High voltage products

COMPASS
Compact Prefabricated Air Insulated Substation
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The ABB Focus Factory based in Lodi, Italy is one of the facilities belonging to the ABB Group. It produces High Voltage electrical apparatus on a covered area of 12,000 square meters. This is a global focus factory and a centre of excellence for design and production of high voltage hybrid circuit-breakers and switchgear. A market leader, it exports approximately 80% of its products worldwide. Production is organized according to “Lean Production” criteria and is managed by means of an integrated ERP system. The quality of the manufacturing processes is guaranteed by the “Six Sigma” system. The quality system conforms to ISO 9001 standards, the environmental management system to ISO 14001 standards, and the health and safety management system to OHSAS 18001 standards for building sites, all certified by an external independent organization.
Laboratories

The ABB plant has internal laboratories equipped with state-of-the-art equipment for carrying out material experimental, climatic, mechanical life, electromagnetic compatibility, commissioning and dielectric tests. Type and routine tests verify whether the components, construction stages and finished products comply with the strict specification requirements. The Test Laboratory is accredited by an external independent organization and complies with UNI CEI EN ISO/IEC 17025 Standards.

Production

Thanks to the new shop-floor layout, designed according to the Just in Time, Lean Manufacturing and Theory Of Constraints techniques, the production workflow is managed on an “Assemble to Order” basis, i.e. each module is fully assembled and manufactured once the order has been received. The output of each production line is a completely assembled and tested product, ready for easy and fast erection and commissioning.

Service

Thanks to its Service structure, the ABB plant provides a full after-sales service for its customers’ needs: analysis and modification of existing installations, diagnosis of module conditions, solutions for reducing life cycle costs, upgrading to achieve compliance with Standards and laws, retrofitting and revamping interventions, maintenance personnel training and updating, as well as emergency interventions.
Way back in 1996, ABB introduced a simple, integrated and innovative 123 kV to 170 kV high voltage switchyard module, called COMPASS.

COMPASS combines the benefits of an open-air connected substation with a very compact and smart design, allowing contractors and end-users to plan, build and maintain high voltage substations with minimum engineering, labour and civil construction costs.

COMPASS is the right choice:
– in the new greenfield substations, where the Life Cycle Cost of a switchyard is the critical factor, COMPASS is cost efficient, particularly where ground space is at a premium;
– when it comes to retrofitting, and the substation needs to be extended with limited ground space available, or when the existing area has to be reduced (suburban areas, etc.).

All these benefits have created a new market where ABB is the price performance leader and technology trend setter: ABB has sold more than 1,300 units around the world during the past 10 years.
What is COMPASS?

COMPASS means COMpact Prefabricated Air-insulated SubStation and includes all the high voltage functions of a single bay in just one module. Each phase includes:
- One circuit-breaker with BLK Drive (both single- and three-phase operation)
- Two disconnectors with their own motor/manual Drive
- Two earthing switches with their own motor/manual Drive
- One current transformer
- One voltage transformer
- One surge arrester
- Local control cabinet.

COMPASS is available with silicone insulators (porcelain insulators on request, only). The position of these parts is shown in the diagram below.

General layout and single-line diagram

1 Circuit breaker
2 Disconnecter switch
3 Current transformer
4 Voltage transformer
5 Surge arrester
COMPASS-I

Coming directly from the long experience in this field, COMPASS-I is a new compact, multi-function, prefabricated device for substations in the COMPASS family equipped with:
- A circuit-breaker with BLK actuator (both single and three phase operations)
- A current transformer
- Local control cabinet.
The positions of these parts are shown in the diagram below.

COMPASS-I is fully factory-assembled and tested and can be transported whole to the site for simple and reliable installation.

Like COMPASS, this product can be fitted with both silicone or porcelain insulators.

Thanks to its limited structural dimensions, this product is suitable for substations where space is at a premium. In addition, COMPASS-I contains less SF<sub>6</sub> gas because the current transformer is integrated in the circuit breaker.

