Agenda

Schedule

- What is PASS
- PASS benefits
- Success Stories and references
PASS – The ABB Hybrid Module
Overall Description

- High Functional integration
- Medium Functional integration
- Low Functional integration

Hybrid Modules
- Circuit Breaker
- Current Transformer
- Voltage Transformer
- Disconnector
- Earthing Switch

DTB
- Circuit Breaker
- Current Transformer

GIS
- Circuit Breaker
- Current Transformer
- Voltage Transformer
- Disconnector
- Earthing Switch
- Earthing Switch
- Busbar / Busducts

Encapsulation
- No
- Partial
- Full

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PASS – The ABB Hybrid Module Portfolio

<table>
<thead>
<tr>
<th>PASS M00</th>
<th>PASS M0</th>
<th>PASS M0S</th>
<th>NEW PASS M0 H</th>
</tr>
</thead>
<tbody>
<tr>
<td>![PASS M00 Image]</td>
<td>![PASS M0 Image]</td>
<td>![PASS M0S Image]</td>
<td>![NEW PASS M0 H Image]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Voltage</th>
<th>50 / 60 Hz</th>
<th>50 / 60 Hz</th>
<th>50 / 60 Hz</th>
<th>50 / 60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>2000 / 3150 A</td>
<td>3150 A</td>
<td>Up to 5000 A</td>
<td>2000 / 3150 A</td>
</tr>
<tr>
<td>Short-Circuit Current</td>
<td>31,5 / 40 kA</td>
<td>40 / 50 / 63 kA</td>
<td>50 / 63 kA</td>
<td>31,5 / 40 kA</td>
</tr>
</tbody>
</table>
1. Stud for HV connection
2. Bushing
3. Current transformer
4. SF6 Voltage transformer inductive type
5. DS/ES Operating drive mechanism
6. Circuit breaker
7. Combined Disconnector/Earthing switch
8. BLK – Spring-type circuit breaker operating mechanism
9. Local control cubicle
PASS – Plug And Switch System
Circuit breaker

Self-blast or Auto-puffer™
Arc-assisted pressure generation leads to less need of interrupting energy

- Smaller operating mechanism
- Lower stresses on mechanical components
PASS – Plug And Switch System
BLK spring drive

BLK spring drive
Simple optimized spring drive designs, based on years of experience: first delivery 1990.

- Extremely reliable
- Low power consumption
- Precise and stable operating times
PASS – Plug And Switch System
Motor Drive

PASS M0 can be equipped on request with the innovative Motor Drive.

A motor drive is a digitally controlled motor that directly moves the circuit-breaker contacts. ABB has developed a servomotor system with digital control, able to directly drive the circuit breaker contacts in a highly accurate and reliable way.

- The motor drive is type tested in accordance with IEC and ANSI Standards.
- Each motor drive is pre-tested and shipped to the installation site in the form of a few pre-assembled units.
PASS – Plug And Switch System
Combined disconnector and earthing switch

**Integrated DS\ES**

The mechanism has a minimal number of mechanical components, it is reliable and maintenance-free.

The position of the combined disconnector/earthing switch is clearly shown by an indicator mechanically coupled to the shaft. Moreover, visual confirmation can be obtained by means of an inspection window in the enclosure. The disconnector/earthing switch can also be operated manually by means of a crank.
PASS – Plug And Switch System
Portholes for safe earthing
PASS – Plug And Switch System
DS\ES drive indicator for safety

Common operating mechanism for combined DS/ES with red/green flags on the drive.
PASS – Plug And Switch System
Gas density control

Density monitor

Since the dielectric strength of the switchgear and the breaking capacity of the SF6 circuit-breaker depend on the density of the SF6 gas, a gas density relay is installed to control gas density and detect leakage.
PASS – Plug And Switch System
Current Transformers

Cast-resin insulated ring type

Several cores can be installed, to suit the end customers’ specifications. The transformer is generally fitted to the front bushing, but can also be installed on the rear one or on both to comply with specific requirements.
PASS – Plug And Switch System Voltage Transformers and Surge Arresters

SF6 Insulated Voltage Transformers
PASS can be equipped as request with conventional GIS inductive voltage transformers. Similarly to Current Transformers, several combinations of windings for protection and measurements with different loads are available.
PASS – Plug And Switch System
Bushings

- **Explosion proof**
  Maximum safety of personnel and equipment

- **Non-brittle**
  Reduced handling damage risk

- **Low weight**
  Easier handling and reduced foundation loads

- **Maintenance free**
  No cleaning in polluted environments

- **Outstanding seismic performance**
  For best safety and reliability
Agenda

Schedule

- What is PASS
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- Success Stories and references
Why Innovative Switchgear Advantages

PASS Main Features:

- Each PASS module is equivalent to a complete switchgear bay
- High customizability yet short delivery time, due to the modular design
- Ideal solution for fast-track projects
- Fast erection and commissioning, due to fully-assembled modules delivered from factory.
- Lower life cycle cost compared to traditional technologies
Why Innovative Switchgear
Flexibility
Why Innovative Switchgear Flexibility

