

Turning vision into reality...

Getting The Most Out Of Smart Field Devices

As this "go-to" guy for maintenance-related questions at his plant explains, there's more to advanced instrumentation capabilities than improved control. Much, much more.

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The accelerated growth of smart instrumentation in process-industry plants over the past 20 years has been stimulated by visions of greater measurement accuracy, useful diagnostics, reduced control variability and better equipment reliability. The promise of this technology is improved all-around performance and higher productivity.

That promise was part of the vision at the LyondellBasell facility in Clinton, IA, where smart instruments have been in use in the ethylene and high- and low-density polyethylene production units since the early 1990s. Today, more than 1800 HART® and FOUNDATION™ fieldbus instruments, ranging from first-generation analog to the latest digital technologies, are integral components of our DeltaV™ digital automation systems.

While the operations group has derived value through better control of the process with our smart devices, their full potential had not been realized in the Clinton plant prior to

2007. This is because the field-generated diagnostics were not being used to support the predictive maintenance strategies that are possible through DeltaV. Clearly, a more proactive environment was needed to turn the visions of greater reliability and better process performance into reality.

Things began to change when an E/I (electrical/instrumentation) specialist was assigned to establish new maintenance procedures and workflows: That would be me. Midway through 2007, I began managing the operation of the AMS Suite: Intelligent Device Manager predictive main-

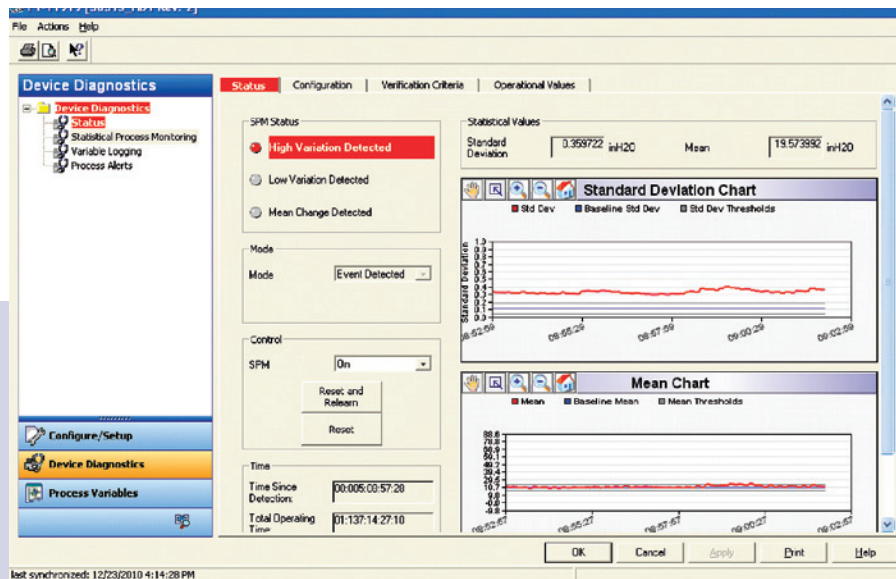


Fig. 1. A pressure transmitter is checked by clicking on the “Device Diagnostics” box and selecting “Status.” The “High Variation” that’s detected could be an indication of a plugged sensor line (depicted graphically on the Standard Deviation chart).

tenance software—which had seen limited use here since its introduction to the plant in 2000. This organizational shift spurred the growth of a successful predictive maintenance program that has delivered a range of troubleshooting, calibration, documentation and operating benefits.

As the predictive maintenance “champion,” I became responsible for updating the site’s smart instrument database and accessing information from the field devices as a means of diagnosing instrument-related issues. One major initiative included the development of alarm parameters to determine which alerts represent potential production problems requiring further investigation and which ones—such as temporary outages—result from routine work in the plant.

Predictive benefits

At the Clinton site, AMS Suite is used to provide preliminary diagnoses right from the instrument shop—something that gives technicians a significant head-start on locating and fixing problems. This can save up to two hours of troubleshooting time per issue. For example, when a temperature transmitter on a reactor roughly 100 feet off the ground stopped transmitting, our initial interrogation of the point showed that the sensor was open (an indication of faulty wiring or a bad thermocouple). The technician was then able to take the right parts and tools and make one visit to the site, thus minimizing repair time. Upon its completion, the repair was checked from the shop, proving that the transmitter was functioning as desired.

With the ability to provide fast, accurate answers, I soon became the “go-to” person for maintenance-related questions. As people across the plant experienced the benefits of using diagnostics, we received general support for the use of this predictive approach.

Today, all device maintenance—including repairs and configurations—is automatically recorded in the instrumentation database, eliminating error-prone manual entries and providing an audit trail of device events. The maintenance history of any instrument can be tracked and viewed by referencing the tag number. Analysis by device type enables a quick check of similar devices in other locations to see whether they may be developing the same kind of problems. Accurate documentation on instrument calibrations is, of course, essential to satisfy the requirements of regulatory agencies.