Certified by Enel Distribution.
The entire COMPASS Module is fully designed, assembled and tested according to IEC Standards in the ABB Adda plant and can be transported to the installation site on a simple truck or in a container without having to be dismantled in any way. This eliminates the need to carry out any major electrical tests on site.

A COMPASS switchyard is very simple, fast and inexpensive to erect, thanks to its design, which not only reduces the erection and commissioning stages, but also allows a lot of space to be saved thanks to the NABLA self-supporting busbar system.

This means that there is no need to have busbar post insulators to support the busbar system, since the weight is supported by the COMPASS modules.

All this means important reductions in on-site costs.
Transport, erection and maintenance

The module can be serviced and inspected easily by lowering the mobile part. This means that the bay can be checked or repaired on site. The technicians work standing up, inside an earthed structure (Faraday cage) so safety and efficiency are ensured.

If major maintenance is required, the mobile part of the bay can easily be removed and taken to a workshop.

The whole bay can be completely replaced in approximately three hours. This saves time and cuts the consequent inconvenience down to the minimum. One spare mobile part of a bay is therefore recommended if the user is particularly concerned about the costs of any damage.
New features

The ABB R&D department has designed a new version of COMPASS in compliance with the latest dictates for high voltage equipment. This new COMPASS has a lot of innovative features:

- better weight distribution that improves the centre of gravity position and reduces the overall weight of COMPASS
- new disconnector motor mechanism which is extremely simple and reliable thanks to drastic reduction in the number of moving parts (pinion gear and rack system)
- silicone bushings which provide better dielectric and mechanical strength
- unique characteristic of being self-cleaning. This means that the silicone bushings do not need any particular maintenance
- the motor drive can be used as a circuit-breaker operating mechanism instead of the BLK. A motor drive is a digitally controlled motor that moves the circuit-breaker contacts directly. ABB has developed a servomotor system with digital control which is able to drive the circuit breaker contacts directly in a highly precise and reliable way. The number of moving parts in the drive is reduced to just one (the rotating motor shaft)

- the UniWire Local Control Cabinet (based on Programmable Logic Controller philosophy) can be installed inside the control cubicle, as well as the integrated protection relay. The UniWire cabinet is designed to replace the traditional wired logic using electromechanical components with a programmable logic controller, while maintaining the same circuit-breaker operating mechanism, DS drive, etc. The wiring diagrams are simple, the cubicle is tidy and mainly consists of standardized parts, with lots of space for the wiring duct, terminal blocks and customer equipment. In addition, station monitoring with the circuit-breaker and disconnector control functions can be integrated into a single commercial high performance protection and control IED.
## Normal service conditions

<table>
<thead>
<tr>
<th>Environmental conditions</th>
<th>Indoor – Outdoor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum air temperature</td>
<td>+ 40 °C</td>
</tr>
<tr>
<td>Minimum air temperature</td>
<td>- 30 °C(*)</td>
</tr>
<tr>
<td>Altitude</td>
<td>1000 m</td>
</tr>
<tr>
<td>Maximum wind speed</td>
<td>130 Km/h</td>
</tr>
</tbody>
</table>

(*) Other on request.

## Normal characteristics

### General characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>123</td>
</tr>
<tr>
<td>Lightning impulse withstand voltage</td>
<td></td>
</tr>
<tr>
<td>- to earth &amp; between phases</td>
<td>550</td>
</tr>
<tr>
<td>- over the isolating distance</td>
<td>630</td>
</tr>
<tr>
<td>Power frequency withstand voltage</td>
<td></td>
</tr>
<tr>
<td>- to earth &amp; between phases</td>
<td>230</td>
</tr>
<tr>
<td>- over the isolating distance</td>
<td>265</td>
</tr>
<tr>
<td>Rated Frequency</td>
<td>50 (60)Hz</td>
</tr>
<tr>
<td>Rated normal current</td>
<td>1600 A (up to 2000 A)</td>
</tr>
<tr>
<td>Rated short time withstand current</td>
<td>40 kA</td>
</tr>
<tr>
<td>Mechanical stress on terminals</td>
<td>According to IEC</td>
</tr>
<tr>
<td>Rated supply voltage of closing and opening devices and auxiliary circuits</td>
<td>110 VDC</td>
</tr>
<tr>
<td>Rated supply voltage of closing and opening devices and auxiliary circuits</td>
<td>400/230 VAC</td>
</tr>
<tr>
<td>Degree of protection of enclosures</td>
<td>IP44(*)</td>
</tr>
<tr>
<td>Seismic withstand factor</td>
<td>0.5 g</td>
</tr>
</tbody>
</table>

(*) Other degrees of protection on request.
Environmental protection is one of ABB’s top corporate priorities. Environmental issues are considered in all its operations and production.

