



CUSTOMER PRESENTATION

UniPack-G

Glass reinforced polyester (GRP) Compact secondary substation (CSS)



Contents

Introduction and product information

- Introduction
- Complete CSS portfolio
- Typical customer requirements
- Main concept
- Components
- Standard layouts
- Common enclosure types
- Segments
- Product features
- What is GRP?
- GRP industry references

Customer benefits

- High safety

- Reliability
- Long lifetime of internal components with minimal maintenance
- Easy and fast installation, commissioning and relocation
- Low cost of ownership
- Eco-friendly

Digitalization

- Smart CSS – key elements in a Smart Grid
- How a Smart CSS is working in a Smart Grid
- Smart CSS configuration and customer value add

Resources

- Key reference projects
- Global presence
- Summary

Introduction and product information

Introduction

What is ABB's Compact Secondary Substation (CSS)?

- CSS is a type-tested substation containing:
 - Medium voltage (MV) switchgear
 - Distribution transformers
 - Low voltage (LV) switchboard
 - Connections and auxiliary equipment to supply low voltage energy from medium voltage systems
- CSS is for energy transformation in secondary distribution network from MV to LV or LV to MV
- CSS is typically installed in locations accessible to the public and should ensure protection for all people according to specified service conditions
- All CSS components shall be type- and routine-tested per their relevant product standards



Complete CSS portfolio

UniPack

ABB offering

The UniPack family is a factory type-tested prefabricated assembly containing:

- Enclosure with natural ventilation and several layouts
- Medium voltage switchgear
- Distribution transformers
- Low voltage switchboard

- Enclosure material
 - Glass reinforced polyester (GRP)

ABB components

- Gas or air insulated MV switchgear up to 40.5 kV
- Oil or dry transformers up to 3500 kVA
- Various number and ratings of outgoing feeders available

Standards

- Fully type-tested according to the latest edition of IEC62271-202, with high reliability and safety
- Arc classification (IAC-AB) test

Typical customer requirements from CSS

Customer requirements

- High reliability and safety
- Designed and tested according to IEC standards
- Reduced downtime - Continuity of service and stable supply
- Space savings - Compact dimensions
- Flexible solution - A wide range of main components, easy to configure and upgrade
- Safe and easy for operators in existing networks and systems
- Optimized life cycle cost – reduced maintenance and easy installation
- Fast delivery time
- Low environmental impact



Main concept

UniPack-G

Overview

- Designed and tested according to latest IEC 62271-202 - classification intended to offer a tested level of protection to operating personnel and general public in the event of internal arcs occurring on the medium voltage side
- Internal arc proof IAC-AB 20kA 1s with different layouts and equipment
- Suitable for harsh environments
- Lightweight (approximately 3 times lighter than concrete)
- Long lifetime of equipment due to thermal properties of enclosure material

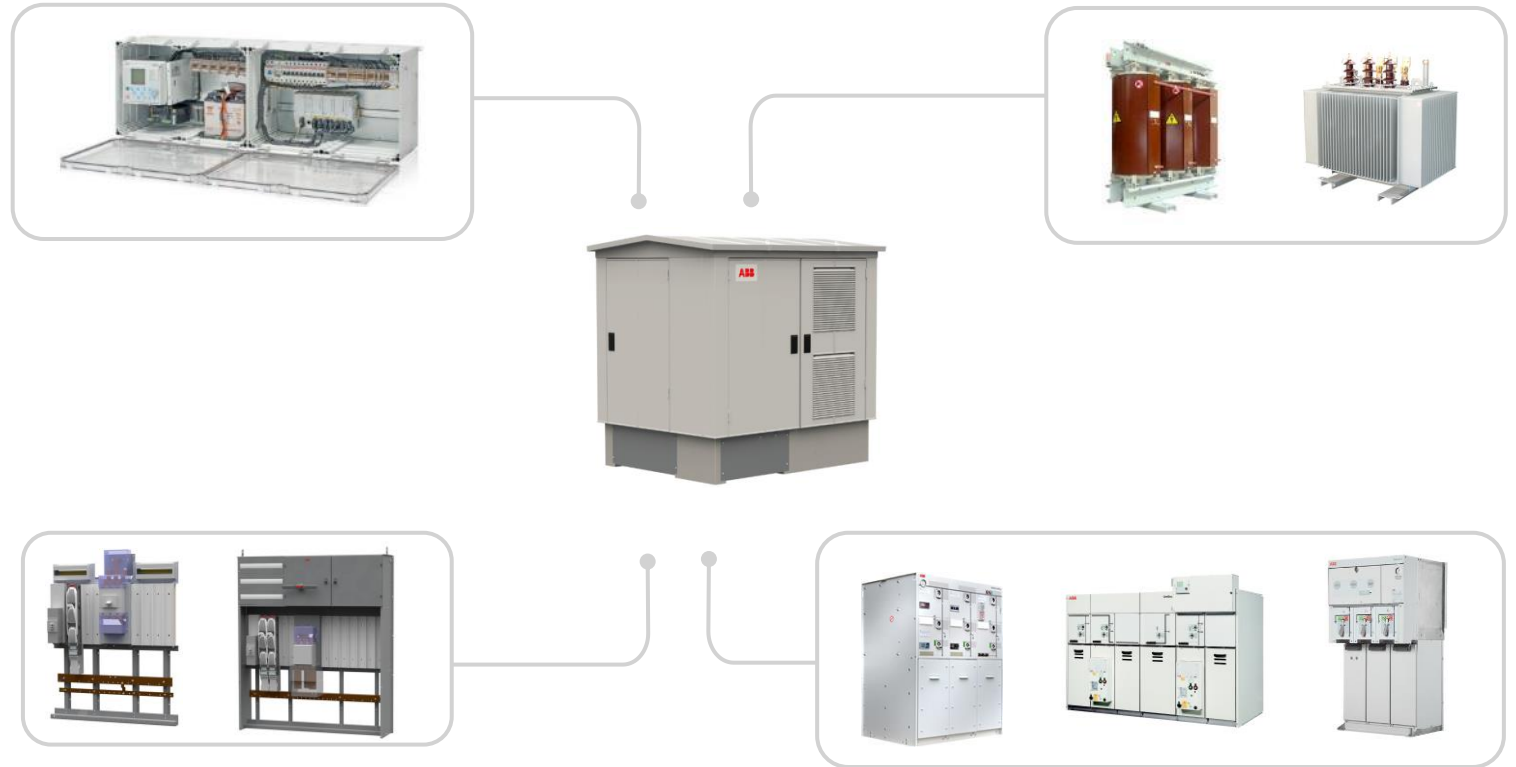


Durability of concrete CSS, lightweight like steel CSS

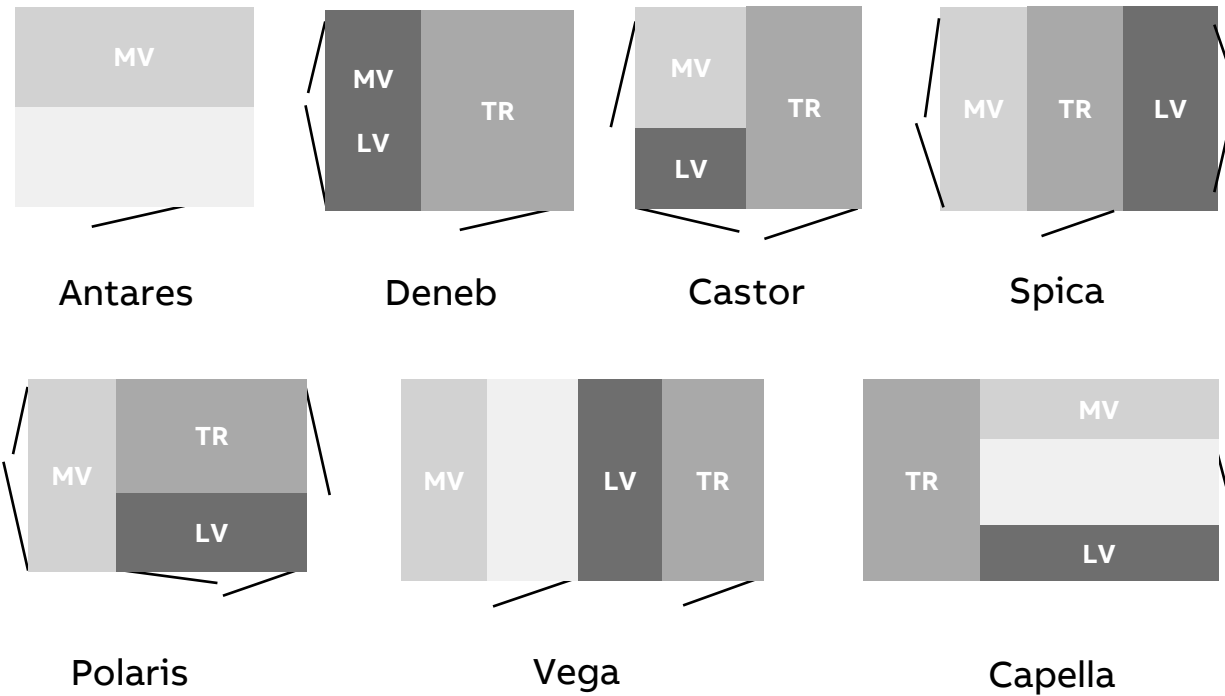
Components

Main components

- Medium voltage secondary switchgear
 - SafeRing/SafePlus
 - SafeRing Air/AirPlus
 - UniSec
 - SafeLink 2
- Distribution transformers
 - Oil type, hermetically sealed
 - Dry type
- Low voltage switchboard
 - UniPack LVS
- Automation



