



**Dow Chemical, Deer Park, Texas, USA
Plant of the Year 2013 Award Winner**

**DOW IMPROVES INSTRUMENT RELIABILITY 66% AND SAVES MILLIONS OF DOLLARS
WITH REAL-TIME HART TECHNOLOGY**

PROJECT OBJECTIVES

- Implement an Instrument Reliability Program as part of a larger equipment maintenance strategy.
- Establish baseline data and track site-wide metrics to prevent track, and improve unplanned events and improve operational uptime.
- Focus on key process units and instruments with high priority on critical control valves, followed by additional instrument reliability projects.

SOLUTION

- Incorporate HART communication between critical control valves and other instruments to the distributed control and asset management system for diagnostics, failure analysis, and preventative/predictive condition-based maintenance.
- Compare real-time valve signature scans with benchmarks, eliminating unnecessary removal/repairs, identifying abnormal conditions, predicting failures and reducing unplanned downtime.
- Collect data from smart instruments using hand-held communicators, mobile computers and networked connections via multiplexer to the plant's Emerson AMS automation platform.
- Identify instrument deficiencies real-time ranging from end-of-life to improper installations to specification discrepancies and rapid response to reduce incidents.

RESULTS

- Reduction in unplanned control valve events from 17 per year to four per year through better prioritization and maintenance strategies.

- Elimination of repeat failures and millions of dollars in losses through detection of problems and replacement of nine differential pressure level transmitters and four firebox temperature sensors.
- Evolution from reactive to preventive and predictive instrument maintenance
- An at-least 66% improvement in downtime reduction over a three year period and financial savings of millions of dollars of in earnings before interest and taxes (EBIT).
- Recognition and awards from management, leading to expansion of the Instrument Reliability Group's strategy at Deer Park and additional Dow facilities.

Dow Chemical's Deer Park, Texas, facility spans 700 acres and employs nearly 800 working across eight separate facilities to produce specialty chemicals. These include methyl methacrylate, acrylic acid, amines, and various acrylates used for diverse products ranging from paints to household and personal care products to automotive coatings and water purification chemicals. By using HART communication as a key piece in its highly proactive instrument reliability program and a larger equipment maintenance strategy, the plant has been presented with the 2013 HART Plant of the Year Award for demonstrating ingenuity in the application of HART Communication for real-time operational improvements.

"HART technology has helped reduce production downtime related to control valve failures. Through our reliability program, the plant has realized a 66% improvement — perhaps more — in downtime reduction over a three year period," says Shadrach Stephens, Dow Chemical I/E maintenance group leader.

Along with performing valve overhauls, he added that the plant uses HART protocol-enabled signals to monitor real time valve conditions, "which has helped with identifying problems before they could cause unplanned events. Combined with several improvement initiatives, this reliability effort has yielded significant financial savings including millions of dollars of EBIT."

To achieve these results, Stephens and Christopher Garcia, instrument and electrical technology leader, have evangelized the success of the site's Instrument Reliability Program, and the Instrument Reliability Group that led implementation of it, with the help of others. Key contributors also included David Taylor, engineering instrument lead; Don Clark, senior instrument technologist; Alan Hoes, senior instrument technologist; Teddy Wyly, I/E reliability technician; and Johnny Garcia, I/E reliability technician.

Pinpointing critical assets

Operating with a philosophy of continuous improvement, the Instrument Reliability Group came to the realization that instrument reliability improvements had been flat for three years running. Working with production, maintenance, and process automation specialists, the group asked for reasons improvements had been flat, and got responses in four categories: end-of-life

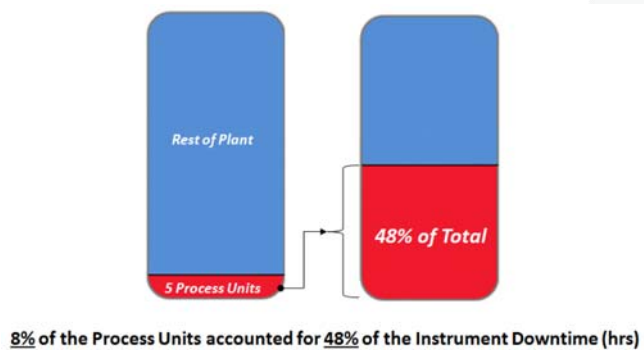
equipment, lack of preventive/predictive maintenance (PPM) strategies, multiple repeat failures, and people/process-related challenges. This, in turn, led the group to...

