

Fieldbus 105

Diagnostics with fieldbus

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Overview

I already have enough to do. Why should I make the added effort to use diagnostics?

By enabling you to identify both the source and the nature of a problem — often before it affects the process — diagnostics can actually reduce the effort required to keep your process and equipment running as they should.

Predictive diagnostic alerts also enable a shift from reactive and preventive maintenance practices to predictive maintenance practices. This shift can significantly reduce maintenance workload and cost while improving overall plant availability.

FOUNDATION fieldbus provides a framework for implementing a vast array of device and process diagnostics. The actual diagnostics, however, aren't specified by the Fieldbus Foundation. Instead, they're device- and vendor-specific. That's why it's important to choose

devices and vendors that provide the diagnostic capabilities you need to meet your plant objectives.

The PlantWeb advantage

PlantWeb architecture builds on the capabilities of FOUNDATION fieldbus, as well as Emerson's 100+ years' experience with the process industries, to deliver a wide range of diagnostic capabilities that can help you detect and solve real-world problems — and improve your plant's bottom line.



This course explores some of the diagnostic possibilities available in PlantWeb architecture. These diagnostics leverage the capabilities of FOUNDATION fieldbus but represent specific PlantWeb implementations.

Hint: As you go through the topics in this course, watch for answers to these questions:

- *What kinds of problems can be detected by statistical process monitoring?*
- *How do diagnostics affect process variability and availability?*
- *How can you avoid being overwhelmed with diagnostic alarms and related information?*

More than device maintenance

Much of the publicity about diagnostics centers on improving the maintenance of field devices, such as measurement instruments and control valves.

That's understandable. Quickly detecting a failing sensor as the cause of a measurement problem, or identifying which valves need service during a plant turnaround, can substantially reduce maintenance costs and downtime.

But diagnostics can also help you improve the performance of other process equipment, as well as keep the process itself up and running at its best.

The next three sections of this course will explain how diagnostics can improve equipment performance, loop performance, and process performance.

Equipment diagnostics

Diagnostics can be used to detect and alarm problems not only with field devices, but also with other process equipment.

For example, **statistical process monitoring** can identify a wide variety of problems with process equipment — from leaks in pipes to fouling in heat exchangers, filters, and similar equipment.

The **advanced diagnostic transducer block** available in Emerson FOUNDATION fieldbus devices allows up to four control or process variables to be monitored for changes in mean and standard deviation. Statistical process monitoring analyzes how these four user-selectable factors change in relation to each other to detect equipment problems.

As heat exchangers and filters foul and clog, for example, the diagnostics can detect a mean change in the differential pressure across the unit without a corresponding mean change in setpoint or flow rate — and alert the operator or maintenance shop of the problem.

The PlantWeb advantage

PlantWeb provides both pre-configured solutions and user-configurable monitoring.



For example, flow and level loop diagnostics are pre-configured. For user-defined monitoring, you simply identify by tag the variables to be monitored by the field device, then set the thresholds of mean and standard deviation change to generate alarms.

Statistical process monitoring is also "self-learning." When the process is running correctly, you just set the device to "learn." The device will learn and verify the process dynamics, then automatically switch to monitoring the process.

