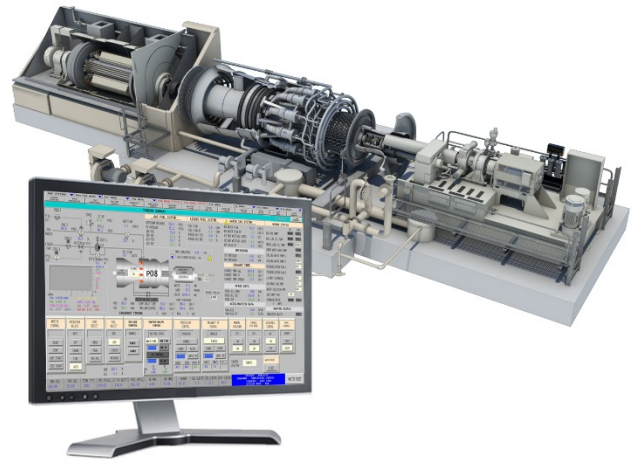


Ovation™ GE 7EA Control System Retrofit

Features

- Fully engineered and field-proven retrofit for GE 7EA gas turbines equipped with Speedtronic™ Mark IV, V, VI and VIe systems
- Ovation-based solution with powerful redundant processors specifically designed to meet the needs of 7EA DLN and non-DLN units
- User-friendly tools and direct access to turbine logic facilitates in-house maintenance and reduces dependence on specialized support
- Incorporates control enhancements that enable
 - Flexible gas turbine operation using integrated AutoTune™ and FlexSuite™ applicationsⁱ
 - Improved unit operation, performance and starting reliability
 - Simplified troubleshooting and maintenance
- Comprehensive suite of integrated products and services to support cybersecurity programs and obligations
- Flexible architecture easily integrates turbine and balance-of-plant systems for unified plant control
- Options available for generator excitation, condition monitoring and instrumentation upgrades



Legacy Control System Challenges

General Electric's (GE) 7EA gas turbines are popular in utility power generation and industrial applications. Many GE 7EA turbines have been in operation for many years using the original GE Speedtronic control systems and associated HMIs. These systems face obsolescence and support issues where maintenance and repairs can be costly as well as difficult to obtain, leading many users to explore replacement options. For more than 25 years, Emerson has modernized hundreds of control systems on GE turbines, ranging from early 1960's Frame 5 to the latest 7FA. Our gas turbine control portfolio includes system retrofits that provide reliable and efficient control of all Frame series gas turbines.

Ovation GE 7EA Gas Turbine Control

Emerson offers a fully engineered and field-proven packaged retrofit for Speedtronic Mark IV, V and VI control systems on GE 7EA gas turbines. The solution is based on Ovation gas turbine controls as a 'drop-in' replacement for the Mark systems on 7EA DLN and non-DLN turbines.

Emerson's comprehensive retrofit program for the 7EA fleet encompasses turbine control development and application enhancements, project specific content, installation and commissioning as well as providing 7EA application lifecycle support and updates.

Applications

Ovation’s packaged retrofit replaces the original Speedtronic turbine control system while incorporating new control enhancements for reliable, flexible and safer turbine operation. The Ovation solution covers governor, sequencer and protection control functions GE 7EA series gas turbines, including:

- Turbine control and sequencing
- Turbine fuel control (governor)
- DLN control
- Turbine protection
- Fuel transfers
- Turbine monitoring
- Vibration monitoring
- Generator monitoring, control and protection
- Manual and automatic synchronizing
- Remote monitoring & communications

Native I/O modules directly interface the Ovation system to speed detectors, LVDT, servo-valves, RTD, thermocouples and other turbine instruments. Ovation’s direct communication with turbine instruments avoids the use of external signal conditioners, provides full diagnostics down to I/O level and ensures fully integrated control of all turbine systems including:

- Variable guide vane actuators
- Fuel systems – diffusion and DLN
- Water injection systems
- Flame detection systems
- Starter systems
- Lube and hydraulic oil systems
- Overspeed protection systems
- Vibration monitoring

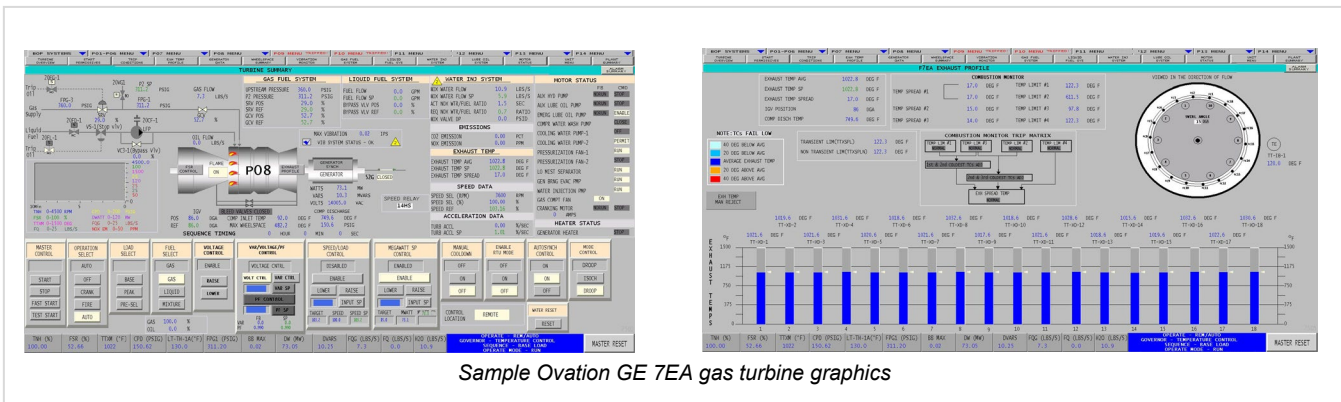
- Excitation
- Generator temperature monitoring
- Auxiliary systems

Emerson maintains a version-controlled library of turbine specific control function algorithms that were developed based on years of turbine control implementation and field-proven in hundreds of gas turbine applications. This approach ensures a high degree of software standardization, eases software testing, improves revision control and reduces commissioning time. Ovation’s turbine controls permit all modes of operation that were provided with the original OEM system.