Standard layouts

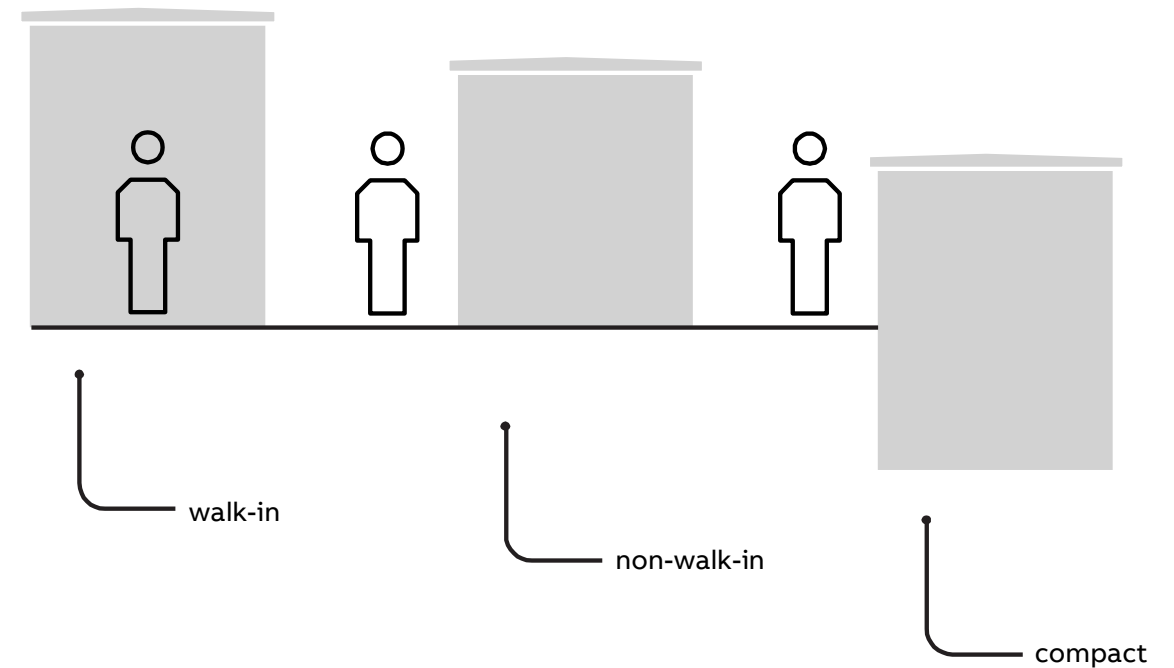


Footprint and layout flexibility to match customer requirements

Common enclosure types

UniPack

- A “walk-in” type CSS is situated at ground level or partially underground and operated by entering the CSS
- A “non-walk-in” type CSS is situated at ground level and operated from outside
- A “compact” type CSS is situated partially below ground level and operated from outside



Reduced visual impact

Segments

Compact Secondary Substations are often used in the following segments

Utility

Industries

Solar and wind

E-mobility

Data center

Small generation

Mining & oil and gas

Food & Beverage

Energy Storage

Infrastructure/ports

Rail



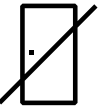
What is Glass-Fiber Reinforced Polyester (GRP)?



Glass-Fiber Reinforced polyester (GRP) is:

- A composite material
- Made of polyester reinforced with fiber glass
- Lightweight
- Corrosion resistant
- Extremely strong and robust
- Proven material technology from several industries that have high demands on corrosion resistance, performance and strength

GRP is the enclosure material used by UniPack-G CSS



GRP industry references

Cable cabinets



Marine applications



Industrial shelters



Underground tanks



Secondary substations



Wind turbine blades





Customer benefits

Customer benefits



1. High safety

- Internal arc fault tested
- Fire retardant enclosure



2. Reliability

- Corrosion resistant enclosure material using UniPack-G
- Mechanically robust



3. Long lifetime of internal components with minimal maintenance

- Thermal characteristics of enclosure



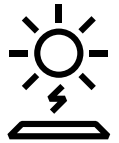
4. Easy and fast installation, commissioning and relocation

- Lightweight product allows for faster installation



5. Low cost of ownership

- Low maintenance cycle costs



6. Eco-friendly

- Low environmental impact

1. High safety

Features and benefits

Internal arc tested per IEC62271-202

- Highest safety in the CSS industry, both for general public and operator
- Arc-tested and low flammability in one material
- Internal arc safety is verified by the type tests per IEC62271-202 with RMU integrated inside CSS



Reliable and proven compartmented design

- CSS is divided in compartments based on the equipment and layout
- Walk-in CSS may have one common MV and LV compartment
- Compartments secure safe access to equipment during operation



Non-flammable

- Self-extinguishing
- Non-flammable (V0 according to UL94)
- Fire resistant for more than 60 mins, according to ISO834
- Protects equipment and investment over product life cycle



Non-toxic housing material

- Enclosure material does not generate harmful gases



Internal Arc Classification (IAC)

Internal arc classified substation

- Prescribed criteria for protection of persons are met in the event of an internal arc and demonstrated by appropriate tests

Internal arc classification IAC-A

- Protection to operators during normal operation on the HV side of the CSS

Internal arc classification IAC-B

- Protection to general public in the vicinity of the CSS on all its sides

Internal arc classification IAC-AB

- Protection to both operators and general public



Internal Arc Classification (IAC)

Safety



Internal Arc Classified per IEC 62271-202 Ed. 2.0

- Operator - A
- Public – B
- UniPack is rated IAC AB, 20 kA for 1 sec *

* Valid for Non walk in layouts. Please contact ABB for walk in layouts IAC rating

Arc-proof CSS



Non-arc-proof CSS



MV switchgear is tested when installed inside UniPack-G CSS

No test extrapolation from IEC62271-200

Test is valid only with the same brand and type of MV switchgear

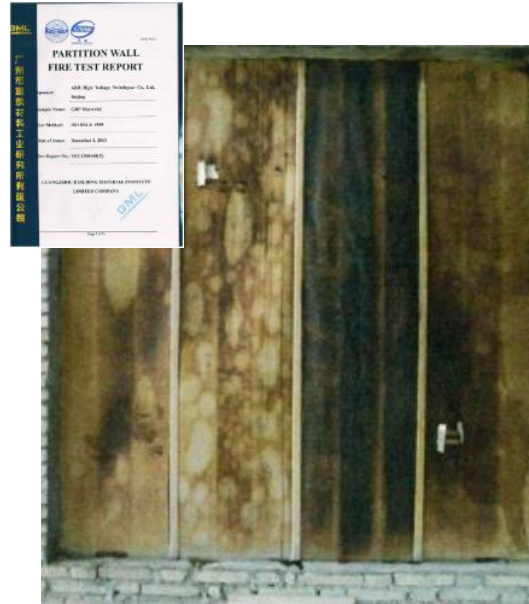
Non-flammable

Non-flammable

All UniPack-G housing panels have the following characteristics:

- Self-extinguishing
- Non-flammable
Classification V-0: UL94/GB8924-88
- Fire resistant
Tested under ISO 834 achieving a fire behaviour for more than 60min Integrity (furnace temperature at this time was 950 degrees C)
- Following option is available based on special request:
 - Integritiy 120 minutes (available to the walls only)
 - Insulation 88 minutes (available to the walls only)
- Non-toxic according to EN45545-2

Improved fire resistance from internal and external fire compared to steel and concrete CSS



UniPack-G fire resistance tested



Non-fire resistant CSS

2. Reliability

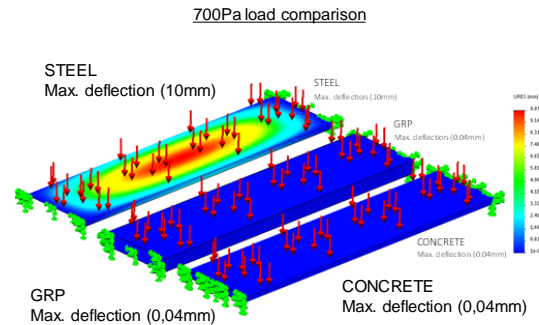
Features and benefits

Mechanically robust

UniPack-G maintain mechanical characteristics of concrete CSS in windy conditions

Robust GRP enclosure provide excellent intruder security

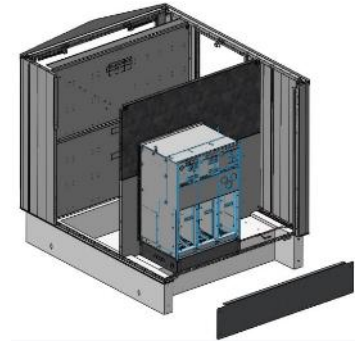
Best external object impact protection



Self supporting structure

No need for metal support frame or separate carrying structure

Therefore, no threat that corrosion will reduce the strength over life cycle

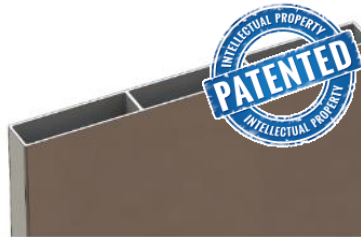


Resistance to external damage

Even if external layer is damaged, the internal surface second layer will keep its characteristics