- Discover problem areas related to end-of-life equipment through the evaluation of instrumentation technologies based on factors such as age, condition and installation specifics;
- Identify strategic PPM requirements through the discovery of instrument PPMS and critical control valves lacking comprehensive maintenance strategies;
- Analyze unplanned event logs to discover repeat instrument-related failures in areas related to equipment, operating discipline, processing, engineering design and process automation; and
- Pinpoint “people or process” improvements through analysis of work orders, overtime history, computerized maintenance management system (CMMS) repair documentation as well as instrument calibration and specification sheets.

Through this discipline and the review of historical data, the group found that just five of the site’s 62 process units contributed to 48% of the plant’s entire instrument downtime. This had been going on for several years, which represented millions of dollars in lost production per year. Fortunately, those five units shared similar process chemistry, so addressing the root causes within these five units was a key factor in leveraging solutions and providing value to the operation.

Completing instrument assessments and taking immediate action in the areas that would add the most value in the five most challenged production units helped garner buy-in from leadership. For example, the Reliability Group identified that 28% of the facility’s instruments contained a deficiency, ranging from end-of-life to improper installations to specification discrepancies; and 13 temperature and level instruments accounted for 60% of problems worth millions of dollars of losses. The group immediately changed those instruments, and the number of incidents fell to zero.

The Instrument Reliability Group documented several additional improvements between 2011 and 2012 that yielded substantial savings in terms of production losses and maintenance costs.



The facility was on track to have 87 unplanned events in two years or an average of 43.5 per year. In 2012, the facility completed the year with a significantly reduced number of unplanned valve events (15), which translated into a 63% reliability improvement and millions of dollars in EBIT improvement. This number has since continued its downward trend.

Below are a few examples of improvements at Deer Park that most petrochemical facilities can also leverage:

- **Control Valve Equipment Maintenance Strategies:** Control valves, the most likely instruments to sustain wear and cycle damage, caused of an average of 17 unplanned events per year at Deer Park. The Instrument Reliability Group reduced this number to four by prioritizing the most critical valves, better managing spare-parts and overhauling/preventive/predictive maintenance strategies.
- **Real-time Equipment Monitoring:** The Instrument Reliability Group, working with the facility's Process Automation team, used two software packages to track real time instrument and control valve performance, and better communicate failures and pending failures, as well as pending failures. This led the plant to avoid seven unplanned events that would have caused multi-million dollars of production losses if not addressed.
- **Technology Improvements:** Two additional technologies suffered repeat failures and accounted for multimillion dollars of production losses over a two year period. Nine differential pressure level transmitters with liquid-filled impulse lines caused failures due to heat tracing, leaks, loss of fill, etc.; and four firebox temperature sensors installed in thermal oxidizers, which experienced thermocouple burnout and damaged elements. Replacing these with new technologies resulted in the elimination of unplanned events, removing them from the group's top opportunity list.

HART's role in the solution

HART communications played a role both long- and short-term solutions. For instance on short-term projects, HART technology, from networks to hand-held communicators provided diagnostic information for use in instrument root cause investigations; live status updates on critical instruments and control valves; and instruments inspections and calibration checks.

HART technology also served long-term projects by extending connectivity to critical instruments and valves. A large portion of valves had already been equipped with smart valve positioners connected to HART multiplexer. These, in conjunction with software packages and the plant's Emerson AMS distributed control and asset maintenance system, helped the team detect and provide more detail on problems as they were discovered. This was accomplished by various means.

Data was collected from smart instruments using HART protocol-enabled devices through various means including hand-held communicators and mobile computers in the field as well as via HART multiplexer networked to the plant's AMS platform. Condition based management used the AMS and data historian software, which led to corrective actions, with maintenance work prioritized and optimized through the use of real-time data.

