Ovation™ Excitation

Benefits

- **Improves operator efficiency** through the use of a single, familiar set of HMIs
- **Enables better decision making** from integrated process graphics, alarming, trends, historical functions and diagnostic data
- **Simplifies configuration** and enables in-house maintenance through a single, common set of engineering tools
- **Provides access** to comprehensive, accessible and knowledgeable service from one vendor
- **Increases reliability and system security** by reducing integration risks associated with interface communications and upgrades of multiple systems
- **Streamlines lifecycle management** through comprehensive product support programs
- **Reduces inventory costs** through a common set of standardized spare parts
- **Supports the ability to comply** with new NERC modeling, data, analysis, protection and control requirements
- **Assists with meeting** cybersecurity obligations through Ovation products and services

Overview

Power plant generators and associated excitation controls play a critical role in maintaining grid stability. Damage or complete failure of an aging generator excitation control system can force an unplanned outage, resulting in lost revenue.

Spare parts and knowledgeable service for obsolete voltage regulators or excitation control systems are often difficult and expensive to obtain. Additionally, original vendor training may not be available to instruct plant staff on how to properly use and troubleshoot older systems. Generator excitation standards are constantly changing to keep pace with the evolving power industry. Legacy systems may not adhere to new requirements and upgrades to bring them into compliance may not exist. In many cases, these issues can be avoided through use of an up-to-date and reliable generator excitation control system. Additional reasons for considering an excitation system upgrade include:

- A lack of diagnostic tools and analytics that can help detect and avoid potential equipment problems or plant performance issues
- Difficulty communicating with other plant equipment or control systems

Emerson’s Ovation™ excitation system is an integrated control and protection solution for synchronous generators that offers innovative features such as high-speed triggered event recording, real-time high-speed oscillography, dynamic bridge balancing and an independent base field current regulator.
Architecture

The Ovation excitation system, fully integrated into the Ovation platform, comprises an Ovation excitation controller along with most power and protection device configurations, depending upon system requirements.

Excitation Controller and I/O

The Ovation excitation controller cabinet is equipped with a specially designed excitation module featuring high-speed I/O for collecting voltage & current data and an integrated controller that executes the excitation logic.

Critical generator data from field transducers is monitored through the on-board high-speed analog and digital inputs. The generator terminal voltage is read from one or two sets of potential transformers providing a three-phase signal that is proportional to the generator’s output voltage. Generator line current is obtained from as many as three current transformers. The generator field voltage and current is also read via high-speed inputs.

Based on these inputs, the Ovation excitation system adjusts generator output voltage through a demand signal from the excitation controller to the intelligent firing circuits. The firing circuits control the rectifier bridges and ultimately the current provided to the generator field.

The dedicated Ovation excitation controller cabinet is also equipped with a standard Ovation controller and I/O modules that collect non-critical data for functions such as starting and stopping the generator. The excitation controller communicates with the Ovation network through traditional interface cards, just like Ovation controllers used for other plant processes.

Oscillography

The Ovation excitation solution includes high-speed triggered event recording and real-time oscillography.

A high-speed triggered event recorder captures high-resolution excitation data, such as generator line voltage and current; field voltage and current; and frequency deviations, when a user-defined trigger is activated. Event durations and sample rates (up to a maximum of 2560 Hz) are selectable. The data from each triggered event is sent to the historian for storage, retrieval and further analysis using the Ovation trend function.

Real-time oscillography, used during the Ovation excitation commissioning process, provides accurate generator performance information for analysis of generator faults. Changes in currents or voltages are measured at a sampling frequency up to 2560 Hz.

Redundancy

Increased system reliability can be achieved by supplying redundant components within the Ovation excitation controller including the excitation modules as well as the standard Ovation controllers and I/O modules.

Similar to traditional Ovation controllers, the Ovation excitation controller includes a primary and backup processor that simultaneously executes the logic. Automatic tracking with watchdog detection circuitry provides bumpless transfer of control from the primary to the backup processor.

Generator Power and Protection

Generator power and protection are provided through field breakers, power rectifiers, field flashing, field overvoltage, de-excitation circuitry, discharge resistors and bus systems as needed. These devices are typically housed in cabinets that are adjacent to the dedicated Ovation excitation controller cabinet or remotely located closer to the generator equipment. Power rectifier bridges are provided using N or N+1 configurations to match specific generator ratings and customer redundancy requirements.