Any damage on one enclosure module will not be carried over to the next

IP of CSS is maintained even in case of mechanical damage



ABB's patented GRP for full enclosure

Design applied in full enclosure including doors and ventilation grilles

Strength and durability applied also on doors and ventilation grilles

Corrosion resistant and durable GRP design without compromise

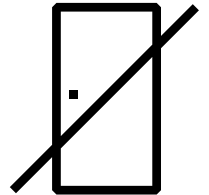


Providing the strength and durability of a concrete CSS with the lightweight characteristics of steel

Mechanically robust

Protection against external elements

- ABB's GRP patented design: robust enclosure does not bend or deform
- Enclosure withstands a minimum wind load of 34m/s
- Heavy duty design: up to 2500N/m² roof load
- ABB patented GRP design increases resistance to vandalism
 - Robust GRP doors of ABB's patented design provide necessary intruder security
 - All fastening is located inside the housing
 - Strong and reliable multi point door locking system
 - Anti-graffiti coating as an option
 - Padlock is protected by additional cover
- Robust GRP transformer cooling grilles
- Any damage on one enclosure module will not be carried over to the next
 - Best external object impact protection
 - Even if external layer is damaged, the internal surface's will keep its characteristics



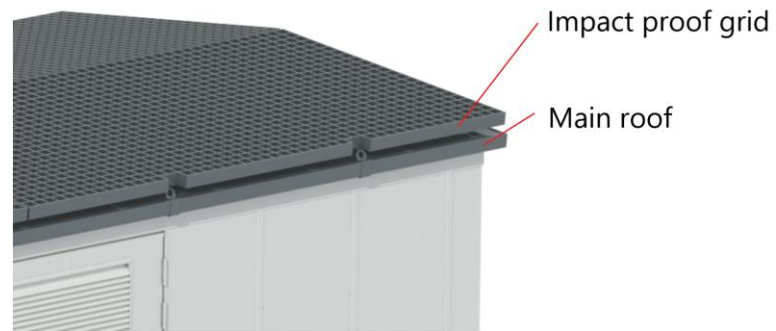
Mechanically robust

Protection against falling objects

Falling ice from wind turbine blades



Additional roof protection available



Protection against falling objects

- Additional mesh grid roof protection add-on available
- Allow to protect CSS roof from falling ice or similar objects with high kinetic energy
- Tested to withstand impact energy 980J

Self supporting structure

Corrosion of steel and concrete CSS

- Even concrete CSS has steel parts that can be prone to corrosion
- Any scratch can initiate corrosion, including common transportation damage
- Environmental conditions may require special painting, not always sufficient in extreme conditions
- Doors and ventilation grilles are made of alternative materials, ie aluminum and stainless steel, have high cost – including the threat of robbery

Maintenance cycle and costs

- Constant painting required to maintain rust protection
- Painting on site more risky than controlled factory painting



ABB's patented GRP for full enclosure

Corrosion resistant GRP material

- ABB's patented GRP material provides the durability of concrete, with better corrosion resistant properties
- UniPack-G performs equal to C5M as for structured steel according to ISO 12944-6
- All external metal parts are stainless steel or hot dip galvanized
- All fastening is located inside
- Internal parts can be made of stainless steel as an option

GRP CSS can be installed in:

- Harbors and close to sea line
- Aggressive environments like chemical plants

Maintenance cycle and costs:

- Repainting not normally required
- Any dirt can simply be washed or wiped off



Suitable to locations with harsh environments

No cracks or weathering

- UV and humidity tested
- UV degradation of the material will not happen because:
 - UV inhibitor and a protective coating used as standard
 - All fastening is done in the inner part not affected by solar radiation
- Avoiding cracks:
 - Easier and safer handling: GRP is lightweight and won't lead to cracks which can happen with concrete CSS
 - No water penetration or oxidation of the metal reinforcement since there is no metal within GRP
 - GRP has a high strength-weight ratio and degree of flexibility
 - Withstands ambient temperature fluctuations without cracking



Suitable to locations with harsh environments

Specimens during test



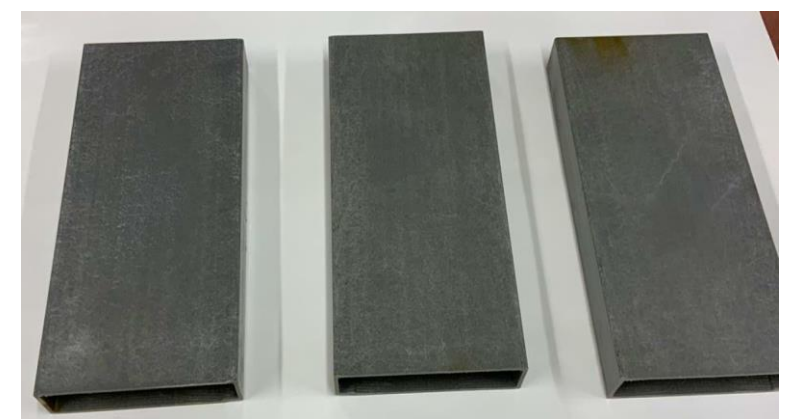
- Concrete and GRP specimens tested together
- 30 freeze thaw cycles applied
- Temperature cycles -30...+20°C
- Test environment: H₂O with 5% NaCl
- Test duration: 128 days

Concrete after 30 freezing cycles



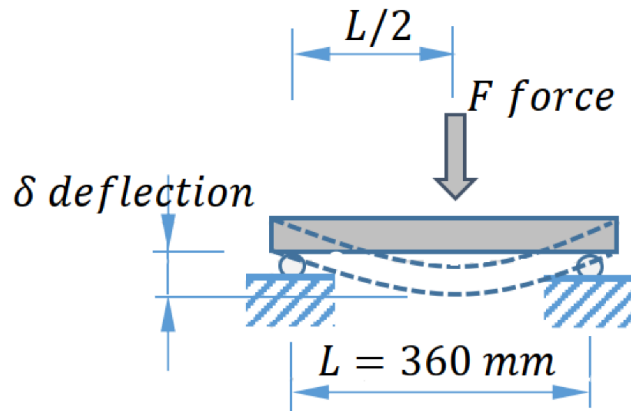
- Test result concrete: surface layer was seriously damaged of approximate thickness 10mm. Rebar is exposed to environment
- Test result GRP: no visual damage

ABB GRP after 30 freezing cycles



Suitable to locations with harsh environments

Three point bending test



- Three point bending test was performed after 30 freezing cycles
- Deflection and applied load was measured
- Specimens were loaded up to failure point

Concrete after 30 freezing cycles



- Test result concrete: bending strength reduced by 2.7 times compared to strength of specimen w/o freezing cycles
- Test results GRP: same bending strength as w/o freezing cycles

ABB GRP after 30 freezing cycles

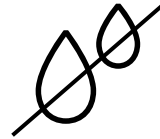


3. Long lifetime of internal components with minimal maintenance

Features and benefits

Low risk of condensation

- Patented GRP design with improved thermal insulation
- Low thermal conductivity of GRP profile
- UniPack-G does not save thermal energy in the walls or roof
- Inner surface temperature of enclosure typically does not drop below the dew point of inner air



Good thermal insulation from cold environments

- UniPack-G's patented design provides thermal insulation for sensitive equipment from the cold climate
- As seen in the figure, UniPack-G maintains higher temperature in the cold climate, where steel CSS has no insulation effect
- UniPack-G extends the lifetime of the internal components



Good thermal insulation from the sun's radiation

- UniPack-G patented design provides thermal insulation from the sun's radiation
- UniPack-G has lower temperature in the inner side of the substation wall, whereas steel CSS has no insulation effect
- UniPack-G extends the lifetime of the internal components



Optimized ventilation

- Different transformer ventilation performance available suitable for different environment and application of CSS
- Ventilation performance is proved by the type tests
- Controlled transformer lifetime as per applicable standard



Low risk of condensation

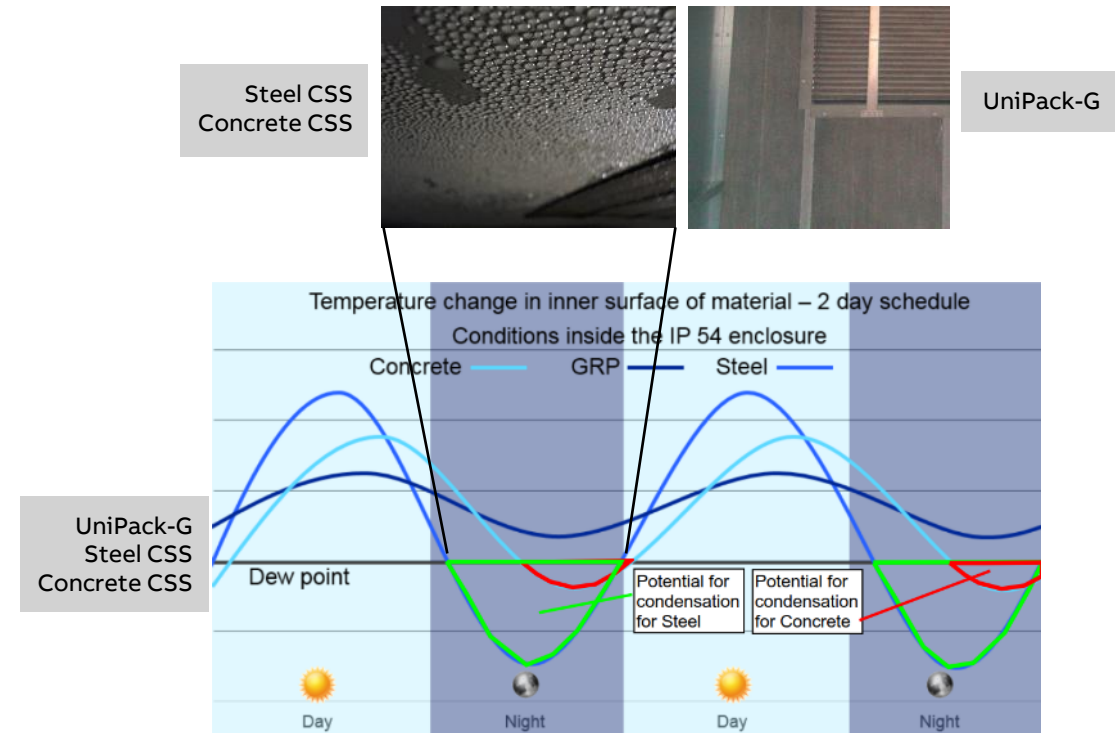
Condensation prevention in UniPack-G

Condensation typically occurs when enclosure surface temperature drops below the dewpoint of air in contact with it (CSS internal air)

