Substation Controls in a Box

Integrated Modular Packaged Solution for Utility and Industrial Applications

Modular solutions offer flexibility and quality. They can be put in place for temporary or permanent situations, and are built in controlled environments that are not subject to the construction delays that plague traditionally built options.

GE’s Substation Controls in a Box is a comprehensive, fully integrated, protection, control, automation, and communication solution for distribution utility and industrial applications. This packaged solution is well suited for projects of various sizes, from small to large, in distribution utility, wind collector and industrial substation applications to provide state-of-the-art, plug and play capability.

Key Benefits

- Can provide overall project cost savings of up to 15% of the total capital expenditure, including engineering and site acceptance costs
- Reduces cycle time, driving accelerated customer acceptance and project turnaround period
- Integrates multi-vendor legacy protection relays, devices and automation sub-systems
- Provides integrated platforms for additional levels of automation, cost optimization and enhanced process efficiency
- Enables faster service restoration and improves system reliability, by providing improved visibility and control of the power infrastructure

Application/Markets

- Distribution Substation Protection & Control - A complete protection & control solution for small to medium-sized municipal, cooperative, rural distribution utility applications
- Wind Collector Substations - A comprehensive solution suitable for wind interconnect and collector substations
- Industrial Substation Applications - A pre-designed, modular protection and control system packaged solution for new green-field and the modernization of brown-field industrial substations

Reduced Overall Cost

- Scalable, pre-engineered integrated protection and control designs reduce recurring engineering design costs
- Modular panel designs and smart multi-function devices reduce operations and maintenance costs
- Factory tested, fully verified solutions provided with complete documentation (including as-built drawings and wiring tables) enable ease of installation and testing at site

Total Quality

- Standardized manufacturing process produces high quality solutions
- Designed, engineered, manufactured and tested in a strict ISO 9001 and Lean, Six Sigma quality-controlled environment to provide enhanced system reliability

Complete Packaged Solution Capability

- Full capability for in-house design, engineering and development of quality packaged solutions applications
- Proven experience in project management, engineering, procurement, control house construction, panel wiring and testing
- Site support for engineering, commissioning and site acceptance testing
Packaged Solutions
GE Packaged Solutions engineers, designs and manufactures integrated drop-in modular solutions for the protection, control and automation of a variety of utility and industrial applications. The Substation Controls in a Box packaged solution offering is suitable for distribution substations typically in the range of 5-100 MVA power ratings. Starting from fairly simple designs for municipal distribution utilities in the 5-100 MVA range, to more sophisticated designs for multiple 100 MW wind farms.

Application Case Study 1
A small to medium-sized distribution substation for utility or industrial applications, typically in the range of a 5-25 MVA substation rating.

Integrated Pre-Fabricated Packaged Solution Features
- A standard pre-designed padmount NEMA 4 ANSI grey 2-bay enclosure, designed for harsh environmental outdoor applications
- Built-in protection and control for incoming feeder (high side), transformer, and up to 4 outgoing feeders (low side)
- Provides T35-based transformer differential, thermal overload, over current backup protection
- Provides F35-based multiple feeder protection, and up to 4 feeders
- Capability to interface and monitor distributed controllers on the distribution line, for example capacitor bank, recloser, and end of line sensing controllers
- Built-in D400-based substation gateway and touch screen HMI to monitor distribution assets and "outside the fence" controllers
- Built-in and integrated substation platform with the D400 capable of running optional applications such as CVVC and FDIR
- Built-in upstream and down-stream communication based on radios and/or fiber, compliant to utility NERC CIP standards
- A standard factory-engineered and tested packaged solution, with built-in battery pack, environmental conditioning, ready for quick site deployment, testing and commissioning

GE's Substation Controls in a Box offering caters to the needs of small co-operative, municipal distribution substations and larger industrial and wind interconnect and switching substations. The pre-designed, pre-fabricated, free-standing, and fully integrated, modular packaged substation solutions are designed and built on the industry leading GE Universal Relay platform and advanced GE substation automation technology. The Substation Controls in a Box is assembled, manufactured, wired and fully tested in the factory, ready for site acceptance testing and commissioning.
Application Case Study 1: Optional Features for Higher Rated Substations

Pre-packaged protection and control solution for higher-rated distribution substations (20-50 MVA), typically used in distribution utilities or large industrial applications.