ABB develops its processes and manufactures its products respecting the environment, in compliance with the ISO 14001 standard. ABB designs its processes and products aiming to reduce environmental impact as far as possible (greenhouse effect, acidification, photo oxidant formation, ozone depletion, etc.). It carefully considers and evaluates environmental impact by means of Life Cycle Assessment (LCA), in accordance with ISO 14040.

The environmental performance of a product must be ascertained on the basis of an LCA. LCA is a useful method for calculating the environmental impact of a product. COMPASS with silicon isolators is the result of our efforts in relation to environmental issues. It has been designed in compliance with the COMPASS project philosophy, which combines functional and reliable systems with the use of highly recyclable materials. Moreover, COMPASS is so compact that it reduces the area required for the complete substation by about 50% (over 65% for the HV switchyard alone). This consequently reduces the use of gas and materials, such as SF6, steel, aluminium, iron, etc.

The compact structure of COMPASS plus the use of eco-efficient materials make COMPASS with silicon isolators a product that conforms to the standards of sustainable development recognized throughout the world. With regard to the greenhouse effect, COMPASS with silicon isolators reduces the environmental impact by about 50% compared to a complete conventional substation.

![Comparison between a standard substation and Compass](image-url)
Substation layout

Single-bay substation
3-bay substation
Substation layout

4-bay substation, ring main diagram

Incoming line / Busbars / Transformer bay
4-bay substation, ring main diagram + bus isolator

Incoming line / Busbars / Transformer bay
A comprehensive environmental, quality, health and safety system testifies to our commitment towards reducing the impact on the environment produced by our processes and improving the health and safety of employees. The Quality Management System has been certified according to ISO 9001 since 1992, while the Environmental Management System has been certified according to ISO 14001 since 1998.

Through the Environmental Product Declarations (EPD) and Environmental Performance Declaration, ABB Adda provides the necessary information about the environmental performance of the products during their whole Life Cycle, in compliance with Standard Requirements (“Specific Product requirements”).

The target of the High Voltage Products division is to be the Quality Leader in the industry and to be clearly perceived as such by Customers. To achieve this goal, ABB gives Quality aspects priority, especially at operational level. All the internal and external functional areas are involved in maintaining and improving global quality, across all processes.

A random test plan ensures that the incoming materials have been regularly inspected. Furthermore, materials, parts or components from new suppliers or from a critical supplier are automatically flagged for 100% inspection.

Special destructive and non-destructive tests are conducted in the laboratories. Compliance with the technical specifications or with prototypes is verified here by means of tests, such as overpressure, corrosion, hardness, etc.

All the instruments and equipment used for testing are systematically and periodically calibrated by the metrology laboratory. Standardized operating procedures are essential to ensure correct assembly processes.

The documents provide step-by-step assembly instructions for each part manufactured. All assembly and test checklists are collected and stored in a file to ensure that the products and individual sub-materials are fully traceable.

The final tests prove that the product conforms to the customer’s specifications and to the applicable International Standards:

- IEC 62271-203 SF6 Switchgear
- IEC 60694 High voltage switchgear
- IEC 62271-100 circuit breakers
- IEC 62271-102 disconnector/earthing switch
- IEC 60044-1 current transformers
- IEC 60137 bushing
- IEC 61462 insulator.

The test results and the Declaration of Conformity to customer specifications and to the applicable International Standards are included in the test report. The completeness of the supply is verified during the final inspection performed on each product.

ISO certifications

HV testing room
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