There is a **low risk of condensation in UniPack-G** due to:

- Air gap between internal and external surfaces
- Low thermal conductivity of GRP profile
- UniPack-G does not store thermal energy in the walls or roof
- Inner surface temperature of enclosure typically does not drop below the dew point of inner air

Condensation phenomena



Superior thermal insulation from the sun's radiation

Thermal properties

- ABB's patented GRP provides superior thermal insulation from the sun's radiation
- UniPack-G maintains a lower temperature in the inner side of the substation wall, whereas steel CSS has no insulation effect
- UniPack-G extends the lifetime of the internal components

Hot climate

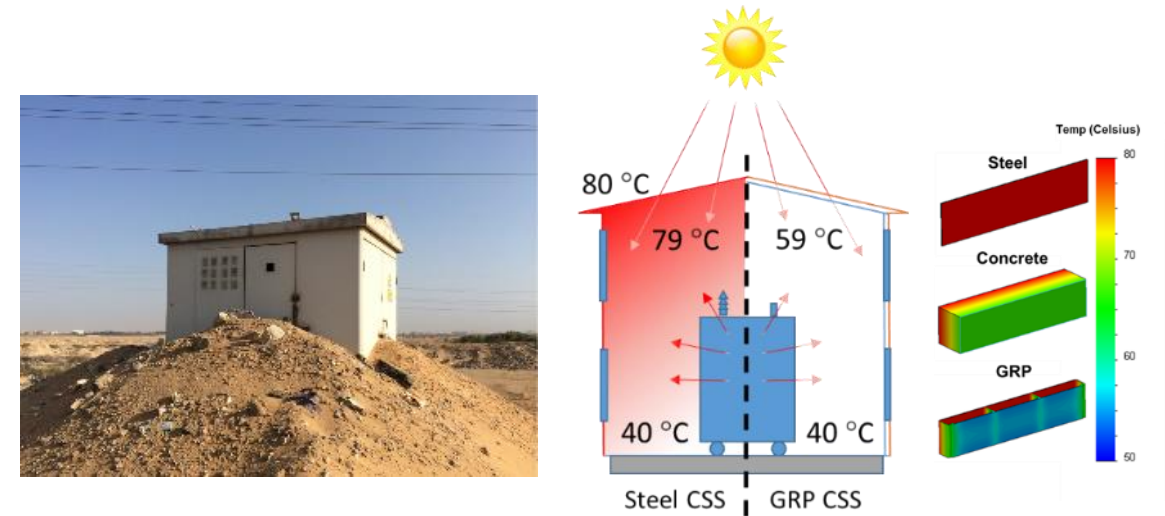


Figure describes simplified temperature gradient visualization based on computer simulations

Superior thermal insulation from cold environments

Thermal properties

- ABB's patented GRP provides thermal insulation for sensitive equipment from the cold climate
- As seen in the figure, UniPack-G maintains a higher temperature in the cold climate, whereas steel CSS has no insulation effect
- UniPack-G extends the lifetime of the internal components

Cold climate

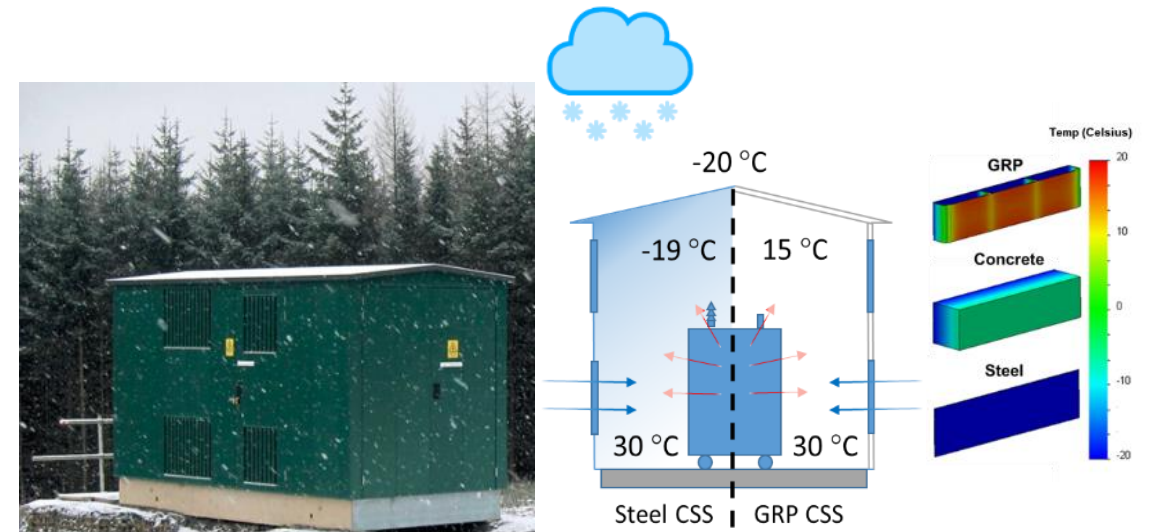


Figure describes simplified temperature gradient visualization based on computer simulations

4. Easy and fast installation, commissioning and relocation

Features and benefits

Lightweight

- Lightweight as steel CSS
- Enclosure weight is up to 4 times lighter than concrete CSS
- More stations can be transported on a single truck compared to concrete CSS
- Lower handling equipment requirements
- Easier and safer handling and won't lead to cracks as what typically happens with concrete CSS



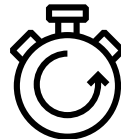
Perfect solution for locations with difficult access

- Lower handling equipment requirements
- Optimized transportation equipment compared to concrete CSS



Faster installation

- Lower handling equipment requirements
- Less work at site base preparation
- Can be moved with transformer inside



Perfect solution for remote locations

- More stations can be transported on a single truck compared to concrete CSS
- Optimized transportation cost compared to concrete CSS



Lightweight

Lightweight

Reduced logistics and installation costs

- Inexpensive transportation costs
- More stations can be transported on a single truck compared to concrete CSS
- Reduced cost on renting heavy crane
- Reduced costs related to site civil works

No repair work is needed after transportation

- GRP's light weight won't lead to cracks as can typically happen with concrete CSS



5. Low cost of ownership

Features and benefits

Low transportation and installation cost

- Reduced cost on renting heavy crane
- Reduced costs related to site civil works



Low maintenance cycle costs

- Repainting not normally required compared to steel CSS
- Any dirt can simply be washed or wiped off



No additional cost related to repair during lifetime

- Robust as concrete CSS
- Full enclosure is made of corrosion resistant material
- UV and humidity tested
- Material withstands freezing cycles
- No cracks during handling and lifting



6. Eco-friendly

Features and benefits

- Smaller environmental impact
 - Oil collection pit under transformer to avoid any leakage to environment
 - Reduced carbon footprint due to smaller transportation and installation equipment
 - Paint without hazardous particles
 - Recyclable enclosure material

Lowest environmental impact possible when supplied with available dry type transformer and MV GIS without SF₆



Eco-friendly

Recyclability

- GRP can be mixed with other materials and recycled 100% for the building industries
- Recycling process is similar to the recycling of the wind turbine blades, large GRP septic tanks and similar objects
- Recycling has to be done by specialized companies
- Collection and transportation to specialized company depends on local authority



Suitable to urban environment

Decoration packages



Optional decoration packages

- Decoration packages for different environment
- Different decoration pattern and colors
- CSS may blend into urban environment
- Decoration panels may support growing plant