Applications

Emerson’s Ovation excitation solution was designed to meet IEEE 421 standards for synchronous machines used with steam, gas, hydroelectric, or nuclear turbine generators. Unique to Emerson’s solution is the ability to implement Ovation excitation on most generator models from a variety of OEMs. Ovation excitation can be applied to rotating or static exciters to monitor generator conditions,
automatically adjust generator output, detect
abnormal excitation conditions and take corrective
actions for generator protection.

An integrated automatic field current regulator feature
maintains a constant exciter field current by using a
reference demand signal generated by the Ovation
controller. Also included is a separate and
independent backup field current regulator providing
the highest level of redundancy.

A real-time bridge balancing algorithm is embedded
within the excitation system logic to dynamically
equalize the field current across each power bridge.

An optional integrated power system stabilizer (PSS)
enables the generator to produce and transmit power
in a stable manner by reducing low frequency rotor
oscillations.

Ovation excitation provides generator control, limiting
and protection functions, including:
- Accidental energization
- Stator differential
- Current unbalance
- Reactive current compensation
- Reverse power
- Volts per hertz limiter
- Over and under excitation limiters
- Instantaneous and time overcurrent protection
- Field ground monitoring and protection
- Over excitation protection
- Overvoltage protection
- Over and under frequency protection

**User Interface**

Operators can view the status of all controlled plant
processes or equipment including generator
excitation through standard Ovation operator
workstations.

Use of a single set of HMIs enables better decision
making by allowing operators to quickly detect
abnormal conditions through Ovation’s robust
trending and alarming capabilities.

Dedicated excitation graphics are provided for
operating functions such as:

- Field breaker control – starts and stops excitation
  by opening or closing the field breaker
- Regulator mode – allows selection of one of the
  available operating modes:
  - Automatic voltage regulator (AVR) mode provides
    high-speed closed-loop control of the generator
terminal voltage by adjusting the generator field
  current

- Loss of excitation protection
- Automatic field current regulator (FCR) mode provides high-speed closed-loop control of the field current to the generator using the excitation module
- A separate and independent field current regulator is unique to Emerson and provides closed-loop control of the field current to the generator using the Ovation controllers
- Pf or VAR control mode provides generator terminal pf or VAR regulation
  - Voltage adjust – adjusts the excitation system voltage setpoint in AVR mode
  - Field current adjust – adjusts the excitation system current in FCR mode
  - PSS enable/disable – enables or disables PSS operation

If required, various options are available to maintain operator familiarity with existing configurations, including:
  - Hard switches for manual excitation control
  - Dedicated meters and indicating lamps to view excitation parameters
  - Dedicated alarm panel for excitation system visibility
  - Customized graphics
  - An HMI mounted on an excitation cabinet

**Engineering**

Ovation’s flexible excitation solution can be provided for either new construction or retrofit projects in cost-effective configurations to accommodate varying budgets and implementation schedules.

A front-end design replaces the existing control cabinet with an Ovation excitation controller while leaving the power and protection equipment in place.

An economical front-end replacement upgrade preserves previous equipment and wiring investments while gaining all the advantages associated with the Ovation platform.

Full replacements modernize the entire excitation system and eliminate the risk of failure from any single legacy component.

Additional engineering options include:
  - Plant interface design packages with wiring and installation diagrams
  - Demolition and installation packages with wiring and installation diagrams
  - PSS and limiter modeling optimizes tuning and automatically documents proper generation operations to help meet NERC compliance requirements

**Service and Support**

Ovation’s excitation solution encompasses more than just the equipment and control & protection applications; it includes access to knowledgeable service and support during installation, commissioning and throughout the system’s lifecycle.

Obtaining services from one vendor for a single plant-wide platform provides numerous benefits for timely and cost effective support.

Optional services available for the Ovation excitation solution include:
  - Turnkey installation services
  - Excitation system commissioning including full site acceptance testing
  - Exciter and PSS tuning to optimize system stability and provide fast transient recovery
  - Generator performance testing services to assist with NERC modeling, data and analysis (MOD-25 and MOD-26) as well as protection and control (PRC-019 and PRC-024) compliance
  - Customer support program that offers an array of services that keep the Ovation system running at peak performance while managing lifecycle costs
  - Training that emphasizes classroom and hands-on learning that is essential to improving skills and performance

1 High-speed triggered event recording requires Ovation 3.5.1 and Ovation Process Historian 3.6