Emerson Combustion Turbine
Hazardous Gas Detection Solution

Benefits

- Reliable, accurate detection of hazardous gas leaks in combustion turbine enclosures using a modular packaged solution that leverages Emerson's Rosemount™ aspirator and Ovation™ automation technologies
- Increases protection and safety of plant personnel and equipment
- Helps to avoid turbine shutdowns and extended outages
- Decreases nuisance alarms and trips using fault-tolerant 2-out-of-3 voting
- Consistent deployment that works with any gas turbine control system, regardless of vendor, within a plant or across an entire fleet

Gas Detection Challenges

Flammable gas leaks from the fuel supply system or generator put combustion turbine enclosures at risk for fire or explosion.

Sensors, typically located on the inside ceiling of the enclosure, help to detect abnormal levels of flammable gasses. Over time, the sensors can become unreliable due to fouling and exposure to extremely high temperatures, which can lead to an increase in false positive alarms or eventual failure.

Routine sensor maintenance and calibration can be extremely difficult due to their location within the space-constrained compartment. Entering the enclosure requires shutdown and cooling of the turbine and may necessitate construction of scaffolding to reach the equipment, something that could extend a planned or forced outage for several days.

Existing gas detection solutions vary by turbine OEM. Utilities with a large, diverse gas turbine fleet are burdened with maintaining numerous different solutions that can increase overall costs. Additionally, the associated trip advisory systems may be obsolete, difficult to troubleshoot, unsupported or have limited programming and expansion capabilities.
Emerson’s Hazardous Gas Detection Solution

Emerson’s combustion turbine hazardous gas detection solution combines its Rosemount patented GDA aspirator panel and Ovation automation technology with sample probes to provide fast and accurate detection of gas leaks within an enclosure. Installed outside of the turbine compartment within an environmentally-safe cabinet, this modular packaged solution is turbine-OEM-independent and can be connected to any gas turbine control system, providing consistency across a fleet of gas-fueled power generators. The solution can be applied to simple cycle or combined cycle units to detect and respond to fuel gas or generator hydrogen leaks.

Aspirator System and Probes

Because of the complexity, sophistication and cost of today’s monitoring systems, careful consideration needs to be given to hardware selection and placement. Emerson’s Rosemount’s GDA aspirator accurately monitors gas in areas where it is not practical to place sensors. Notable features/functions of the GDA aspirator system include sample line blockage monitoring; high- and low- temperature operation; an adjustable vacuum created by an air-driven eductor; sample-line clearance and detector testing; and, applicability for Zone 1 or 2 hazardous areas.

Emerson’s standard GDA aspirator panels are located outside of the gas turbine enclosure to enable easier maintenance and in-line calibration without requiring the unit to be shut down. An optional aspirator panel can be provided to detect hydrogen leaks in the generator terminal enclosure. The aspirator’s transmitter and flow tube conditions can be visually inspected thru a window on the front panel door.

Each aspirator panel typically includes self-compensating duct probes that continuously and safely draw equal volumes of representative samples from the enclosure. Placing the gas sensors within the external aspirator panel rather than inside the hot enclosure increases measurement reliability.
Trip Advisory System

Emerson’s Ovation automation technology acts as a trip advisory system to help protect gas turbines from the potentially damaging consequences of a gas leak. An environmentally-safe, wall-mounted cabinet equipped with a redundant Ovation compact controller, redundant power supplies and I/O modules works with the aspirator panels to monitor gas detection and exhaust flow data. Standard communication protocols are used to pass process values and health indications from the Ovation trip advisory system to the existing turbine controls.

The Ovation trip advisory system uses two-out-of-three voting logic with three independent 24V-powered HART channels to assess data quality and remove an unhealthy device from the trip calculation, which decreases nuisance turbine alarms and keeps a running machine online. Real-time communication between the Ovation compact controller and the GDA aspirator panel ensures the use of accurate, unaltered measurements for the voting logic; not user-entered or off-scan measurements. Diagnostics from Ovation high-performance HART analog input modules validate the quality of the data provided by the aspirator gas sensors.

Control logic alerts the operator when gas is present in the enclosure before its level approaches the lower explosive limit. For enclosures with exhaust fans and/or actuators on the dampers, a control output is sent to the turbine control system to indicate that the enclosure should be vented when the unit is offline.

Safety logic alerts the operator when hazardous gas is detected:
- A single high-level sensor reading sends a “trouble” alarm
- One high-level and one approaching high-level sends an alarm to initiate an action such as opening the dampers
- Two high-level sensor readings activate a trip signal

The Ovation trip advisory system is easily programmed using standard Ovation engineering tools. Process values are automatically archived within the controller and can be retrieved for troubleshooting or analysis. The system can be expanded by adding new I/O modules or compact controllers and is fully supported by Emerson’s lifecycle programs.

<table>
<thead>
<tr>
<th>Ovation Trip System Quality Flags</th>
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</thead>
<tbody>
<tr>
<td><strong>Fault Sources</strong></td>
</tr>
<tr>
<td>Sensor, sensor communication, digital input status and point quality</td>
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<tr>
<td><strong>Point Quality</strong></td>
</tr>
<tr>
<td>Good (point is functioning properly)</td>
</tr>
<tr>
<td>Fair (based on sensor diagnostic alarm)</td>
</tr>
<tr>
<td>Bad (point is not functioning properly, typically caused by sensor failure)</td>
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<tr>
<td><strong>Potential Quality Flag Causes</strong></td>
</tr>
<tr>
<td>Test mode</td>
</tr>
<tr>
<td>User definable engineering or reasonability limit</td>
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<tr>
<td>Failed communication to the channel</td>
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<tr>
<td>Over/under-range, input/blown fuse/open loop - when the corresponding points input is less than 2.5mA (open loop condition), or greater than 25mA (over-range)</td>
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Installation & Commissioning Services

Emerson offers expanded scope (EPC) services for installation and commissioning of the hazardous gas detection solution, including:

- Laser-scanning that creates a 3D probe placement model
- Engineering design of probe placement
- Wiring and conduit designs from the aspirator panel to the gas turbine enclosure and from the Ovation compact controller cabinet to the UPS inside enclosure.

Optional Integrated Plant Control

Emerson’s hazardous gas detection solution works with any operating gas turbine control system, regardless of manufacturer. As an option, Ovation automation technology can be provided to replace disparate balance-of-plant, HRSG, duct burner management, combustion turbine or steam turbine control systems implemented on multiple different platforms.

For simple or combined cycle operation, use of a single Ovation platform provides numerous benefits including reduced hardware; lower maintenance and service costs; improved time synchronization; and harmonized configuration, trending and alarms. The Ovation automation platform continues to evolve well beyond the bounds of traditional distributed control and data acquisition systems. In addition to native, advanced applications for optimizing power generation operations, the Ovation platform supports integrated vibration monitoring, generator excitation control, safety instrumented systems, scalable footprints for small or distributed applications, virtualization and embedded simulation — all backed by Emerson's comprehensive support programs.

References

- Ovation Automation Technology
- Ovation Compact Controller
- Ovation I/O Overview
- Rosemount Flame & Gas Detection Solutions
- Rosemount GDA Gas & Smoke Aspirator System

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