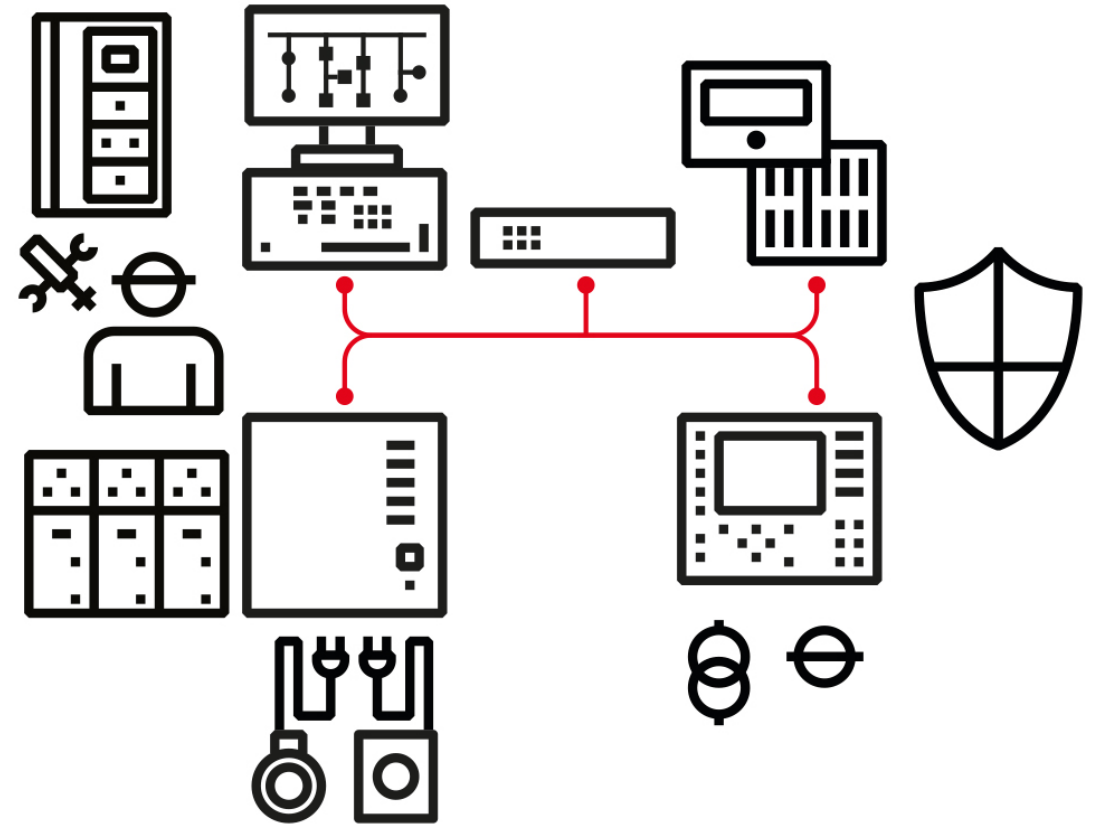
Digitalization

Market trends

Increasing levels of automation are expanding into secondary substations. These need to be connected for distributed applications and for SCADA and DMS applications.

There are various levels of digitalization, from basic communication to implementation of a station-level self-healing strategy.

Centralized, self-healing capabilities maximize distribution circuits' reliability and require automation of switching points and communications platforms.



Digitalization

Benefits and features

Flexible, modular and well integrated solutions

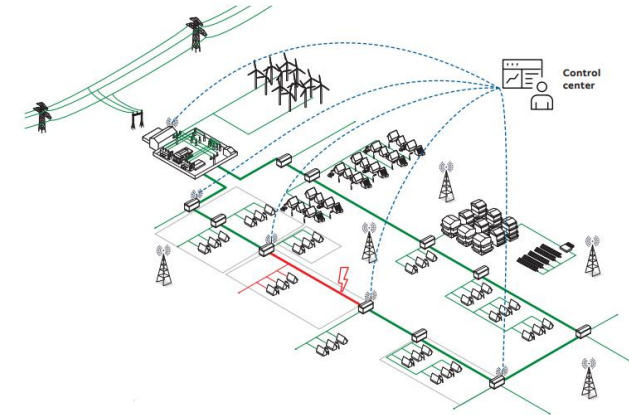
- A wide portfolio of solutions to cover the basic demand of monitoring and control to more demanding solutions for the diverse and evolving power distribution grids including fault management and protection selectivity
- Fully integrated and tested in the factory to minimize time on site

Bringing your asset within reach

- With secure and cost effective connectivity over public wireless networks the communication will be managed with the control center from the CSS to maximizing uptime and availability

State of the art fault passage indication

- ABB's unique, multifrequency admittance-based earth-fault detection algorithm for fault passage indication (FPI) is now able to detect all types of earth faults with unequalled accuracy, irrespective of the type of distribution network

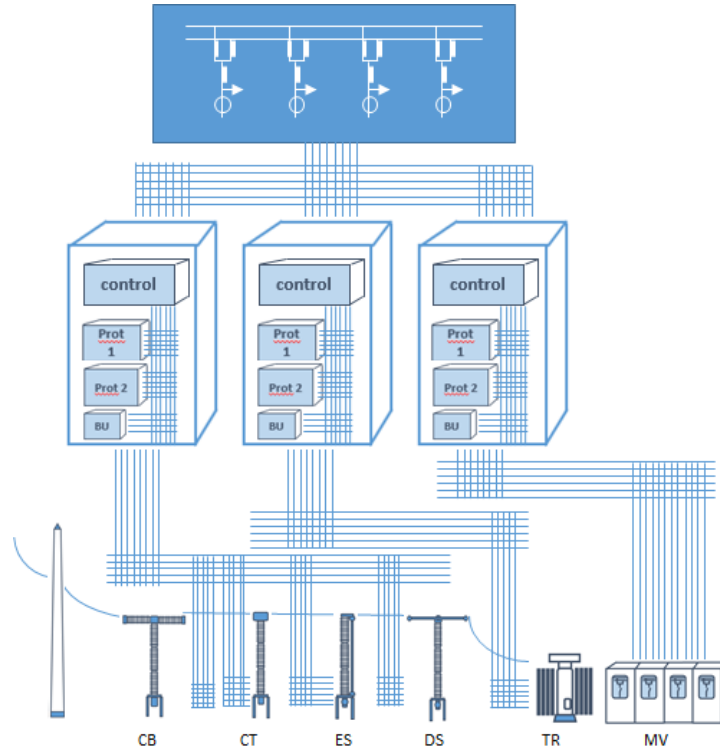


Smart CSS

Conventional compared to Digital

Conventional substation (example MV)

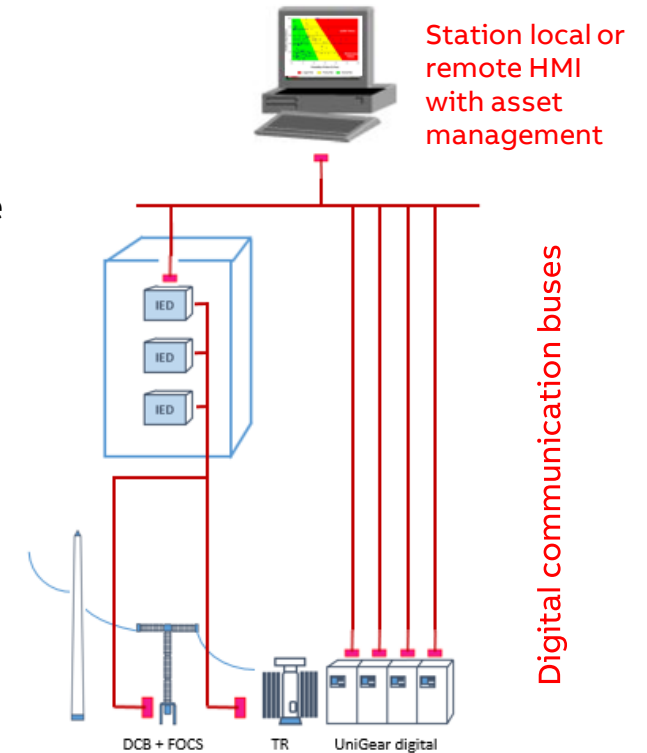
Primary components stand alone



Digital substation (example MV)

Small foot-print integration

- 80% copper reduction
- 40% shorter installation time
- 50% less space required
- Operational cost reduction
- 50% outage time reduction

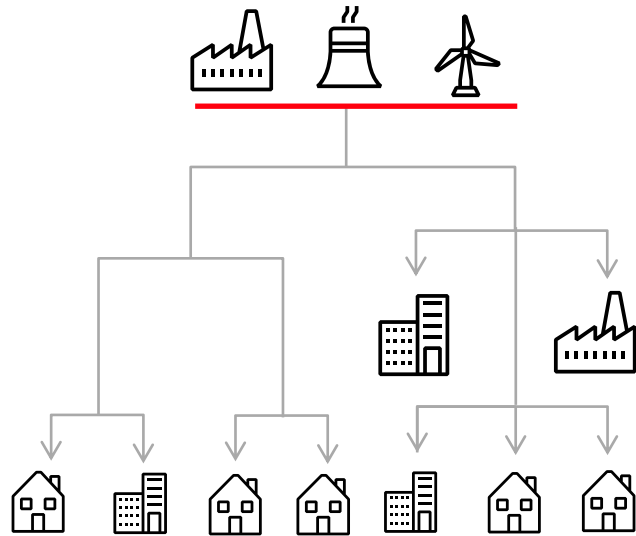


Smart CSS - key elements in a Smart Grid

The evolving grid

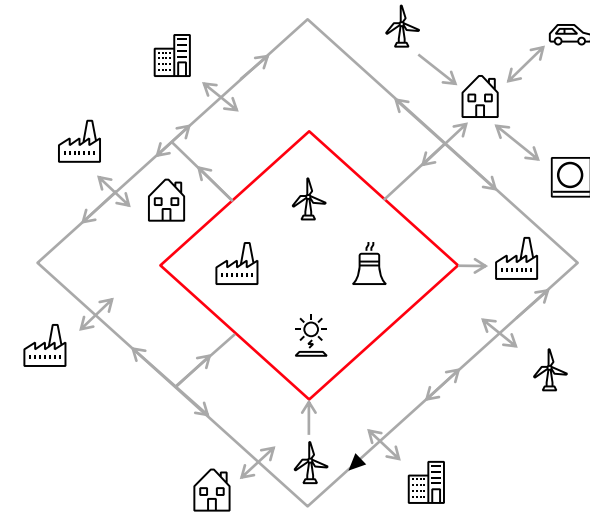
From traditional to smart grids – Smart CSS a key element