Loop diagnostics

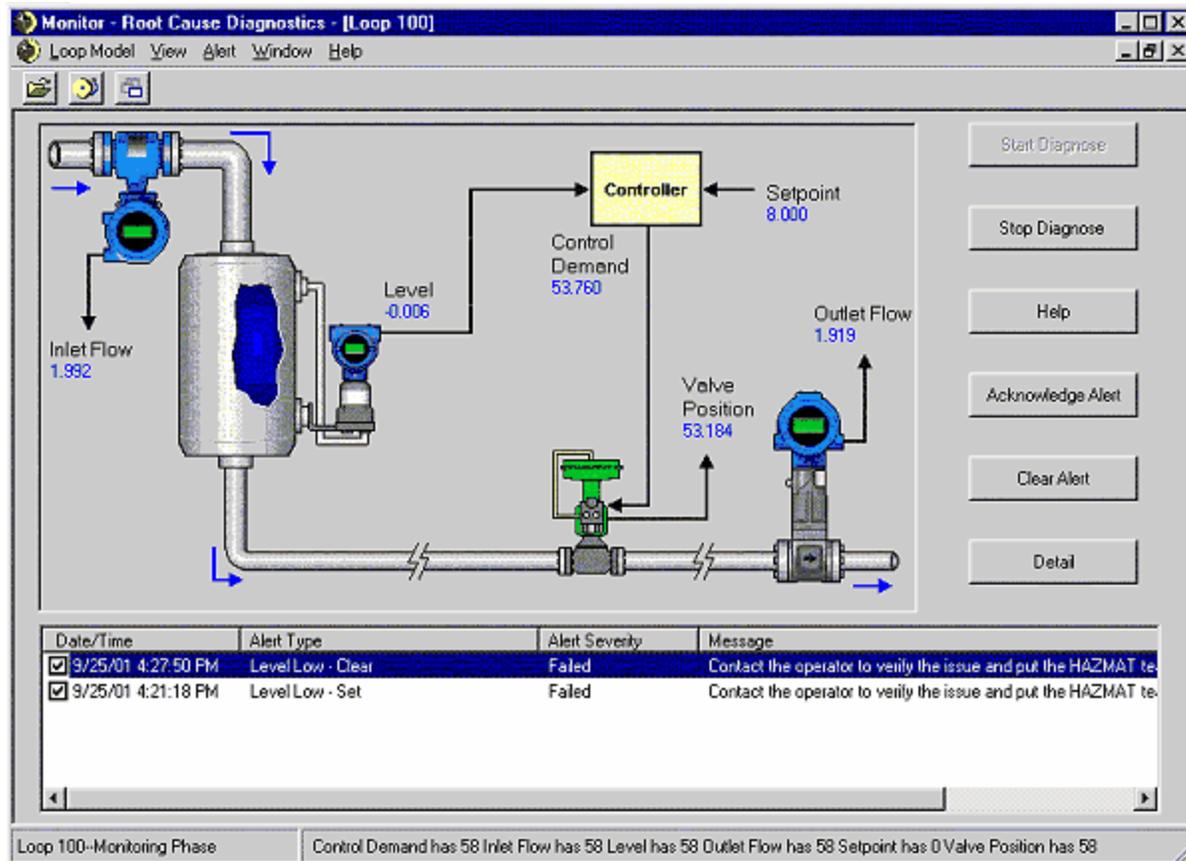
PlantWeb diagnostics can also be used to detect and alarm problems at the loop level.

Here again, statistical process monitoring provides a good example: detecting wet-leg evaporation in a liquid level loop by monitoring process variable (PV) setpoint, output, and actual valve position.

How does this work?

Liquid level is maintained at setpoint by comparing the actual process level to the reference level in a wet leg. But if the liquid in the wet leg evaporates, the reference level drops — and the control function responds by moving an outflow valve to a more open position to lower the process operating level accordingly.

When this happens, the diagnostic function detects that both control demand and actual valve position are more open without a change in setpoint or measured process variable. This means the measurement has drifted, so an alert is generated. Here is an example of an alert.



Improving plant performance

You probably have enough problems to deal with already. Why do you need diagnostics to help you find more?

Because finding and solving those problems can help you meet plant efficiency and economic objectives.

For example, the diagnostics available with PlantWeb architecture can help you reduce process variability, improve process availability, and enhance safety and environmental compliance.

The next three sections of the course explain how.

Reducing process variability

Process variability increases production cost by increasing material and energy costs, and reduces plant production by producing off-spec product that must be blended, reprocessed, or disposed of.

One tool for reducing process variability in Emerson valves is the **valve signature diagnostic**, which (among other purposes) can be used to detect a wear-induced condition called stiction.

Stiction causes a valve to stick at one position until there's a large change in actuator force. Then the valve moves a significant amount — perhaps several percent. As a result, the valve spends most of its time at the wrong position.

