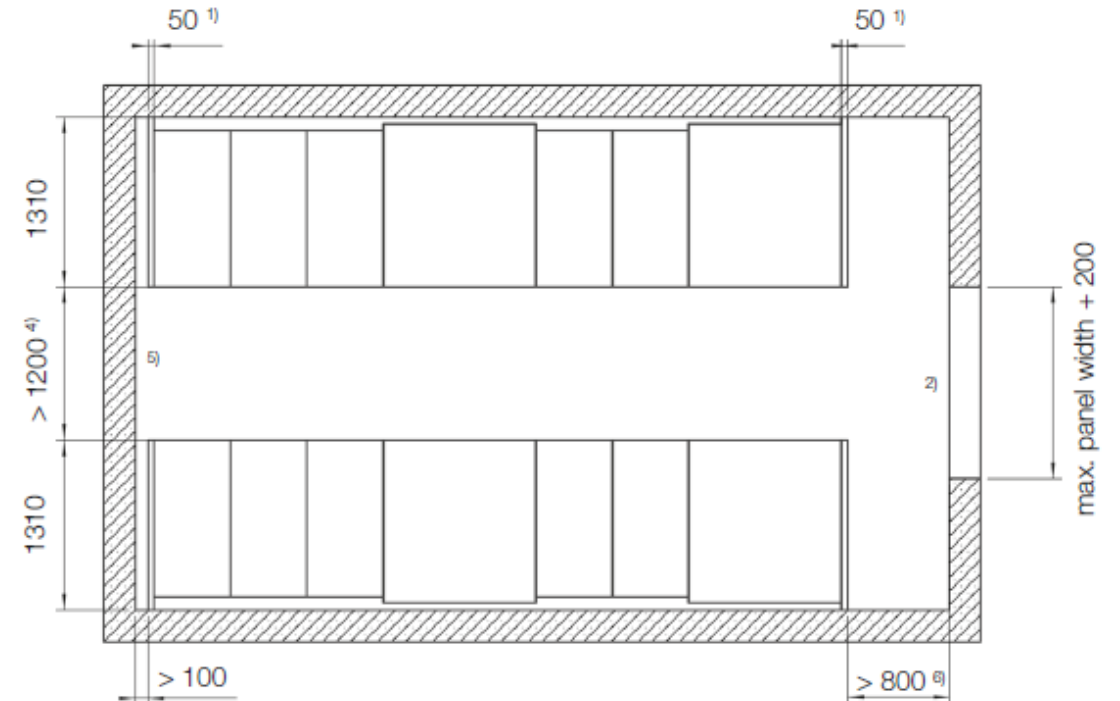


# MV Primary Gas-insulated Switchgear – ZX0.2

Saving space helps to reduce cost

## Installation

- Delivery of **factory filled and tested panels**
- Installation without gas works at site
- Wall mounting installation
- Transverse installation is possible
- Installation on standard floor frames embedded in concrete floor, on intermediate frame or on raised false floor
- Installation and commissioning shall be done by **trained and certified service personnel**





# Digital GIS - ZX0.2 and ZX2

# Digital Concept



ABB's innovative sensor technology



Advanced communication concepts:  
- Station bus incl. GOOSE (8-1)  
- Process bus incl. redundant network (9-2)



Well-proven ABB switchgear



**Comprehensive concept for medium voltage gas-insulated switchgear**

# Digital Sensor Variants

## Sensor variants

### Current Sensor

KECA 80 C85

- Nominal current up to 2500 A
- Rated primary current 80 A / 150 mV at 50 Hz or 80 A / 180 mV at 60 Hz
- Accuracy class 0.5 / 5P630 for 50 and 60 Hz



### Voltage Sensor

KEVA 36 G22/G23

- Rated voltage up to 38 kV
- Rated primary voltage 33 /  $\sqrt{3}$  kV
- Rated power frequency withstand voltage 70 kV
- Rated lightning impulse withstand voltage 170 kV
- Transformation ratio 10 000 : 1
- Accuracy class 0.5 / 3P