Traditional grid



- Centralized power generation
- One-directional power flow
- Generation follows load
- Top-down operations planning
- Operation based on historical experience

Smart grid



- Centralized and distributed generation
- Multi-directional power flow
- Intermittent renewable generation
- Consumption integrated in system operation
- Operation based on real time data

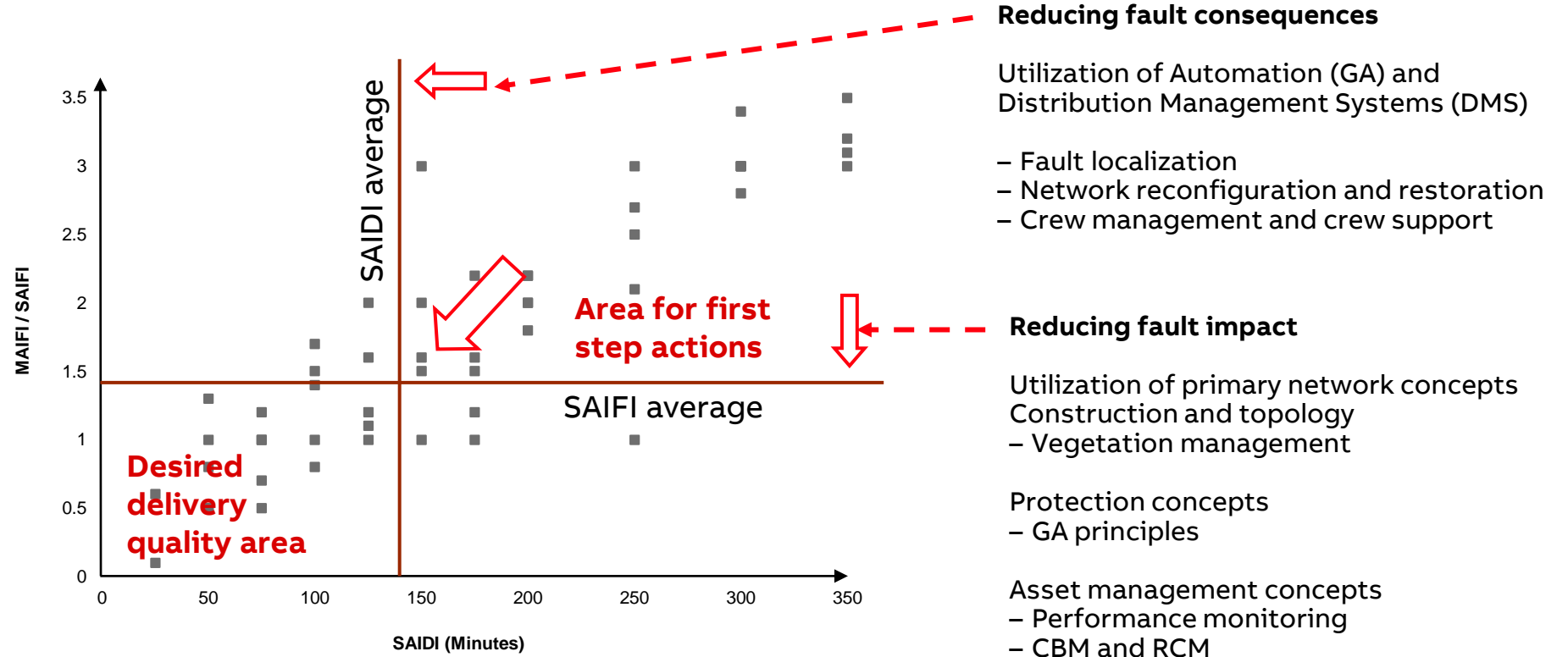
Smart CSS for grid automation

Digitalization can help reduce the number of outages and the duration

– SAIFI
= System Average
Interruption
Frequency Index

– SAIDI
= System Average
Interruption
Duration Index

– MAIFI
= Momentary
Average
Interruption
Frequency Index





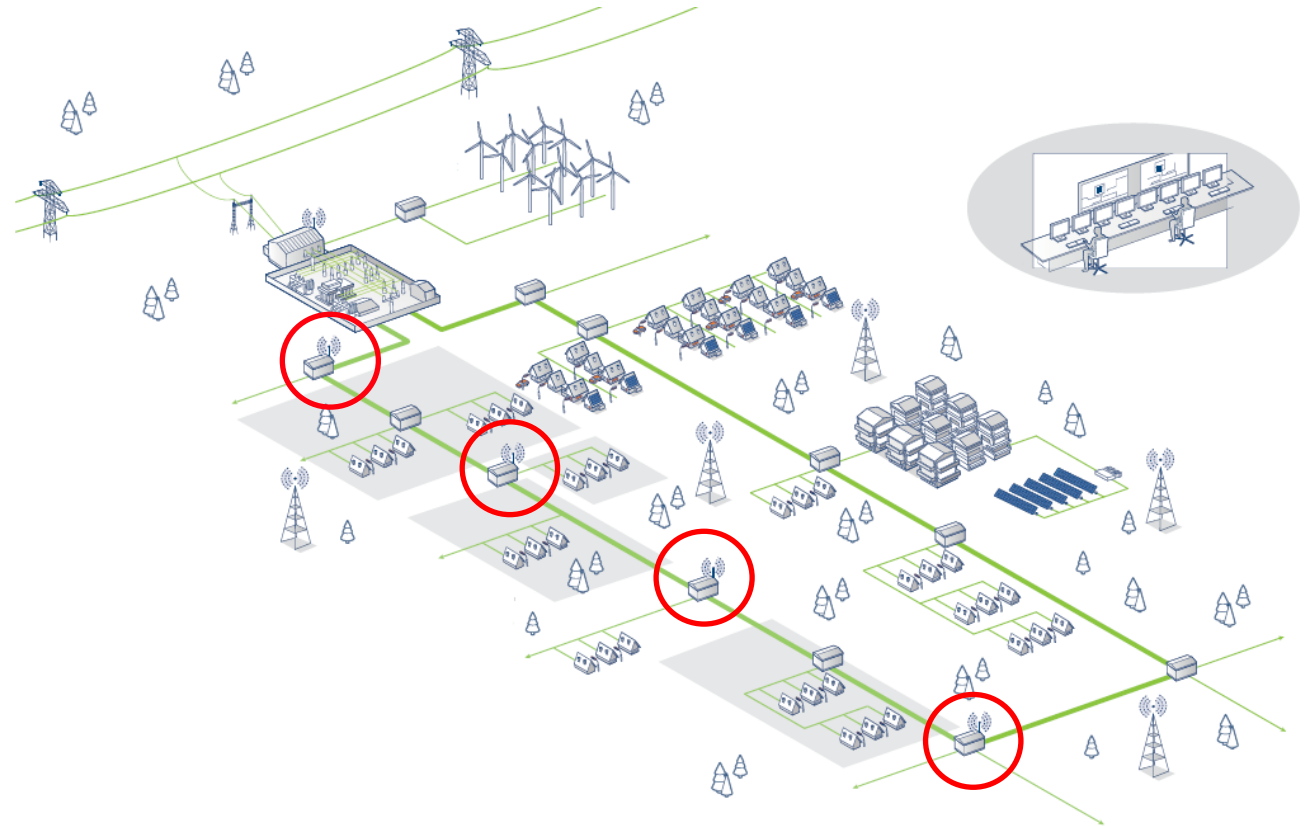
How a Smart CSS is working in a Smart Grid

Digitalization - The zone concept

Fault management

Example

- Open ring cable network with **coupling points** from other feeders/rings
- Compensated network
- Feeder is divided to zones
- Protection in primary switchgear
- **Fault passage indicators** in secondary substations
- **DMS controls automatically the restoration** process in case of fault

