



Power on the move

Integrated, modular and prefabricated switchgear bundles with extended functionality for modern HV substations

PER SKARBY, KENNETH N. JABRAND, ALBERTO ZULATI – Electricity market liberalization is forcing utilities to be nimble concerning their obligations to keep a reliable supply of power flowing. At the same time, they also face the challenge of connecting a rapidly increasing number of renewable energy generators to the grid in a way that does not threaten overall power quality. It is to help utilities meet these two challenges that ABB has built upon decades of technical achievements in high-voltage substation technologies with advanced degrees of compactness, availability and automation to expand its prefabricated and functionally integrated offerings into fast-deployable switchgear bundles. ABB's integrated gas-insulated switchgear (GIS) and Plug and Switch System (PASS) are two concepts that have taken conventional switchgear technologies to new levels of prefabrication, mobility and functional integration. They are designed to respond to increasing needs of renewable integration, fast installation and quick power restoration after a natural disaster.



Because the PASS-based MFM is so transportable and so simply installed it is ideal not only for covering substation outages but also for providing power infrastructure for disaster recovery.

Integrated GIS is defined by its functional integration and the inclusion of a housing that enables a wide spectrum of auxiliary equipment to be installed and configured in the factory, with flexible connection options that include cable terminations, busducts or bushings for overhead lines.

PASS switchgear has a modular design that allows several elements to be combined. These elements include the circuit breaker, combined disconnecter-earthling switch, outdoor SF₆/air bushing, slip-over current transformers, voltage transformers, cable entry/exit and surge arresters. All PASS solutions are delivered fully assembled and factory tested.

Both of these products are at the heart of ABB's integrated, modular and prefabricated extended-functionality switch-

gear bundles for modern high-voltage substations.

Integrated GIS applications

Prefabrication and functional integration of switchgear are concepts that have converged toward, and reached a substantial degree of, standardization at medium-voltage and medium-power ratings.

Products in this segment include, for example, ABB's "electrical houses" and compact secondary substations (CSSs), which have existed for some time. The same concept is now also available in the high-voltage segments up to 420 kV.

This builds on and extends ABB's well-proven and reliable GIS product portfolio. The growing demand for power in expanding urban areas as well as in the mining and oil and gas industries requires a power supply that is both flexible and

available at short notice. In urban expansion, substation appearance is also of great importance. Common to nearly all applications, however, is the fact that power interruption, no matter how short, can be very costly, can disrupt the lives of thousands and can severely upset industrial production. Reliability and availability remain, therefore, a priority item on utili-

Integrated GIS units can easily be transported to the next site – this reduces the “stranded asset” drawback typically encountered by conventionally installed switchgear.

ties' agenda. This is a major driver for the adoption of GIS technology.

Electrical infrastructure is reaching the end of its life cycle in several cities around the world. In these places, overhead lines

Title picture

This PASS-based MFM, pictured in Algeria, can be installed and put into operation within hours of arrival on site.

1 Integrated GIS



2 Integrated GIS – available ratings

GIS Product	Voltage class (kV)	Breaking current (kA)
ELK-04	72.5 – 145 170*	40 50* 63
ELK-14	170 – 300	63
ELK-3	420	63

* 170 kV voltage class has a 50 kA current rating.

Substantial reduction in installation time is achieved by carrying out all the planning, design, assembly, testing and quality control in the ABB factories.

are often converted to cable systems to free up land and improve visual appearance. A logical next step is to convert traditional air-insulated substations. Here, integrated GIS can provide a more compact, less obtrusive and better-protected replacement substation → 1. The building's outer features can easily be adapted to blend into the local environment.

Urban grid conversions by, eg, undergrounding, are typically lengthy projects and integrated GIS units are well suited to serve as temporary installations throughout the construction phase. Once the cabling has been completed, it is even possible to switch the connection type from the old overhead line connected by a bushing to the newly installed cable system. For redundant installations (eg, double busbar schemes) these steps can be taken without power interruption. This greatly minimizes the impact on users and the supply of electric power. Once the project has been completed, the result is a well-protected, safe and visually compelling installation.