- A standard pre-designed padmount NEMA 4 ANSI grey 3-bay transclusion, designed for harsh environmental outdoor applications
- Provides advanced F60-based, dedicated feeder protection, for up to 4 feeders
- Provides an integrated B30 low-impedance bus protection relay system

Application Case Study 1: IEC 61850 Brick-Based Optional Design

An IEC 61850 brick-based solution with pre-packaged plug-in protection and control, typically used in distribution applications to simplify the protection and control design and to provide overall accelerated project delivery cycles.

A pre-designed packaged solution simplifies the protection and control design of a distribution substation by providing plug and play functionality using bricks.

This design eliminates high energy current signals from protection and control cabinets by using fiber optic cables. It is particularly useful for quick engineering, manufacturing and site installation of a protection and control system.

The brick-based system design is available in 2-bay or 3-bay outdoor enclosure configurations to suit application needs. The bricks are installed at the primary equipment location or provided in NEMA 4 brick boxes for outdoor deployment. This design also features a built-in test panel to facilitate brick testing at the site.
Application Case Study 2
Protection, control, automation and communications system for large industrial, utility and/or wind collector or switching substation applications, typically in the power range of 50-250 MVA.

Pre-Designed, Pre-Fabricated Substation Controls in a Box
Packaged Solution Features
A standard pre-designed NEMA 4 control house enclosure, designed for harsh environmental outdoor applications, containing the following equipment:

- AC/DC distribution panels, automatic transfer and disconnect switch
- Control power battery system with ventilation, HVAC system, building lighting, smoke and safety detectors and alarms
- Substation SCADA and HMI cabinet equipped with state-of-the-art GE substation automation technology
- Advanced transformer protection panel for the protection of the main transformer featuring GE UR technology and auxiliary equipment
- Advanced secondary transmission line protection panel with main and backup relays
- Feeder breaker protection and control panel
- High-impedance bus differential protection panel
- Field wiring termination cabinet
- Standard ruggedized packaged solution, with built-in protection and control panels, HVAC system, battery system, AC/DC disconnect and field wiring termination system, fully factory tested, ready for quick site deployment, testing and commissioning

Typical Wind Farm Interconnect and Collector Station
A typical wind farm consists of a number of wind turbine generators (WTGs), with each WTG producing electricity at 690 VAC nominal output, which is stepped-up to a nominal voltage of 34.5 kV by an outdoor, wind turbine generator step-up transformer (unit step-up transformer).

This step-up transformer is usually placed near the base of each WTG tower. The output of each wind turbine step-up transformer in the wind farm is usually coupled to the substation by a wind turbine collector system (WTCS). Feeders of the WTCS terminate in the substation, where the voltage is stepped up again to a higher transmission voltage level, such as 138 kV, by the main transformer, before being put on the utility transmission line.
Value Add Services

Integrated Pre-Fabricated Packaged Solution Features

GE Packaged Solutions provides cost-effective solutions and engineering consulting services for protection, control and automation applications. Our comprehensive packaged solutions capability includes engineering a protection and control and/or automation system, real-time digital simulation (RTDS) studies, design and supply of a Substation Controls in a Box or a transclosure solution, protection engineering, including relay settings, testing, assistance and support for site acceptance testing and commissioning.

Power System Engineering Studies

- Power system modeling and simulations
- Real-time digital simulation (RTDS) close-loop performance studies
- Arc flash studies and reports
- Short circuit studies
- Protection system settings and relay coordination
- Power flow and system stability studies
- Harmonic analysis and design
- Industrial system studies and designs

GE's value add services include design, studies, testing and support for protection and control and automation systems.

Protection, Control and Automation Services

- Protection and automation system design
- SCADA communications architecture design and programming
- HMI design and programming
- Design and implementation of microgrid control systems
- System-wide peer-to-peer communications using IEC 61850 GSSE/GOOSE
- Special protection schemes such as WAMS and RAS
- Load shed schemes and systems