Speedtronic Panel Retrofit

Ovation’s turbine control retrofit is a drop-in replacement for the Speedtronic Mark IV, V or Mark VI control systems. The Ovation solution covers the replacement of the entire Speedtronic control panel and GE HMI systems, while retaining the existing field wiring and turbine instrumentation. Eliminating the entire panel ensures that no legacy control components are retained, thus mitigating potential risks due to obsolescence issues. This solution also allows for full factory testing of the complete panel assembly, both hardware and software, which reduces commissioning risks.

Options are available for integrated combustion dynamics measurement system (CDMS) and integrated AutoTune to enhance machine protection and provide flexible operation over different operating conditions.



Sample Ovation GE 7EA gas turbine graphics

Benefits of an Ovation 7EA Control Retrofit

Benefit	Ovation System Enhancement
<p>Enhanced operator decision making</p>	<ul style="list-style-type: none"> ▪ Unit operation maintenance summary automatically updates factored hours/starts ▪ Smart dashboard displays start and trip data and MWH for each run ▪ Automatic turbine trip reports provided by the Ovation Process Historian ▪ Enhanced exhaust temperature display with tabular views of combustion data ▪ Generator capability monitor shows capability curve with automatic alarming
<p>Improved unit operation and performance</p>	<ul style="list-style-type: none"> ▪ Integrated AutoTune and FlexSuite for flexible gas turbine operation ▪ Integrated combustor dynamic measurement (CDMS) for machine protection ▪ Unit start profile compares startup and coast-down times to alarm on blade tip rub ▪ Gas turbine performance indicator predicts megawatt capability and calculates heat rate ▪ Easy-to-read combustion monitor helps to quickly identify hot/cold spots ▪ Automatic turning gear scheduling reduces dovetail wear ▪ Manual synchronization from Ovation operator workstations ▪ Upgrade of water injection control valve eliminates legacy control problems ▪ Manual bias of water injection improves NOx control ▪ Automatic droop tests and frequency response
<p>Simplified troubleshooting and maintenance</p>	<ul style="list-style-type: none"> ▪ Exhaust swirl charts provide load-adjusted exhaust profiles to easily identify the location of combustion problems ▪ Embedded condition monitoring using Ovation machine works gives peak & phase readings and provides automated imbalance, misalignment, looseness, rub, fluid instability and mechanical wear monitoring ▪ Dedicated start permissives and trip displays enable fast problem identification ▪ High-speed trending to pinpoint event data ▪ HMI based maintenance functions including overspeed testing and fuel valve calibrations



Ovation GE turbine control packaged retrofit of a Mark V system

Optional Upgrades and Enhancements

Emerson offers a wide range of options that when combined with the Ovation 7EA controls provide a comprehensive turbine solution:

- Automated tuning and combustion dynamic measurement (CDMS) for DLN units
- FlexSuite applications add peak power mode, increased turndown and other flexible operating enhancements
- 10-minute fast start/fast load (available for certain GE turbine models)
- Automated pre-start check routine
- Emerson CSI6300 SIL3-rated electronic overspeed upgrade that includes eddy current type speed sensors for improved diagnostics and true zero speed detection
- Integrated Ovation Safety Instrumented System (SIS) for safety protection up to SIL3
- Advanced condition monitoring
- Gas fuel flow measurement upgrade
- Gas chromatograph for monitoring of fuel gas supply BTU changes
- Power and Water Cybersecurity Suite assists with meeting cybersecurity obligations
- Integrated generator excitation system
- Fuel system or fuel valve upgrades
- Instrumentation and control valve upgrades
- Full range of wireless devices
- Monitoring of 125VDC battery cell condition
- Workstations for remote operations
- Turbine simulation for control validation and operator training

Integrated Combined Cycle Control

Many gas turbines operate in combined cycle plants. The Ovation platform is perfectly suited for all combined cycle control applications, including steam turbine, heat recovery steam generator (HRSG), balance-of-plant (BOP) and auxiliary controls.

Controlling the entire power block using a single unified automation platform not only helps enhance reliability, but also provides further opportunities for operational improvement such as increased plant efficiencies and megawatt production, and long-term operation and maintenance savings.

Ovation - Designed for Power

The foundation of Emerson's 7EA control solution is Ovation technology. Ovation was designed to:

- **Eliminate obsolescence concerns** by using commercially available technology.
- **Provide intuitive built-in diagnostics** that enables quick problem identification.
- **Secure operations** with standard features that address cybersecurity concerns
- **Simplify configuration and maintenance** with integrated user-friendly engineering tools.

Summary

Emerson understands the changing dynamics of the power industry and stands ready to apply our expansive portfolio of solutions to help increase performance and reliability of GE 7EA turbines.

The Ovation GE Frame 7EA retrofit program was developed by Emerson's dedicated gas turbine solutions group that includes highly specialized experts with years of experience designing, implementing and supporting turbine controls from every major OEM including GE, Westinghouse, Siemens, ABB, Pratt & Whitney, Solar, Rolls Royce and more. An integral part of the program is Emerson's commitment to long-term product support and cost-effective migration paths that reduce lifecycle costs while keeping pace with technological advancements.

¹ AutoTune and FlexSuite are trademarks of PSM Ansaldo Energia Group

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