Due to its prefabricated design and fast deployment, integrated GIS is also ideal for industrial applications in the oil and gas, and mining sectors. Modern gas-insulated switchgear has a lifetime in excess of 30 years and this often exceeds localized industrial processes such as mining or oil and gas drilling. However, integrated GIS units can easily be transported to the next site. By providing this mobility, the electrical equipment can be

3 Integrated GIS in Anchorage, Alaska



redeployed, thus reducing the “stranded asset” drawback typically encountered by conventionally installed switchgear.

Predesigned and, largely, standardized configurations ensure high quality and reliability. For the customer, this translates directly into a more homogeneous installation base that, in turn, reduces both staff training needs and spare part inventory. Substantial reduction in installation time, compared with conventional substations, is achieved by carrying out all the planning, design, assembly, testing and quality control in the ABB factories → 2.

Alaska – integrated GIS success story

In 2009, the city of Anchorage in Alaska wanted a new substation quickly to address a growing demand for power. In addition to the time constraint, the customer also required the substation to be as discreet as possible as the space allocated for the project was close to a shopping center. Needless to say, the equipment also had to withstand Alaska's freezing climate and frequent seismic events.

ABB responded by providing an ELK-04 123 kV GIS substation. This was installed and energized in only a few weeks → 3–4. The substation consists of a four-breaker ring integrated into two 40-foot containers. The local control cubicles are also fully integrated inside the containers.

4 Integrated GIS – exterior view



The integrated GIS met all the customer's requirements and, based on the success of the first project, the customer ordered their next substation using the same layout.

PASS family

The PASS family covers a wide range of currents and voltages → 5. ABB launched PASS M0S 420kV with a breaking current of 63kA in the first quarter of 2013. Although complex configurations like PASS M0S imply significant size, it is still delivered fully assembled and tested. Keeping this important characteristic is a decisive competitive advantage at this rating.

PASS modularity and flexibility allow the design of very compact solutions. For example, two PASS double circuit breakers can be combined into a MOH to fit any H-scheme substation layout.

Pass-based MFM (Multi-Functional Modules)

The number of power plants is rising faster than substations can be built. This has led to the development of a quick-install solution – MFM. To be able to offer a complete mobile installation and short installation times, ABB developed a solution that uses prefabricated module bays as building blocks → 6.

The Multifunctional Module (MFM) includes all the HV, MV, power transformer and auxiliary equipment merged into one single module.

5 The PASS family

Assembly module	Voltage class (kV)	Breaking current (kA)
PASS M00	72.5 – 100	40
PASS M0	123 – 170	50 (145 kV 63kA 60Hz)
PASS M0S	252	50
PASS M0S (Q1 2013)	420	63

6 Prefabricated PASS-based MFM bays like this make up the basic elements of a fast-deployable substation



The PASS-based MFM is a new approach to prefabricated solutions: The integration of the PASS into the power transformer makes the MFM the most compact solution ever designed in the mobile module business. The overall dimensions are such that the modules can be transported by normal commercial vehicles and, thanks to the provision of a lifting system, the operations for the loading, unloading and positioning on site can be carried out without the need for a crane or lifting gear.