In one case, HART communication helped reveal that 36% of control valves did not need to be removed and repaired. This led to new processes whereby technicians in the control room or alternately in the field using a portable device perform a flow scan on each valve signature, compare it to a baseline scan to see how much change has occurred in the valve and avoid unnecessary actions as well as more quickly identify abnormal conditions such as improper actuation.

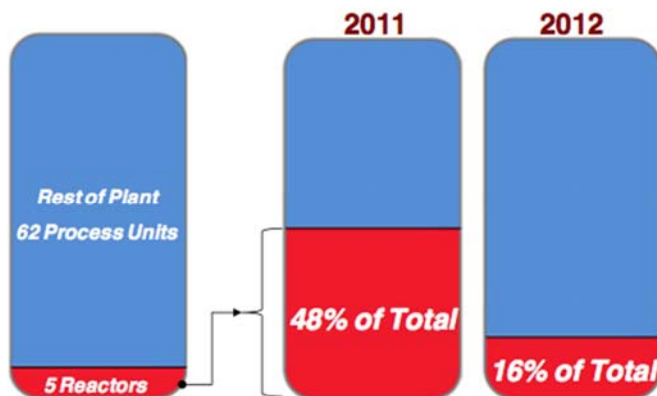
“It takes about six to eight hours to do six to eight tags, about 1 hour per valve on average,” according to Stephens. “Compared to pulling the valve, the cost is much lower and the savings could be used for other priorities.”

Bottom-line value creation

Early on, conducting more than 10,000 instrument assessments led personnel to gain a greater appreciation for the value of prioritizing maintenance activities. From those assessments, personnel found 2400 concerns and produced 400 work orders for quick fixes of basic problems such as improperly installed vents, devices and terminal housing covers. Realizing that a one- or two-hour job could be completed without taking the process offline, and could prevent a major shutdown, helped create a new culture of taking responsibility for devices and assets. This attitude improved priority-setting and better evaluation and escalation of alerts to personnel who could quickly grasp problems and their impact.

The work undertaken by the Deer Park facility’s Instrument Reliability Group has earned a management award from Dow, as well as earning promotions for individuals involved. The plant has expanded its instrument reliability program to employ eight service groups. “In this program, the plant has realized a 70% improvement in downtime reduction over a three year period.

The Case for Change – Value Creation



Validation that We’re on the Right Track

Additionally, Stephens and Garcia gave a presentation of this program at a company conference in Houston in the summer of 2013. The program is now being leveraged across other Dow facilities.

“Through better integration with plant processes and technologies, HART technology helped the facility better communicate the health of instrumentation, and “move from reactive to predictive maintenance” on devices including control valves, according to Stephens. Asked for a few words that best describes HART, “a digital gateway that provides access to a new world of hidden potential.

“By using the existing HART tools and resources we had and engaging multiple levels of management and functions, we were able to change the process and the culture – for lasting benefits throughout the operation,” he added.

Regarding the five process units that contributed to 48% of its instrument downtime, that number was reduced to 16% in the first year and 10% in 2013. Addressing the “bad actors” and moving to a proactive management strategy has allowed the plant to reduce major problems and prevent others before they become problems.

“The sound technology principals of the HART Protocol’s design have enabled users like Dow Chemical to ‘get connected’ to valuable process and device data within their plant – to improve plant performance in a cost-effective way,” said Ted Masters, HART Communication Foundation President and CEO, in presenting the Plant of the Year award to Dow. “Connectivity to the enterprise for visualization, analytics and integration into other systems multiplies the value that leveraging HART data in real-time can bring to a business.”



HART technology is likely to help facilitate future plans under consideration. These include pulling diagnostic data from additional instrumentation including pressure and temperature transmitters as well as Coriolis flowmeters. Real-time data visibility may be used to create new alerts or alarms when a change exceeds acceptable parameters. This can be enabled through real-time statistical analyses in the device that can be transmitted via HART communication to a system such as the plant’s AMS.