



Mark* Vle for Gas Turbine Control Retrofits

GE is proud to provide controls you can trust from experts you can trust. For more than four decades, GE has supplied control systems for heavy duty and aeroderivative gas turbines as well as steam turbines, generators, and excitation. Today, many of these legacy systems are limited by the technology of their era and require an upgrade to deliver turbine performance, operability, and availability improvements. GE's family of e-technology platforms include the Mark Vle for turbine control, the EX2100e for excitation control, and the LS2100e for static starters. They provide significant performance enhancements in a modular structure, lengthening the lifecycle of your control systems and streamlining support for years to come.

The Mark Vle (for both GE and non-GE gas turbines) is available for upgrades of all legacy controls and supports the most advanced turbine technology enabled by modern model-based control. Upgrading to a Mark Vle adds significant new performance enhancements to your turbine control through new features and algorithms for turbine functions, such as advanced dry low NO_x systems and GE OpFlex* Software enhancements. The upgrade includes a complete modernization of operator stations and networks to current technology.

Pre-engineered migration packages also are available to upgrade Mark IV, V and VI controls while retaining field devices, field wiring, and cabinet terminations. These packages significantly reduce installation effort and required outage length.

Benefits

The Mark Vle provides performance, operability and reliability for today's connected plant.

- **Increased computational power** – advanced technology Mark Vle processors provide access to sophisticated software enhancement modules to improve turbine performance, reliability, and operability.
- **Intuitive features** – GE's powerful ToolboxST* software, with modern drag-and-drop type editors, industry leading trender with video type forward-reverse-freeze capability, and code-compare tools.
- **Increased operational productivity** – user-friendly HMI graphics, alarm/event management, and trending leading to improved operator recognition and resolution of system faults.
- **Maintenance efficiency improvements** – reduced engineering time due to a single integrated software tool for configuring networks, processors, and I/O boards, along with editing application software, managing block libraries, and displaying system diagnostics.

- **Latest GE software libraries** – Leverages years of GE OEM experience to ensure safety-related software updates are delivered while also retaining the majority of the existing control system customization.
- **Improved reliability** – TMR controller redundancy provides 2-out-of-3 voting to improve reliability and eliminate single-point communication failures within the control.
- **I/O expandability** – flexible and modular architecture allows for future growth of capabilities and applications.
- **Built with cyber security best practices** – Achilles™ Communications Certification Level 1 Mark Vle Controllers feature hardened network switches and HMIs within a segmented network.

Flexible and Scalable Architecture

The Mark Vle consists of a single board controller with networked I/O power of 24/28 V DC versus the 125 V DC of legacy systems. This flexible and scalable architecture can be configured for simplex, dual, and triple redundancy as needed for the application. It is typically supplied as simplex or dual redundancy for Mark I and II analog control upgrades—and as simplex, dual, or triple redundancy for Mark IV, V and VI digital control upgrades, which are primarily triple-redundant in their original design.

Normally clustered together in the control cabinet, the distributed I/O modules can also be distributed on a 100 MB Ethernet to integrate auxiliary systems in adjacent cabinets or on turbine skids. Distributed solutions can offer reduced installation effort, improved signal quality, reduced ground faults and lightning susceptibility. The wide range of available I/O types makes integration of auxiliary control and monitoring systems both feasible and cost effective. I/O Networks can be provided in any redundancy configuration with fiber optics to reduce noise and lightning susceptibility.



Each I/O module has a local processor with a local operating system. Therefore, computing power grows as I/O modules are added. In addition, I/O modules are compatible with existing field devices for all but the earliest control systems. Consequently, third party signal converters are not needed, which reduces single point failures, simplifies ongoing maintenance, and enhances the diagnostics with a direct interface to the field devices. Some currently available I/O features include:

- 1 ms SOE for all contact inputs (standard)
- Embedded auto synchronizing with backup synch check protection
- RTD monitoring (isolated and non-isolated)
- HART®, PROFIBUS, and MODBUS® I/O communications

Operator and Maintenance Software

The Mark VIe runs off a Windows® 7 HMI. With this HMI, your existing operator and maintenance stations will have the latest HMI/SCADA CIMPLICITY graphics system featuring easy screen navigation, alarm/event management, and trending tools. Your Windows 7 HMIs are able to run GE's cyber security applications to help provide security and compliance with current and emerging cyber security standards.

In addition, Windows 7 HMIs use the latest versions of ControlST* and ToolboxST*, which will augment your existing Modbus® and TCP-IP GSM links to plant controls. This modern 32-bit software suite includes drag-and-drop type editors, math blocks, macros, and trending tools. Changes can be downloaded online without rebooting the new controllers. Your existing site-specific software is converted using GE's Tree File Importer into the latest ControlST turbine control application, using an ISO 9001 certified process.

OpFlex* Software Enhancement Modules

GE's OpFlex software enhancement modules for GE Heavy Duty Gas Turbines add significant new performance enhancements to your Mark VIe turbine control to improve reliability, provide system diagnostics, help to prevent trips, and improve operator productivity. There are four packages featuring 20 modules which complement the power of the Mark VIe control system.

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Cyber Security

Upgrading to the Mark VIe control system allows you to take advantage of GE's cyber security solutions, helping reduce your risk. Our cyber security solution provides defense-in-depth protection. The SecurityST* Mark VIe Solution and Commissioning Services is Achilles™ Practice Certified – Bronze, indicating the solution has undergone strict cyber security best practices demonstrating to customers that systems are developed and implemented securely. The Security ST appliance and Cyber Asset Protection Subscription are designed to support the plant operation's compliance to cyber security standards and guidelines including NERC CIP, NEI 08-09 and ISA99/IEC 62443.

Controls LifeCare* Partnership

This comprehensive 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.

Mechanical Solutions Options

GE's electromechanical solutions are a critical piece of a control system migration or full panel retrofit. Integration considerations need to be made based on the age of the control system and the interface with the software and electromechanical components. GE has the expertise and OEM knowledge to evaluate these needs to ensure assets remain reliable. Our solutions have the potential to improve performance, online capability, provide redundancy and fit within the current operations envelope.

Critical components that need to be evaluated include transducers and transmitters, fuel valves and fuel skids, and speed sensing. GE also provides solutions for Trip Manifold Assemblies (TMAs), Hydraulic Power Units (HPUs), and other assets that are important to operations. Our experience includes steam, hydro, and gas turbines as well as balance of plant. We have the application knowledge to make sure that your assets are upgraded correctly.

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