

## Nuclear Turbine-Generator Controls

# fact sheet

Increase the reliability of your turbine-generator controls with GE Energy's Mark VI turbine control and EX2100\* generator excitation control. These reliable and proven systems are the modern descendants of your current analog controls, reflecting three decades of fleet experience. Unlike your current controls, these systems can be applied on all GE steam and gas turbines. And, with more than 1,500 Mark VI and 500 EX2100 installations worldwide, they are designed with specific attributes for BWR and PWR nuclear applications.

GE has invested more than six years of rigorous analysis, reliability studies, simulations, and quality control to certify the Mark VI for nuclear plants. Many of you have participated in this preparation by reviewing this product at nuclear user's conferences, site visits, and plant demonstrations. We invite you to inspect a running unit or review a demonstration to learn how these controls can improve the reliability and performance of your plant.

### Turbine Reliability

GE Energy's Mark VI provides increased fault tolerance over your current EHC controls with triple redundant electronics for all of the control, protection, and monitoring functions. This includes redundancy for the reactor pressure control and application-specific functions, such as power load unbalance, servo loop positioning of steam valves, integrated control and protection of overspeed, thrust bearing wear trip, vibration and expansion, and dual TMR trip manifolds that permit on-line repair without compromising protection redundancy. With triple redundancy, you receive running and tripping fault tolerance to ride through both hard and soft (partial) component failures. Since there are three sets of data to compare, the diagnostics continuously evaluate the data for



discrepancies, enabling a more precise location of faults and quicker online repair.

The Mark VI family of controls can be applied to your feed pump turbines and feed-water control system, enabling common spare parts as the main unit control. For economy, a pair of feed pump turbines can be controlled within a single Mark VI. This extends the benefits of redundancy, while retaining on-line maintenance capability of one unit while the other is running.

### Benefits

- Improved reliability with triple redundancy and on-line repair
- Reduced mean-time-to-repair with modern alarm management
- Decreased maintenance of instrumentation
- Easier to operate with access to all data and friendly tools
- Fewer, and more readily available, spare parts to carry in inventory
- Extensive pool of trained service engineers



## Generator Reliability

Generator excitation controls are now designed and manufactured in the same facility as the steam turbine controls. Like the turbine controls, they are available in a redundant configuration with on-line repair to improve equipment availability over the original analog systems. The EX2100 also provides improved response per IEEE 421, better accuracy, decreased maintenance, and enhanced features, such as power system stabilizer in its software.

For ALTERREX\* applications, the EX2100 can be supplied as a warm backup regulator (600Vac, 450Adc) or as a multi-bridge, full static excitation system (1,300Vac, 7,700Adc) with PPT. Also, a refurbishment program is available for the power diode bridges.

For GENERREX\* applications, the EX2100 can be supplied as a multi-bridge system with ratings up to 1,300Vac and 7,700A. The product includes conversion of the CPS or PPS system to a potential source system supplied from the generator terminals or station auxiliary bus. P-Bars are no longer needed for excitation voltage and are disabled in place within the generator.

## Life Cycle Cost

Product life cycle cost is an important consideration for any control system. The Mark VI and EX2100 are GE Energy's premier control solutions, with production levels far exceeding those of your original EHC and exciter. Support is available from an extensive pool of trained service engineers. Additionally, multiple training centers offer standard and custom on-site and off-site classes and remote diagnostic centers. Even site-specific control simulations are available to upgrade your existing plant simulator for on-going training.

## Operation and Maintenance

The main unit, feed pump turbine, generator, and balance of plant controls communicate peer-to-peer on redundant Ethernet networks to reduce the cost of hardwired interface. Standard, built-in 1ms sequence of events (SOE) is provided for turbine and generator controls and synchronized between units to eliminate the cost of separate SOE instrumentation including the parallel wiring of contacts to trip and monitor.

Existing operator consoles can be retained and augmented with modern, networked operator and maintenance stations. This provides access to "all" equipment data with user-friendly screen navigation, modern alarm management to quickly identify and address abnormalities, and extensive trending and analysis tools. A common software maintenance tool, Toolbox, is used for all GE controls to simplify maintenance and lessen on-going training. GE also offers a wide range of asset optimization and condition monitoring products such as System 1\* Optimization and Diagnostic Software Platform and the Bently Nevada\* 3500 monitor, which enable convenient network connectivity.



Contact your GE Energy representative today for complete product specifications and ordering information.

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