



# EX2100e Excitation Control for Hydro Turbine Generators

The EX2100e Excitation Control is GE's advanced platform for generator excitation systems. EX2100e builds on the EX2100 experience of over 2,000 units in gas, steam, and hydro applications for new units and upgrades, in addition to GE's 50+ years of experience with over 6,000 excitation systems in 70 countries.

The "e" designates enhanced technology and indicates the EX2100e is part of GE's advanced Mark VIe\* control platform, using ControlST\* software suite. Mark VIe technology and ControlST operate critical assets in a wide variety of control and protection applications around the globe, including power generation, oil and gas, plant control and safety systems. The design philosophy of the "e" series is extended life through a modular structure. This allows for incremental technology upgrades, obsolescence protection, and comprehensive system upgrades, without replacing the entire control system. The EX2100e can also be integrated with GE's cyber security solution to help protect from cyber threats. The EX2100e demonstrates GE's commitment to deliver high performance, secure and sustainable controls ready to operate in today's evolving global environments.



## Benefits

- Enhanced reliability with optional redundant control and protection
- Better availability with improved diagnostics and online repair
- Improved performance with proven advanced algorithms
- Enhanced operability and maintenance with a versatile software suite
- Ability to expand I/O capacity, providing a clear path for future enhancements and extended life cycle support

## Performance

Typical functions performed in the controller and protection system include:

### Control

- Automatic voltage regulator
  - Reactive current compensation
  - current compensation
  - Volts per hertz limiter
  - Overexcitation limiter
  - Underexcitation limiter
- Manual field voltage regulator

### Protection

- Volts per hertz, dual level (24EX)
- Loss of excitation (40EX)
- Bridge ac voltage phase unbalance (47EX)
- Generator overvoltage (59EX)
- Off/online overexcitation (76EX)

Software can also include a power system stabilizer (PSS) which enables the generator to produce and transmit more power in a stable manner. Field testing services are also available for commissioning to verify and document system performance to existing specifications. As part of the EX2100e project, an Excitation System Model Setting Report (ESMSR) is provided which includes the system IEEE model, and documents critical system parameters and settings to support regulatory and grid submissions.

## Flexibility

- Because of the wide variety of hydro turbine-generator excitation systems, the EX2100e family of products is designed to be applied to most generator control configurations. The EX2100e controls are mated with a set of scalable power converters, matching excitation system capabilities and initial cost to unit requirements. EX2100e systems can be configured with available redundant controls, power converters, and cooling fans to allow owners to further tailor the system to meet both control and budgetary requirements.
- The system hardware is paired with a flexible application software structure, allowing the EX2100e to be a single solution for most hydro turbine-generator excitation and operational arrangements. The platform supports static, compound, rotating AC and DC, and brushless excitation systems.
- Generations of GE digital exciters have been successfully applied to specialty hydro turbine-generators including pumped storage with a range of starting methodologies with reduced voltage, across-the-line and back-to-back configurations. The EX2100e control also provides native support of advance Reactive Differential Compensation software and electric braking.

## Networks and Communications

The EX2100e excitation control communicates on the same Ethernet network as the Mark platform turbine controls. Data is exchanged peer-to-peer between control systems for functions such as var/power factor control to simplify plant interconnections. Alarm/event management tools are shared on the networks with high-resolution time tags, including 1 ms sequence of events reporting. A network time-server can be provided for time synchronization to a local time source or a global positioning satellite. This is available with  $\pm 1$  ms time accuracy between a controller and a time source, and  $\pm 2$  ms time coherence between control systems.

The EX2100e integrates with plant level Distributed Control System (DCS) using OPC™, Modbus™, or GE Standard Messaging (GSM) protocols. All three protocols support full operation and monitoring of the controls from the DCS, with OPC and GSM also providing local high-resolution time tags.

## Software Packages

The ControlST software suite comprises several high-performance tools for ease of use by operators and maintenance personnel. These include the WorkstationST\* software for management of HMI and Historian functions, the ToolboxST\* application for configuration and diagnostics, and a CIMPLICITY™ graphics user interface. Seamless integration provides direct connectivity from parameters on operator screens to their corresponding alarm history, trends, logic diagrams, watch windows, and browsers.

Software tools include system diagrams with signal flow, sequencing, and regulator control in the excitation control.

The diagrams display variables and their values in real time. Parameters shown in the diagrams can be modified.

## Controls LifeCare Lifecycle Management Partnership

Partner with GE for your lifecycle needs with Controls LifeCare. This subscription helps to maintain the health of turbine and plant control, generator control and static starter systems. Subscribers benefit from GE expertise and a true partnership in the maintenance and servicing of control systems with a simple, packaged approach.

Controls LifeCare is available in one, five and ten-year agreements and is applicable for both new and existing units. All offer levels include:

- Parts availability and replacement
- 24/7 phone technical support
- Software updates (TILs)
- On-site technical support from an annual visit from a Controls Field Engineer (FE) and ControlsCare Service Manager

Five and ten-year subscriptions as well as subscriptions on currently installed units include ControlST upgrades. A ten-year subscription also includes an HMI upgrade.



## Conclusion

The EX2100e excitation control is a highly reliable control, protection, and monitoring system. Its flexible architecture, modern networks, and versatile software suite simplify operations and integration with plant-level controls. Advanced algorithms incorporate decades of fleet experience and the latest controls technology to deliver the performance needed in today's power generation industry.

For further assistance or technical information, contact the nearest GE Sales or Service Office, or an authorized GE Sales Representative.

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