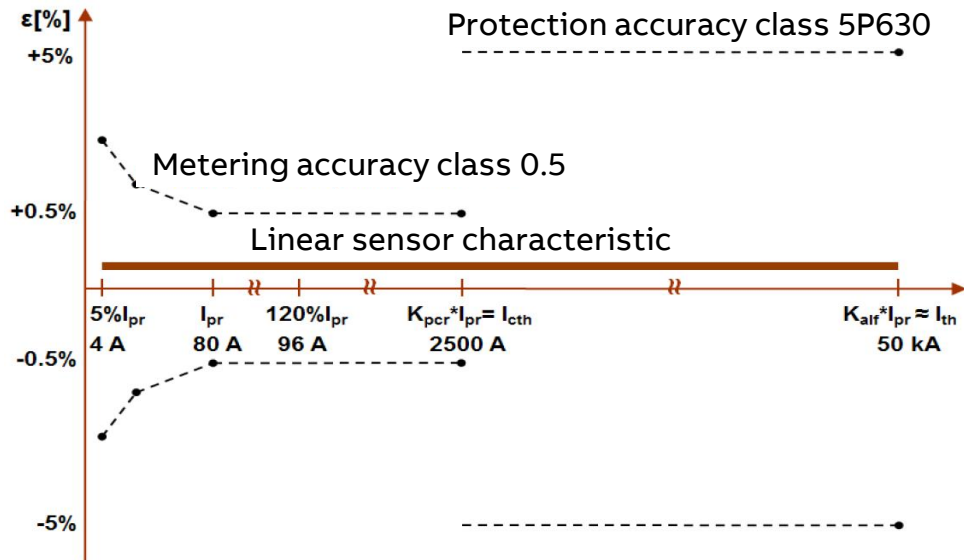
Two sensor variants cover ZX0.2 portfolio