This condition can be revealed by the valve signature diagnostic. If stiction is present, the signature shows valve movement as a series of "bumps" — rather than the normal smooth line — as actuator force is increased or decreased.

Economic consequences of stiction can be significant. For example, excess variability in steam flow to a distillation column can increase utility costs in excess of \$1,000,000 per year.

Another example is **sensor fouling detection**.

Fouling of analytical probes causes bad readings that can lead to excess material consumption, off-spec product that must be reprocessed or discarded, or even safety problems.

Sensor fouling detection in Emerson analytical devices can help you avoid these costs by triggering maintenance requests or even automatically initiating cleaning the sensor.

Improving process availability

Diagnostics can improve process availability both by reducing the length of scheduled shutdowns and by eliminating unscheduled shutdowns.

For example, you can reduce the length of scheduled shutdowns by knowing which valves need repair and which don't, so you pull only the ones that need it. Through valve diagnostics, engineers for one of Emerson's customers found that only 14 of the 188 valves scheduled to be pulled out and rebuilt actually needed that level of services.

Detecting a problem in critical equipment before it fails completely can also help you take action to avoid a process trip and unexpected shutdown. But diagnostics can also help you avoid "on-stream" availability problems.

For example, a bad pH reading in a fermentation application can ruin a complete batch — causing a loss of production even though the actual plant equipment is online. The **sensor fouling detection** diagnostic described in the previous section can help you detect problems like this.

Enhancing safety and environmental compliance

Diagnosing device and equipment problems from the control room or maintenance shop enhances safety by reducing the time technicians spend locating and fixing problems in hazardous areas.

Consider the example of a valve that controls the flow of an acid. If technicians can check the valve's packing friction and other operating parameters from the maintenance shop, they don't have to put on protective gear and go out to the valve's location -- or expose themselves to hazardous conditions.

Diagnostics can also help you detect problems that could lead to equipment failures with safety or environmental consequences.

The PlantWeb advantage

One example of how PlantWeb can help improve safety is **plugged impulse line detection**.



When impulse lines to a pressure transmitter become plugged, the pressure at the time of plugging is trapped in the line -- giving the appearance of a valid process variable. Besides reducing process quality, this false reading can affect safety (especially in gage pressure applications) by masking overpressure conditions.

Often the only indication of a plugged line is a variable that is TOO stable, without the normal level of variability. PlantWeb's plugged impulse line detection diagnostic uses this change in variability to detect both single and double line plugging and send an alert.

Managing alarms and alerts

Plant personnel are drowning in a sea of alarms, alerts, advisories, events, and other automation-generated data. Diagnostics can either help the situation or make it worse.

Diagnostic information should only be sent to people who will be affected by the situation the diagnostic detects, or those who will use the information to correct problems or improve performance. In addition, the level of detail each person receives should be appropriate to the action that person can take.

The PlantWeb advantage

In PlantWeb architecture, the DeltaV system and AMS Suite: Intelligent Device Manager software provide alarm and alert management for appropriate alarm logging, annunciation, filtering and suppression, level of detail for the recipient, and alarm destination.



Alarm broadcasting and narrowcasting. You can configure each type of alarm or alert to go to personnel with specific job functions, or to specific individuals. Alarms can even be sent via pager, cell phones, or other methods.

Alarm annunciation. To ensure that the operator only receives meaningful diagnostic alarms and alerts, all diagnostic alarms and alerts are evaluated within the device and only those that have operating impact are displayed to the operator.

Alarm detail. The level of detail in alarms is appropriate to the function of plant personnel. For example, the operator can be notified that a field device is non-operational or will need maintenance soon, while a maintenance technician receives information needed to repair or maintain the equipment.

Alarm filtering and suppression. Alarms can be filtered and suppressed to minimize nuisance alarms. For example, if a point has intermittent diagnostic alarms, the alarm can be suppressed for the operator and redirected to the maintenance team. Once the cause is fixed it can be redirected to the operator and enabled.

Alarm and alert logging. Alarms and alerts generated both by devices and by the DeltaV system are integrated in the DeltaV logs. These alarms and alerts can be displayed on log and historian displays, as well as trend displays.