



# Power house

A strong and light enclosure for substations

ALEXANDRA L. GOODSON, BRIAN C. JOHNSON, DANIEL TURK – ABB's latest compact secondary substation (CSS) provides utilities with smart and efficient equipment that provides real-time data, reliability and a performance that ensures the network meets customer needs. Extending the life of such equipment means that utilities have lower maintenance costs and fewer replacement or warranty concerns. The provision of an appropriate enclosure for the CSS is a very important strategy for extending equipment service life. Traditional steel, concrete or brick structures have many drawbacks concerning space, speed and flexibility of installation, and environmental robustness. ABB's state-of-the-art glass reinforced polyester (GRP) enclosure obviates all these concerns and provides the perfect housing for a CSS and many other electrical applications.

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It is robust enough to protect the equipment inside from the extremes of heat and cold, while being lightweight enough to be easily transported to remote locations.

**T**he CSS market was created when distribution utilities transitioned from overhead power lines to underground cables. With cables underground, the traditional, large step-down substation with its overhead lines became impractical. Customers now required a compact piece of equipment that could be installed quickly with a minimum of site work but that provided the same functionality as an overhead line substation.

#### Concrete

Driven by aesthetics and safety concerns regarding overhead lines, Europe was one of the first regions to embrace the practice of undergrounding cables and installing CSSs. CSSs can be built on-site with either brick or concrete. Concrete is weather-resistant, but very heavy, difficult to work with and on-site construction labor costs can be significant. However, if the unit is preassembled before shipment to site, the transportation and rigging costs can be excessive as a concrete CSS weighs, on average, 24 t. If the CSS is heavier than 24 t, separate shipments to site may be

needed due to transportation limits, further complicating matters. Concrete CSS factories are located in many regions and close to customer sites in an effort to lower transportation costs.

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## ABB recognized that customers needed a new CSS enclosure solution – one that combined the benefits of steel and concrete.

While this situation may have been acceptable years ago, it is now challenged by population growth and city expansions that force CSS installations further away from the CSS factory.

#### Steel

As underground cabling and urbanization continued apace, new, rural locations began to create challenges for heavy concrete CSSs. A lighter and cheaper solution was needed for this

evolving CSS market. A steel enclosure was found to fit the bill. With the comparatively lighter weight of a steel CSS, transportation to rural locations was no longer as expensive and heavy on-site installation work was not required. Steel provided the same functionality as concrete but the CSS had an average weight of just 12 t. This allowed CSS units to be transported and rigged without significantly impacting budgets.

However, while lighter than concrete, steel does not have the same strength and is more sensitive to ambient weather conditions. High levels of sunshine may increase the steel temperature to such an extent that a derated transformer has to be used, thus lowering the overall efficiency of the CSS.

ABB recognized that customers needed a new CSS enclosure solution – one that combined the benefits of steel and concrete. Ideally, it would be robust enough to protect the equipment inside from the extremes of heat and cold, while being lightweight enough to be easily transported, even to remote locations. To fulfill this need, ABB developed a modular platform that encompasses the strength and durability of concrete with the lightweight characteristics of steel. The platform is suitable not only for housing

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#### Title picture

The robustness and flexibility of ABB's UniPack-G make it the ideal enclosure for the complete spectrum of ABB's smart grid product portfolio.

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CSSs, but also for housing a wide range of other electrical equipment. In addition, it is appropriate for cold, moderate and warm climates and for locations ranging from sea-spray-soaked coastlines to remote, heat-seared sandy deserts. This new product range is called UniPack-G, where G stands for glass-reinforced polyester (GRP). GRP is a material used in many everyday applications, such as wind turbine blades, boats, civil construction, cable pillars and garden furniture, to name but a few.

#### UniPack-G

GRP is unaffected by temperature change and can withstand attack by salt and humidity. As a UniPack-G CSS enclosure weighs far less than its equivalent in concrete or steel, transportation costs are reasonable and installation in remote or difficult locations is far easier. Although lighter, GRP has greater durability than both concrete and steel. Since a CSS can be installed in publicly accessible locations, the UniPack-G's inherent ability to withstand vandalism is important. UniPack-G's durability also ensures there will be no damage from transportation or shifting, as can occur with concrete → 1.

The UniPack-G design has been tested to the highest safety standards in the GB and IEC ranges for CSS applications. In addition, the standard UniPack-G design has passed the internal arc classification (IAC) test, which ensures it has the highest level of safety for the public and for operating personnel.