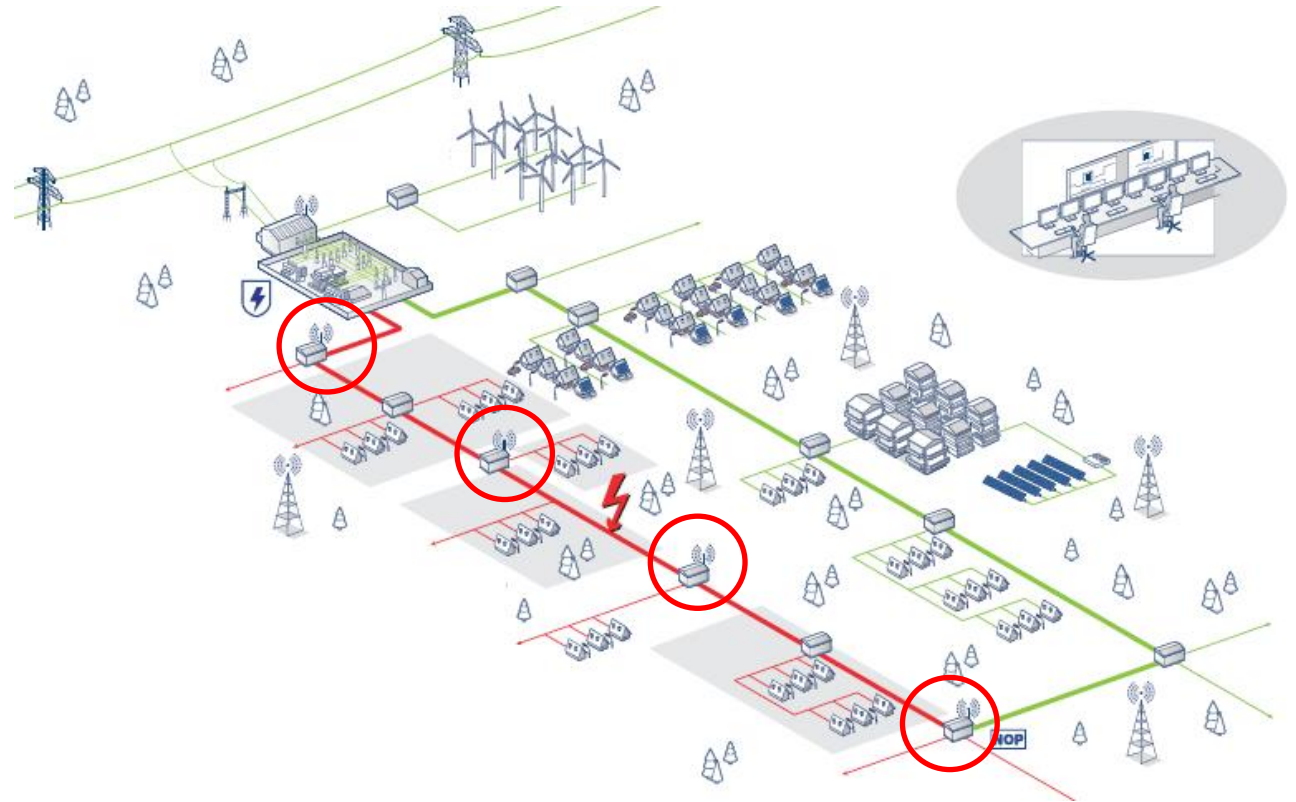


Digitalization - The zone concept

Fault management

Example, protection

- When an over current or earth fault occurs in the feeder protection in the primary substation trips the feeder

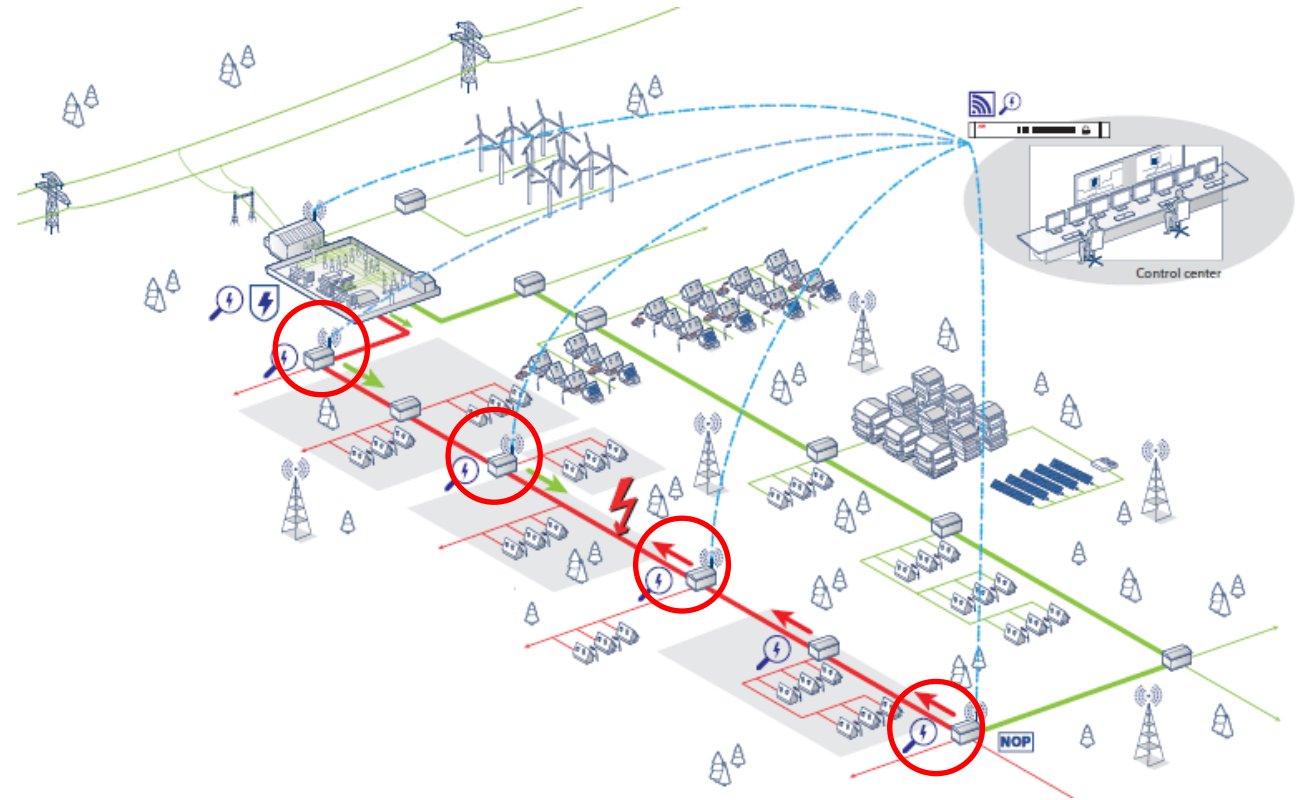


Digitalization - The zone concept

Fault management

Example, indication

- Fault passage indicators installed between zones **indicate the direction of the fault**
- Fault information from each node is **communicated to DMS**
- In case of over current fault protection relay can calculate distance to fault (Primary Substation)

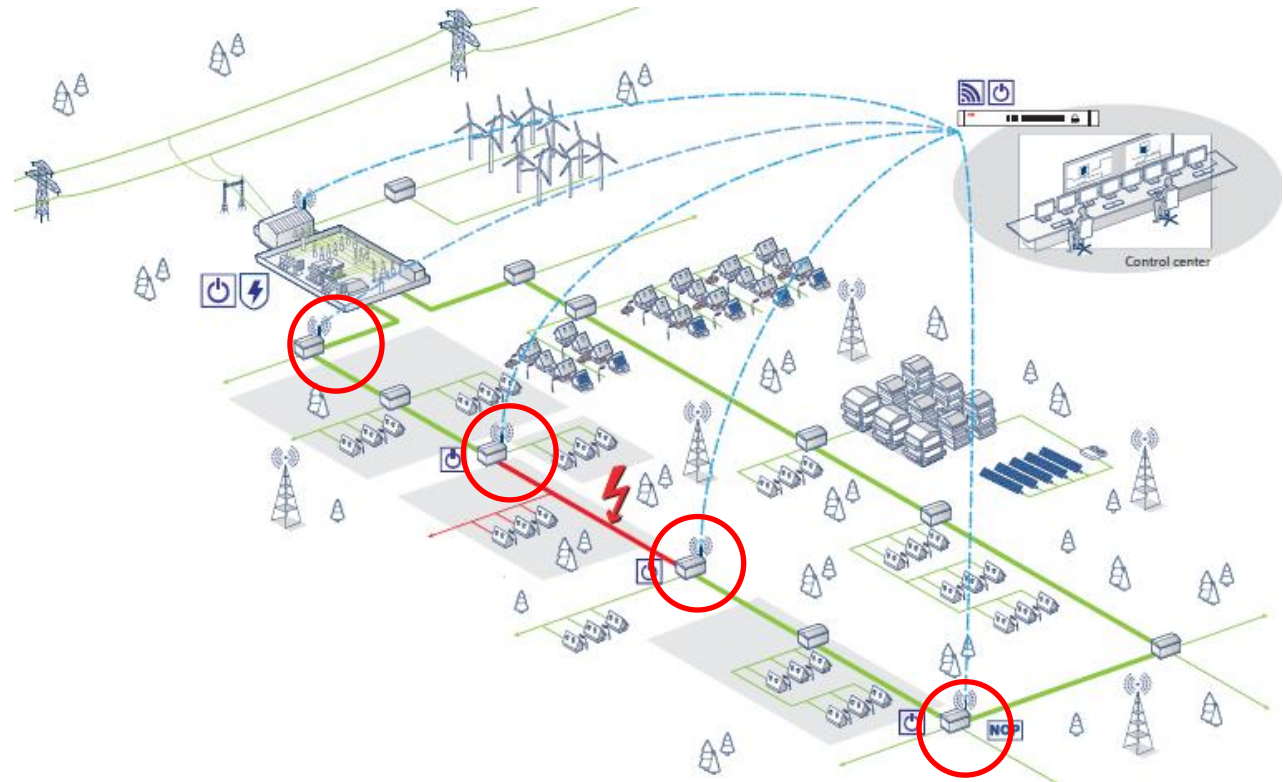


Digitalization - The zone concept

Fault management

Example, restoration

- Based on received fault information **DMS locates the fault**
- **Controlling remotely** the primary equipment limits the affected area
- **Rest of the network is restored** in fast manner



Smart CSS configuration and customer value add

Smart CSS

Typical challenges by segment

Utility typical challenges

- Large and complex MV distribution grid
- Cable and overhead line
- Large distance between CSS
- Outages at consumers cause penalties \$\$\$
- Hard to localize and clear the fault
- Outages may affect multiple CSS