# Digital Sensor Variants

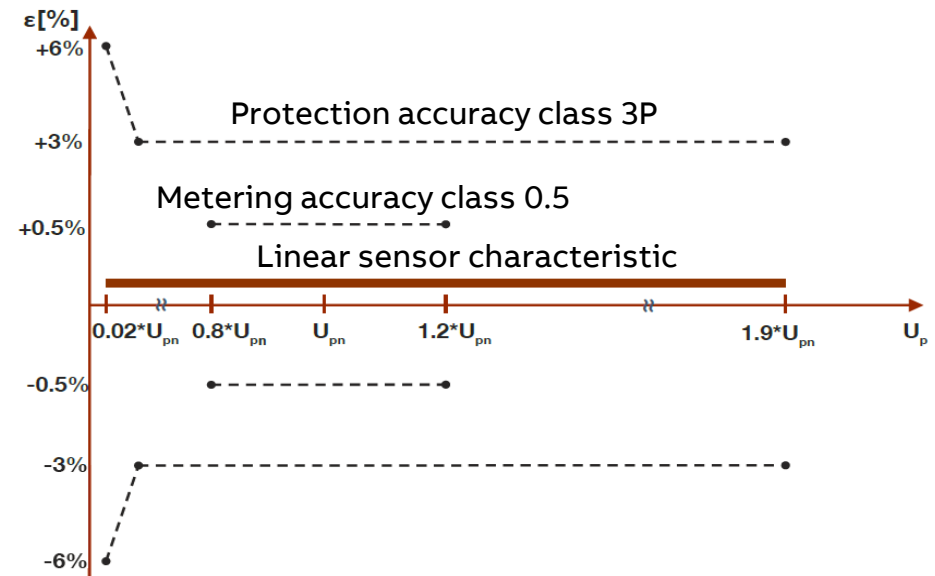
## Current Sensor

KECA 80 C85



## Voltage Sensor

KEVA 36 G22/G23

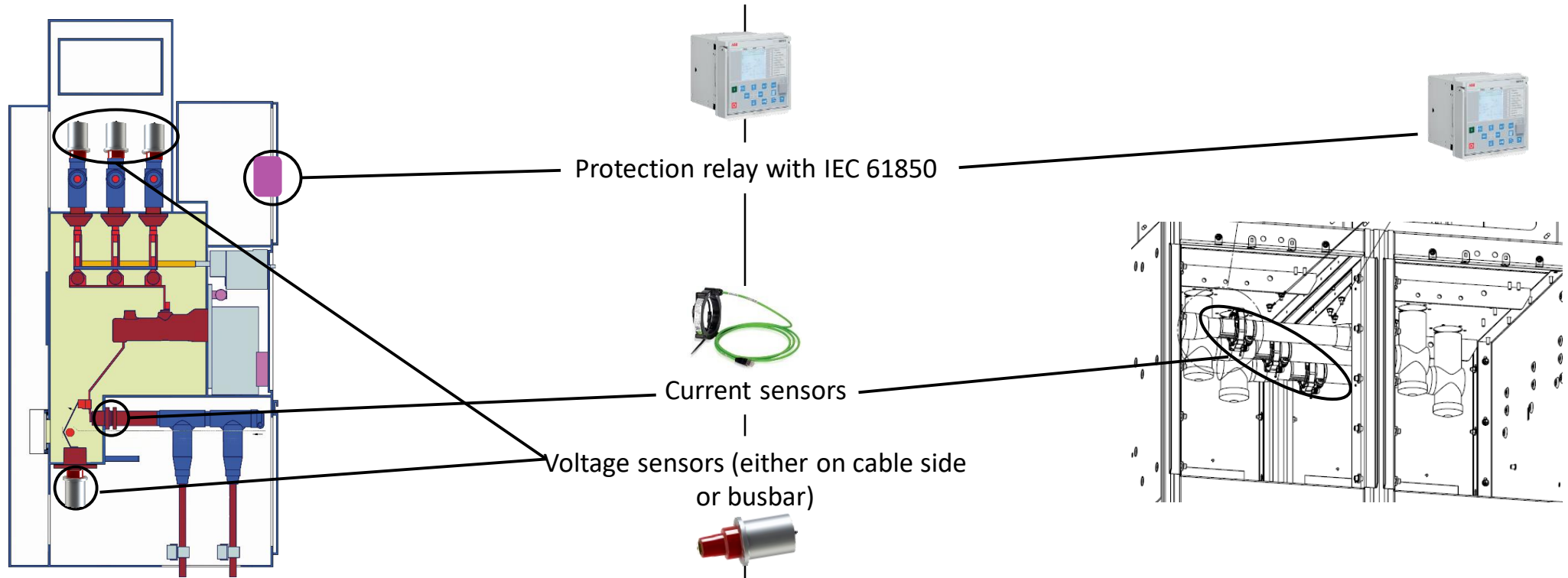


Superior characteristic of voltage and current sensors

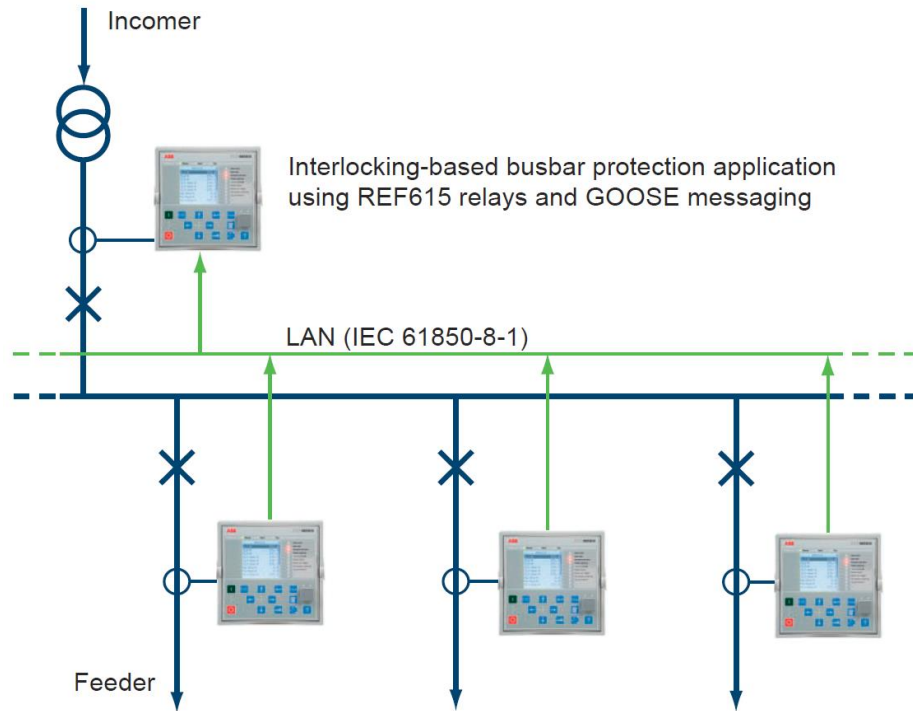
# ZX0.2 Digital Sensor locations

**Feeder (450mm panel w/o cable voltage sensor)**

**Coupler/Riser**



# Communication according to IEC 61850-8-1 (GOOSE)



## Superior data transmission with GOOSE messaging

On behalf of ABB AG, KEMA tested the performance of GOOSE communications in comparison with direct signal transmission between two devices through conventional wiring. The test programme was based on IEC 62271-3 and was performed with gas-insulated switchgear of type ZX and the REM615 and REF630 protection devices from the Relion® product range.

The results of the KEMA test at a glance:

- Data transmission with GOOSE is between 12 ms and 15 ms faster than with conventional wiring.
- In the event of an interruption to GOOSE communication, the system reacts as specified and blocks the set protection functions.
- Interlocks to prevent double switching operations function as specified

The Relion® devices comply with class P1, message type 1A "Trip" to IEC 61850-5 for message transmission time less than 10 ms.

Easy implementation of protection schemes: e.g. Reverse interlocking, circuit breaker failure protection.

**ABB**