Automatically Retrieves Waveforms

Merge Multiple Waveforms into one File
## Specifications

<table>
<thead>
<tr>
<th>MECHANICAL STRENGTH AND RATINGS</th>
<th>Outdoor Transclosure</th>
<th>Drop-in Control Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seismic category compliance</td>
<td>A, B &amp; C</td>
<td>A, B &amp; C</td>
</tr>
<tr>
<td>NEMA rating</td>
<td>3R</td>
<td>4</td>
</tr>
<tr>
<td>Pounds per square foot ground snow load</td>
<td>40 lbs</td>
<td>60 lbs</td>
</tr>
<tr>
<td>Enclosure with metal doors, walls and floor</td>
<td>2 or 3 doors</td>
<td>Building enclosure</td>
</tr>
<tr>
<td>Zinc primed exterior surface with customer specified paint</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>High-performance rigid or foam fiberglass insulation in floor, walls, and ceiling, (R Value as shown respectively)</td>
<td>Foam 5/5/5</td>
<td>Fiberglass 30/21/38</td>
</tr>
<tr>
<td>Walls — Exterior sheeting with an interior support structure</td>
<td>Yes, Ext: 11GA Int: 7GA</td>
<td>Yes, Ext: 24GA Int: 12GA</td>
</tr>
<tr>
<td>Floor - One layer of A36 structural steel, with industrial-grade coating</td>
<td>Yes, 11GA</td>
<td>Yes, 3/16”</td>
</tr>
<tr>
<td>Door(s) - 42 inch wide x 84 inch high insulated steel exterior door with stainless steel ball-bearing tamper-proof hinges and 3-point latch</td>
<td>Yes, 2 or 3 doors</td>
<td>Yes, 2 doors</td>
</tr>
<tr>
<td>HVAC system - 14,000 BTU, 230 VAC, NEMA 4 housing with powder coat finish, R410A refrigerant, epoxy coated condenser coils and a closed-loop cooling system</td>
<td>Optional</td>
<td>Yes</td>
</tr>
<tr>
<td>Shipped with loose Hilti quick bolt kit for ease of installation</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Foundation - customer-supplied pier or slab</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<th>POWER DISTRIBUTION</th>
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<tr>
<td>20A AC specification-grade duplex receptacles</td>
<td>Optional</td>
<td>Yes, 8</td>
</tr>
<tr>
<td>Single-throw safety (disconnect) switch</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>One DC distribution panel, 125 VDC 30 A and 20 A two-pole branch breakers, and circuit breakers for all installed equipment</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>One DC single-throw safety (disconnect) switch</td>
<td>125 V, 200 A, fused</td>
<td>125 V, 200 A, fused</td>
</tr>
</tbody>
</table>
## Specifications

<table>
<thead>
<tr>
<th><strong>GROUNDING SYSTEM</strong></th>
<th>Outdoor Transclosure</th>
<th>Drop-in Control Building</th>
</tr>
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<tbody>
<tr>
<td>Copper ground bar along with exterior ground pad</td>
<td>Yes</td>
<td>Yes</td>
</tr>
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<tr>
<th><strong>BATTERY SYSTEM</strong></th>
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<th>Drop-in Control Building</th>
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<tbody>
<tr>
<td>Nickel cadmium cells, with seismic zone 4 battery rack</td>
<td>Optional</td>
<td>Yes</td>
</tr>
<tr>
<td>Battery charger, microprocessor controlled, 120/240 Vac input, 130 Vdc, 12 A output with battery eliminator filter, temperature compensation, alarm monitoring, and serial DNP 3 communications</td>
<td>Yes</td>
<td>Yes</td>
</tr>
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<tr>
<th><strong>MANUFACTURING CODES AND STANDARDS</strong></th>
<th>Outdoor Transclosure</th>
<th>Drop-in Control Building</th>
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<tbody>
<tr>
<td>ISO 9001-2000 for all manufacturing processes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ASTM D635: standard test method for rate of burning and/or extent and time of burning of plastics in a horizontal position</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ASTM B117: Standard Test Method for Salt Fog Resistance</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ASTM A1008/A1008M: standard specification for steel sheet, cold-rolled, carbon, structural, high-strength low-alloy, high-strength low-alloy with improved formability, solution hardened, and bake hardenable</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ASTM A1011/A1011M: standard specification for steel sheet and strip, hot-rolled, carbon, structural, high-strength low-alloy, high-strength low-alloy with improved formability, and ultra-high strength</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<th><strong>OTHER SPECIFICATIONS</strong></th>
<th>Outdoor Transclosure</th>
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<tbody>
<tr>
<td>Safety - first aid kit, portable 20-pound ABC fire extinguisher, and phosphorescent exit sign</td>
<td>Optional</td>
<td>Yes</td>
</tr>
<tr>
<td>Switchyard termination cabinet</td>
<td>Optional</td>
<td>Yes</td>
</tr>
<tr>
<td>Alarm devices</td>
<td>Optional</td>
<td>Fire alarm system</td>
</tr>
</tbody>
</table>