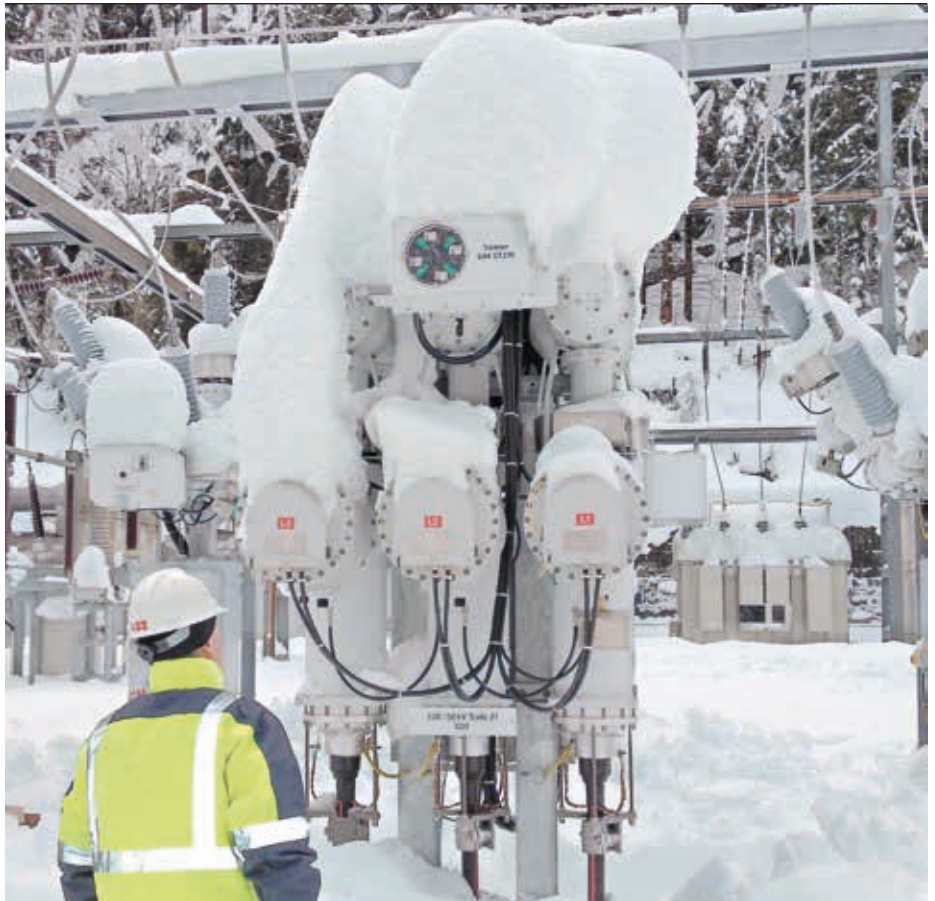
An MFM may be composed of three HV line bays (single busbar type) equipped with cable plug-in terminations. It can fit on a 40-foot standard trailer that can be freely moved by road without oversize load permits. The LV section can be assembled in a transportable container on the same standard trailer. All these features allow full assembly and testing of the entire mobile solution in the factory. The MFM can also be equipped with a service station voltage transformer designed to be connected directly to the high-voltage network to guarantee an uninterrupted 230 VAC power supply.

The PASS-based MFM was conceived to be small and easily transported. Because it is so transportable, and so simply installed, it is ideal not only for covering substation outages during refurbishments but also for providing power infrastructure in case of major faults due to catastrophic events.

Although complex configurations like PASS M0S imply significant size, it is still delivered fully assembled and tested.

Pre-designed and, largely, standardized configurations ensure high quality and reliability.

7 The PASS family can be installed in the most extreme climates – cold as well as hot.



Algeria – PASS-based MFM success story

Twenty-six MFMs will supply energy derived from mobile gas turbine generators provided by Energy Services Inc. (ESI), a Pratt and Whitney subsidiary, in different regions of Algeria → 7. ESI, who issued the order to ABB, will provide the ABB MFMs to Sonelgaz, the state-owned utility responsible for electricity and gas distribution.

Sonelgaz supplies more than 6 million households with electricity – representing a 98 percent coverage of the country. Algeria is the largest country on the African continent and has over 225,000 km of power lines, serving a population of 37 million. It is expanding the size of its transmission network to reach isolated communities and to support hydrocarbon developments in the Sahara Desert.

ABB's MFMs, which can be installed and put into operation within hours of arrival at site, will provide the generators' connections to the 60/220 kV Algerian grid. For ESI, it is crucial to be able to move the equipment by truck across all types of terrain, including mountains and des-

erts. MFMs can be transported by sea, road and air and will be used for electrical energy generation in different sites in Algeria, dramatically increasing the network power capability. ABB products were chosen because the MFM concept allows extreme flexibility and is the ideal solution for quick connection of distributed generation to the existing grid.

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