Double circuit breaker

2 PASS DCB are equivalent to 4 complete switchgear bays
Why Innovative Switchgear
Flexibility
145 kV H5 Substation Layout
Top View comparison

PASS solution: 18.5 m x 25.5m

AIS solution: 35.1 m x 38.8 m
145 kV H5 Substation Layout
3d Comparison
145 kV H5 Substation Layout
Chart and benefits

- Save in land acquisition thanks to reduced size of components
- Save time for bureaucracy related to land acquisition
- Reduces civil works for foundations and basements
- Faster erection & commissioning
245 kV H3 Substation Layout
Top View comparison

PASS solution: 25 m x 28 m

AIS solution: 63,7 m x 74,5 m
245 kV H3 Substation Layout
Chart and benefits

- Save in land acquisition thanks to reduced size of components
- Save time for bureaucracy related to land acquisition
- Reduces civil works for foundations and basements
- Faster erection & commissioning
Innovation with PASS
PASS M0H module – Multifunctional Module

Pre-assembled
Pretested
Transportable
No high voltage test on site

PASS M0H, H4-type

Advantages:

• Civil works reduced to the minimum
• Transportation fully assembled
• Electromechanical installation activities limited to the HV and LV connection and SF6 filling only
• Reduced risks related to installation activities
Innovation with PASS
PASS M0H module – Multifunctional Module

Pre-assembled
Pretested
Transportable
No high voltage test on site
Why Innovative Switchgear
Space Saving

H4 145 kV Footprint comparison in square meters

- AIS: 21x33 sqm
- PASS SBB: 21x18.5 sqm
- PASS DCB: 21x13.5 sqm
- PASS M0 H: 15x5 sqm
Why Innovative Switchgear
Easy transportability

PASS M00 and M0 in a container
Why Innovative Switchgear
Easy transportability
Why Innovative Switchgear
Easy transportability

PASS M0 on a skid
Why Innovative Switchgear
Easy transportability
Why Innovative Switchgear Erection & Commissioning

Unloading & unpacking
Rotation of poles
Erection on support structure
Service position
Transport module

Total: 16 hours
Why Innovative Switchgear
Ideal solution for fast track projects

Easy transportation, fast erection & commissioning

Hybrid Module is fully engineered, pre-assembled and pre-tested in the factory

No need for high voltage tests to be performed on site.

PASS - the ideal solution for fast-track projects.
Why Innovative Switchgear
Financial comparison

20% saving compared to AIS
Agenda

Schedule

- What is PASS
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PASS M0S 245 kV - Compactness
Tenaris Dalmine co-generation plant

Customer need
- Sub-station solution with limited space availability at a hazardous material deposit

ABB response
- Outdoor substation made with PASS M0S DCB in a small area between two trafos

Customer benefit
- Space and environmental saving using a different area far from deposit
Customer need
- Old substation that needs to be retrofitted

ABB response
- Substation H4 on the roof of the building made with 2 PASS M0 DCB

Customer benefit
- Further reduction of switchgear overall dimension
Customer need

- Additional bus tie to existing SBB configuration substation

ABB response

- Extension made without outage of the power transformer

Customer benefit

- No requirement of additional land using PASS M00 SBB or need to reposition existing equipment
Customer need
- Refurbishment of two old AIS S/S minimizing the outage and installation time
- Utilize pre-existing bus bar system and AIS equipments (PT, SA)

ABB response
- ABB supplied 10 completed HV bays made by Hybrid switchgears type PASS M0 in SBB and DBB configuration (132 kV)
- ABB optimized the PASS design to be suitable for aggressive environmental condition (Desert storm, +52 °C, High solar radiation)

Customer benefits
- Costs and time saving during erection and commissioning
- Reduced outage time during S/S revamping
PASS M00 72,5 kV - Safety
Interlocking safety system for mining industry in Australia

Customer need

- Ensure the highest personnel safety for workers in the mining industry.

ABB response

- ABB has developed a mechanical key interlocking solution for the PASS family of hybrid modules.

Customer benefit

- The interlocking procedure, provides a safe earthing procedure
PASS M0 H 145 kV – Fast Erection & Commissioning Samsung Engineering for Lukoil in Iraq

Pre-assembled
Pretested
Transportable
No high voltage test on site

Customer need

- High voltage solution to be installed easily and quickly.

ABB response

- Innovative pre-assembled and pre-tested PASS module for H3 configuration substations with integrated protection & control.

Customer benefit

- The full H3 switchyard, mounted on skid, records a 32 hours erection and commissioning time.
PASS – The ABB Hybrid Module Reference Map

- More than 5500 modules installed at July 2012
- More than 7500 equivalent bays*

* SBB = 1 bay equivalent
* DBB = 1.5 bay equivalent
* DCB = 2 bays equivalent
Power and productivity for a better world™