Device diagnostics

The Clinton site uses AMS Suite to interrogate field measurement instruments online to determine

key operating issues. Figure 1, for example, shows how a pressure transmitter is checked: by clicking on the “Device Diagnostics” box and selecting “Status.” The “High Variation” that’s detected could be an indication of a plugged sensor line (depicted graphically on the Standard Deviation chart). We can track this device over a number of days to determine if the deviation remains within acceptable limits or how quickly it is changing. These diagnostics help us determine whether an immediate repair is needed or if it can be delayed until a regularly scheduled shutdown period. Operators are always kept informed if readings from certain instruments are questionable so they can take necessary actions to maintain production.

Valve diagnostics

Digital valve controllers (DVCs) mounted on control valves deliver detailed diagnostics not previously available online, including travel deviation, supply pressure and drive signal. We can now access these points without someone going into the field and using a handheld communicator.

Since travel deviation is user-defined, valves in our plant must normally move to within 5% of the desired position within five seconds. If this does not occur, a travel deviation alert is raised. In one case, a travel deviation alert occurred on an 8” butterfly valve used to control cooling water to a reactor as the unit was being shut down for scheduled maintenance. The valve should have been completely closed, but it remained open and was not moving. Upon disassembly during the maintenance period, a jagged metal fragment almost eight inches long was found lodged in the valve, preventing it from closing (Fig. 2). Without

the travel deviation alert, that valve would not have been checked, and the problem might not have been recognized until after the reactor was restarted, resulting in a lengthy troubleshooting delay. Or worse, the fragment could have been carried downstream resulting in extensive mechanical damage.

In another case, a “low supply pressure” alert on a 6” disk level-control valve prevented a valve failure that was just waiting to happen. Air supply pressure is another user-defined value—with the “high” setting normally 5-10 psi above the normal operating range of the valve, and the “low” setting right around the pressure required to operate the valve. This critical rotary valve, which uses air pressure against a diaphragm to move a piston to open the valve, had to be removed immediately for repair. The piston was deeply scored and the diaphragm cut, so it was only a matter of time before the valve failed, causing a significant and costly upset in the olefins unit.

Online diagnostics are the only way to consistently identify a problem like air escaping from a valve in a noisy plant. Relying solely on human observation often results in major device issues not being identified and resolved in time to prevent costly delays and process upsets.

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Fig. 2. Without a travel deviation alert, this control valve would not have been checked and problems not identified until too late.

Value from valve signatures

Signature scans of all new valves are recorded before installation, providing a model of each valve’s operating characteristics. Comparison with a future signature on the same valve can help us determine internal conditions that are causing poor performance and potential downtime. A comparison of the original signature (straight green line) with one taken later can be seen in Fig. 3. Substantially more air pressure was needed to open the valve (red line), especially as it got closer

to 100% open. The saw-tooth pattern indicates friction and valve sticking. Even though this valve was working, during disassembly at its next scheduled maintenance period, internal damage was found. The comparison with the original valve scan helped predict that the valve would continue to operate, so an immediate repair was not necessary. However, knowing about the problem in advance—and that a repair would eventually be required—helped ensure the valve’s long-term reliability. Some training and experience are required to recog-