2 Steel structures are prone to deterioration in many environments.



#### Location

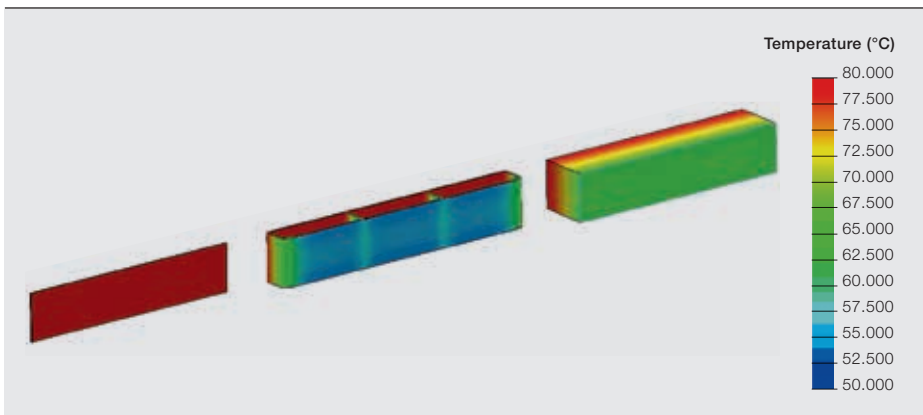
Ever more rural and environmentally harsh locations are being supplied with electricity. Because the UniPack-G has the same robustness as a concrete CSS – with one-third of the weight – and on-site installation and material handling effort is minimal, it is ideally suited to this type of location. UniPack-G is easier to transport over longer distances and it requires less lifting effort. This reduces the utility's reliance on local suppliers and allows it to depend on ABB, who can exploit and pass on the advantages that come with being a global supplier.

Rural and environmentally harsh locations usually require low-maintenance equipment because of remoteness and difficulty of access. In addition, the smarter networks now being installed around the globe can be controlled and monitored remotely, so CSSs are visited less often and this reinforces the requirement that equipment be as maintenance-free as possible. The UniPack-G has an exterior that can withstand severe conditions better than a typical CSS enclosure, it is corrosion-resistant and never has to be repainted → 2. In addition, UniPack-G's GRP enclosure material does not dampen radio waves, so communication antennae can be installed inside to reduce the risk of vandalism. These features all reduce the maintenance effort and cost for the utility.

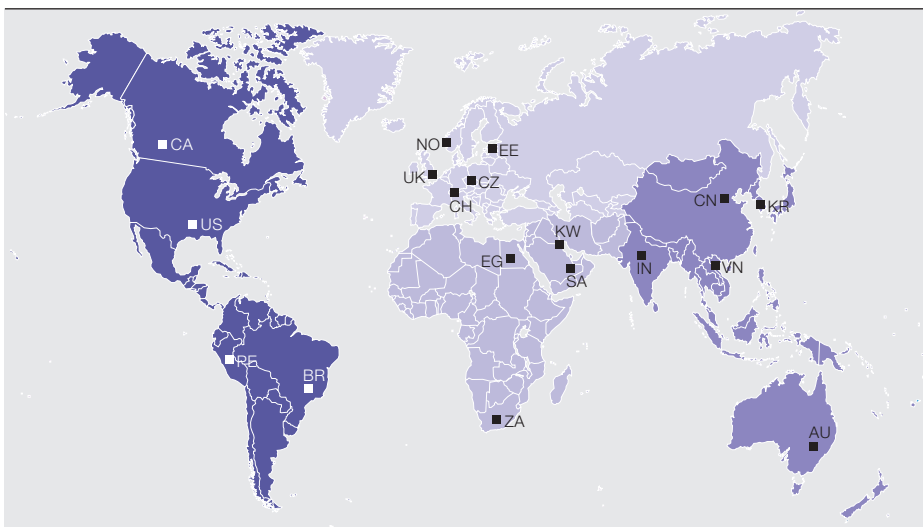
#### Insulation

Electrical equipment and automation electronics are often sensitive to humid-

3 The UniPack-G (middle image) impedes heat ingress far better than steel (left) or concrete (right).



4 ABB has factories and personnel to support all GRP projects. The map highlights ABB's global CSS footprint. (The map colors indicate ABB marketing regions.)



ity and temperature. For this reason, steel CSSs require additional insulation, which can be difficult to install. Concrete CSSs require less insulation in warm environments but need to be heated in cold locations or when in idle mode.

UniPack-G's double-layer design ensures that ambient temperatures do not affect the equipment inside → 3. The figure shows the high level of insulation provided by ABB's UniPack-G. The first image shows the interior wall of a typical steel enclosure in intense sunshine – the interior will be difficult to keep cool and this will affect the performance of the equipment inside. The second image highlights the UniPack's double layer insulating design: The red of the exterior wall demonstrates an environment with high solar irradiation, while the blue of the interior wall reflects the cool internal temperature. The ability to maintain the internal temperature, regardless of external conditions, is inherent in the double-layer feature of the UniPack-G, which is

included in all standard solutions. The third image represents a concrete enclosure wall. While the heavy wall is thicker, the light green of the interior wall shows it is not as cool as the UniPack-G.

The temperature consistency inside the UniPack-G allows equipment to run at its highest efficiency and without the need to derate. This increases the utility's return on investment and ensures a high equipment utilization rate.

UniPack-G's flexibility makes it the ideal enclosure for the complete spectrum of ABB's smart grid product portfolio – including monitoring, control, measurement and protection products. Its modular design offers flexibility and allows a wide range of other electrical equipment (eg, energy storage modules, E-houses and solar inverter stations) to be accommodated, while still abiding by transportation, installation and durability requirements.

UniPack-G's GRP enclosure material does not dampen radio waves, so communication antennae can be installed inside.

GRP's features, along with emerging applications, provide new opportunities for grid solutions and utilities can now work with one supplier for all their GRP needs. GRP is a material that supports these initiatives, while ABB provides a global footprint and support → 4. Customers demand a smart, optimized and safe CSS solution and ABB's UniPack-G portfolio exceeds the customers' requirements by combining concrete's benefits, steel's lightweight features and smart grid compatibility.

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