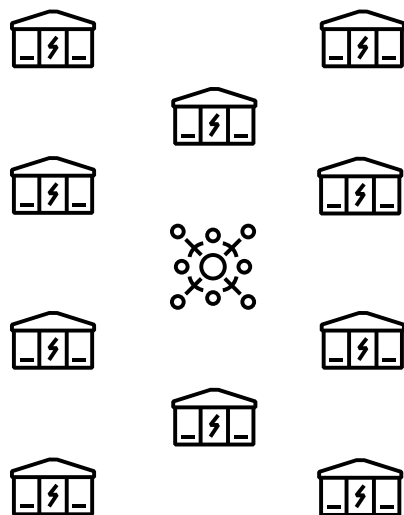


ABB advantages

- Alarms of potential issues, enabling action prior to outage for circuit breakers and transformers as well as auxiliary equipment
- Fast and accurate protection to minimize damage for the power system
- Remote control provides flexibility from control room and minimizes site visits
- Advanced earth Fault location (FLIR)
Automatic network reconfiguration in case of line fault to minimize outage time
- Predictive maintenance based on MV Switchgear, transformer or low voltage switchgear condition

Digitalization Packages - simplify the selection of advanced functions and logics with group of packages able to satisfy requirements by market segments and applications

Smart CSS

Typical challenges by segment

Solar, small generation and industry challenges

- High power utilization
- Lifetime and health of equipment is critical
- Downtime cause loss of \$\$\$
- Need to minimize energy cost and carbon footprint
- Need to implement generator plant protection and comply to the grid code

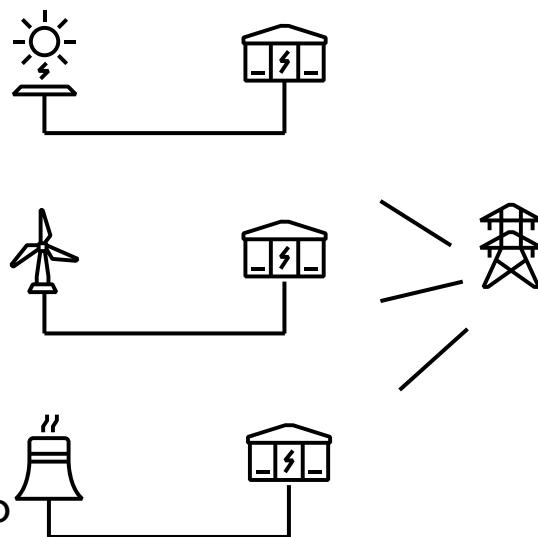








ABB advantages

- Alarms of potential issues, enabling action prior to outage for circuit breakers and transformers as well as auxiliary equipment
- Provides information for more efficient maintenance, minimizing costs
- Fast and accurate protection to minimize damage for the power system
- Improves uptime and capital allocation
- User generation plant protection disconnects when ever grid voltage and frequency are out of range prescribed by local connection standards

Digitalization Packages - simplify the selection of advanced functions and logics with group of packages able to satisfy requirements by market segments and applications

Smart CSS

Utility

		<u>MV</u>	<u>Transformer</u>	<u>LV & Enclosure</u>	
Remote Access 	 Cloud	- Predictive maintenance		- Predictive maintenance	<ul style="list-style-type: none"> ✓ Trending data to identify weak links ✓ Improves uptime and capital allocation
	 SCADA interface	<ul style="list-style-type: none"> - Advanced earth Fault location (FLIR) - Automatic network reconfiguration 	<ul style="list-style-type: none"> - Alarm handling - Monitor status 	<ul style="list-style-type: none"> - Monitor status - Alarm handling - Remote control - Product condition 	<ul style="list-style-type: none"> ✓ Fast network restoration ✓ Minimize outage time ✓ Maintenance data for better efficiency ✓ Crew mgt. & support improved
Protection & Control 	 Field devices	<ul style="list-style-type: none"> - Directional and Non-Dir. O/C protection - Auto reclosing - Fault Location - Advanced earth fault indication - Automatic transfer switch - Remote open/close 	<ul style="list-style-type: none"> - Over temp protection - Over pressure protection 	<ul style="list-style-type: none"> - Overcurrent protection - Remote open/close 	<ul style="list-style-type: none"> ✓ Fast and accurate protection to minimize damage for the power system ✓ Selective coordination minimizes outage scope ✓ Remote control provides flexibility from control room and minimizes site visits
Monitoring 		Signals: <ul style="list-style-type: none"> - Switch/CB status - Fuse blown - Spring charged - SF6 low - Basic Fault passage indication - Local/remote switch position - Remote reset of fault 	<ul style="list-style-type: none"> - Winding Temp (dry TR) 	Ekip digital combo: <ul style="list-style-type: none"> - LV analog values (U, I, cos phi etc.), data logger, synchrocheck Signals: <ul style="list-style-type: none"> - LV breaker status - Aux. Supply battery replacement notification - Battery charger failure - CSS Door open - Smoke detector alarm 	<ul style="list-style-type: none"> ✓ Easy access to CSS status from communicating field devices ✓ Alarms of potential issues, enabling action prior to outage for circuit breakers and transformers as well as auxiliary equipment ✓ Event data speeds troubleshooting and reduces outage time ✓ Provides information for more efficient maintenance, minimizing costs.

Smart CSS Medium voltage

Basic range

REJ 603



REJ603 V 1.5

Self powered feeder protection relay with CTs HMI as an option

51, 50, 51N, 50N, 68, 49

REJ 603 V3.0

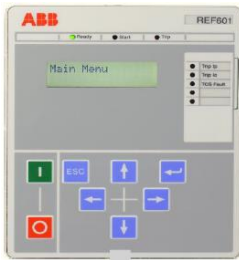


REJ603 V3.0

Self powered feeder protection relay with conventional CTs + front port comm

51, 50, 51N, 50N, 68, 49

REF 601



REF601

Feeder protection relay with breaker control

51, 50, 51N, 50N, 68, 49

REF 611



611 series

Protection relay with breaker control, current and voltage functions (up to 4I+4U + 8BI) +IEC61850 Ed.1+2 +PRP/HSR comm

50/51/49/67/67N/46/59G/68 ...

REF 615



615 series

Advanced feeder protection and control, current and voltage, advanced communication with GOOSE, IEC61850, IEC60870-5-103, Modbus

50/51/49/67/67N/46/59G/68 ...

Smart CSS

Levels of digitalization

Benefits of levels



Level 1 - Monitoring

- MV Fault and switch indications
- LV Measurements

Benefits

- Faster fault localization
- Network switching status information



Level 3 - Measurements

- Accurate measurements (U, I, f, P, Q, S, $\cos\phi$)
- Advanced fault indication algorithms

Benefits

- Network power flow status
- Trustworthy fault indication



Level 2 - Control

- Remote switch operations

Benefits

- Fast fault isolation and power restoration



Level 4 - Protection

- Advanced protection algorithms

Benefits

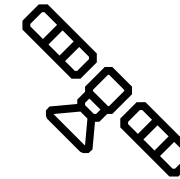
- Selective protection
- Integration of distributed generation

Communication solutions for Smart Grids

Communication alternatives

- Public wireless is the most cost efficient solutions for bringing in a large amount of nodes to the NCC
- Our products have integrated support for the most common ones: fiber-optic and public wireless
- We also support all other communication alternatives through interface modems

Wireless



Satellite

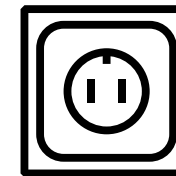


Private wireless



Public wireless

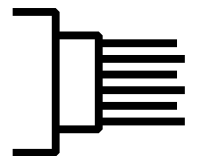
Wireline



Copper wire



Power line





Summary

Compact Secondary Substation

Key reference projects

1. GRP wind segment, Brazil project - provided 69 units of special material CSS to withstand high temperatures in NE Brazil

2. Universal Studios in China- delivered full set of CSS for this high end project in CN

3. UK wind farm: UniPack-G used for power collection in the wind farm in a very harsh environment

4. Major utilities in Finland – automated CSS for the cabling projects around Finland. All units are tested, including SCADA connection testing in the factory for quick installation.

5. Major utilities in Norway – automated CSS for the distribution network in Norway.



6. Egypt utilities – CSS for distribution network for major Utilities and EPC in the development of the new cities

7. UAE, QA, OM, & KW Steel and GRP CSS for the O&G industries in the region for both infrastructure and well site electrification

8. VN Solar projects- large Solar plant using integrated Skid solutions with central inverter

9. Solar projects- Several projects in renewables with UniPack-G in European countries (DE, HR, DK, HU)

10. Santos Australia – More than 200 secondary solutions delivered across different stages for gas collection areas

11. Saudi Solar– large solar plant using integrated skid solutions with central inverter

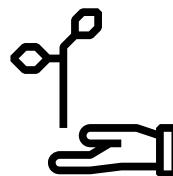
12. Smart cities in India– several projects for the Smart cities development in IN

Summary

UniPack-G



Safety and reliability – Internal arc classified for both operators and public, UniPack ensures the highest levels of safety



Eco-friendly - Recyclable enclosure material, with lowest environmental impact possible when supplied with available dry type transformer and MV GIS without SF₆



Ease of maintenance – Built to withstand the harshest environments to extend lifetime of internal components, with remote monitoring



Ease of installation - a lightweight product allows more stations to be transported on a single truck, reducing cost and eliminating repair time from cracks after installation

ABB