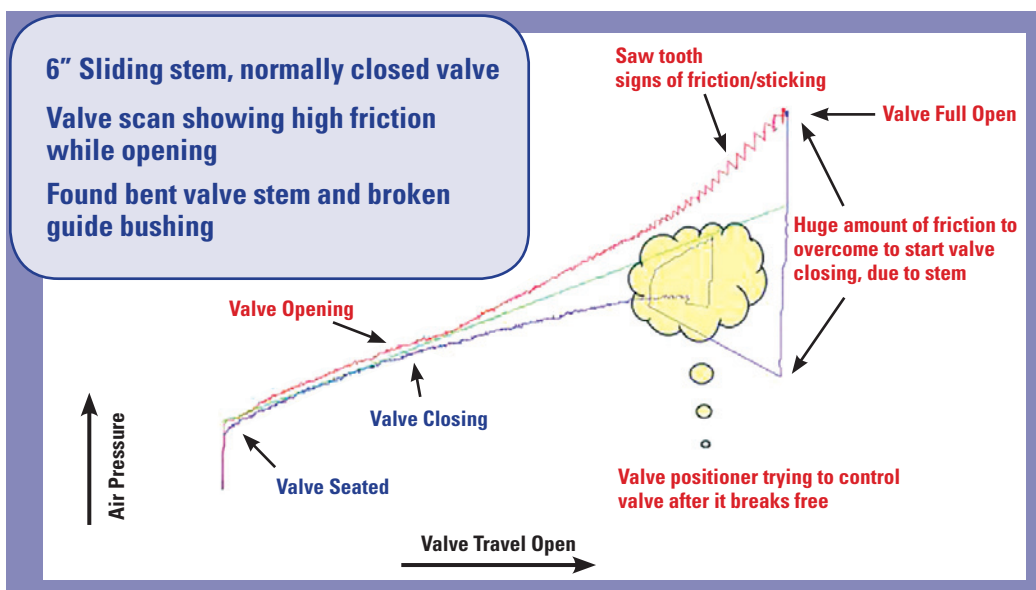
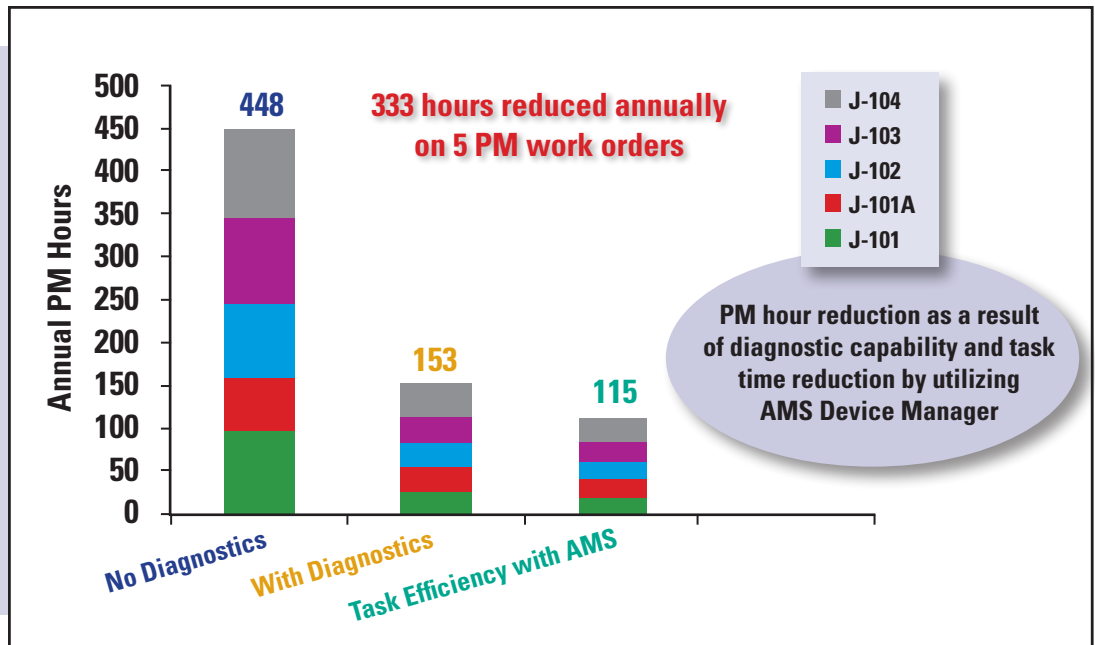


Fig. 3. Comparison of an original valve signature recorded prior to installation (straight green line) with one that was taken later showed that substantially more air pressure was being required to open the valve (red line), especially as it got closer to 100% open. The saw-tooth pattern is indicative of friction and valve sticking.

A direct result of our plant-wide reliance on diagnostics has been the ability to extend PM intervals. Operational benefits include fewer costly process upsets and being able to avoid the loss of millions of pounds of product.

Fig. 4. A reduction in maintenance on just five major assets quantifies some of the benefits that the Clinton site has derived through smart field-device diagnostics.



nize problems like this, but the benefit in terms of process availability is immeasurable.

The payback

The value of using diagnostics at the Clinton operations is vividly illustrated in Fig. 4, which shows the reduction in annual maintenance hours on just five major assets, including steam-driven turbines and compressors. An average of 448 hours was required for this equipment before diagnostics were available for device calibration and other maintenance tasks. When diagnostics were put to use, 333 hours were saved, and a further reduction was realized when AMS Suite was utilized to increase maintenance efficiency.

A direct result of the plant-wide reliance on diagnostics was the ability to extend the time intervals for preventive maintenance (PM) on several pieces of equipment. Many PM schedules were

overly protective—and had been implemented simply per OEM recommendations. When production managers became comfortable with the fact that critical process equipment was adequately protected through monitoring and the application of the field-generated diagnostics, the plant was able to significantly reduce the amount of time devoted to preventive maintenance.

Operational results include fewer costly process upsets, avoiding the loss of millions of pounds of product. In the olefins unit, for example, shutdowns due to the failure of an asset are a rarity, equipment availability is increased and production is sustained. **MT**

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