Reliability Solutions

EMERSON

The paths to reliability success are as varied as the organizations that develop them. Around the globe, organizations rely on Emerson technology and expertise to help chart their path to Top Quartile performance.

Stronger Operational Efficiency through Improved Alert Management

By reducing the number of nuisance alerts and improving the usefulness of meaningful alerts, a North American chemical facility has created a highly efficient maintenance workflow process, thus avoiding $500K in costs per year. It's a testament to the benefits of well-designed alert management.

Consistently valid alerts that direct attention to potential issues and suggest corrective actions assist operations and maintenance departments in steady process availability. But if alerts unnecessarily pull attention from important tasks or from important alerts, the facility suffers with poor issue resolution and low productivity.

Device manufacturers often set defaults so that a multitude of conditions are communicated to users. The alerts might be useful in certain situations, but not all alerts prove useful for all users' environments. Some devices even send alerts to let users know they are operating as expected. Too often, teams must sift through these alerts to evaluate and glean pertinent information to keep the facility operating efficiently.

Improving Alert Management

As the process evolved over the years to meet industry demands, devices were changed and nuisance alerts eventually required too much attention. The chemical facility dedicated a team to eliminating nuisance alerts to more efficiently operate eight control units that manufacture and package agricultural and pharmaceutical products.

With a single maintenance team covering four DeltaV™ distributed control systems and all eight control areas, the company needed to be mobilized as efficiently as possible. Because maintenance was becoming overloaded by the nuisance alerts and productivity was suffering, the team initiated a project to make alert management more useful to enable more effective responses from the maintenance team so the facility could better meet customer demands.

In the end, the team succeeded and reduced device alerts by an average of 82%. The maintenance team has become more productive and can act more easily as needed without wasting time. The work was detailed, but presented here are some of the most successful strategies that were developed.

"I'm Healthy. I'm Healthy. I'm Healthy."

As the company's long-time automation partner, Emerson assisted in assessing and revising the alerts communicated to the operation and maintenance groups. Together, the companies began analyzing the most often seen alerts to assess their value.

The team noticed that unnecessary alerts fell into three groups:

- Health-status alerts that did not mean much in context with the facility's needs
- Standard-related alerts (e.g., HART, Fieldbus) that had no recommended actions
- Process-condition alerts that were not important to the maintenance group

For example, one device produced default alerts that simply said, "I'm heathy. I'm heathy. I'm heathy." This single device frequently flooded the control environment, automatically added unnecessary activities to the maintenance group to-do list, and took up valuable database space. In another area of the facility, a single planned event would trigger six separate and unnecessary alerts.

There were thousands of these types of alerts that steered maintenance attention away from more important activities and prohibited efficient operation.

Ferreting out the Bad Actors

The team defined characteristics that would make an alert useful. Alerts need to be valuable to the process environment, must have consistent usage and wording, and must present actionable recommendations. Alerts without those characteristics needed to be eliminated or improved.

Investigation showed that twelve device types generated 91% of all alerts. The ten worst offending tag types generated 41% of the alerts. With this knowledge, the team focused on the devices generating the most nuisance alerts, eliminating some alerts and tailoring recommended actions. Assisted by AMS Device Manager, the team also looked at similar groups of devices to normalize the alerts and create consistent actions.

The AMS Device Manager dashboard (Figure 1) clearly shows device health, enables users to sort and filter, and helps users choose consistent alert details and recommendations.

Hours were reduced by 35% thanks in part to the streamlining of data interpretation. Total annual cost savings were $608K in work hours.

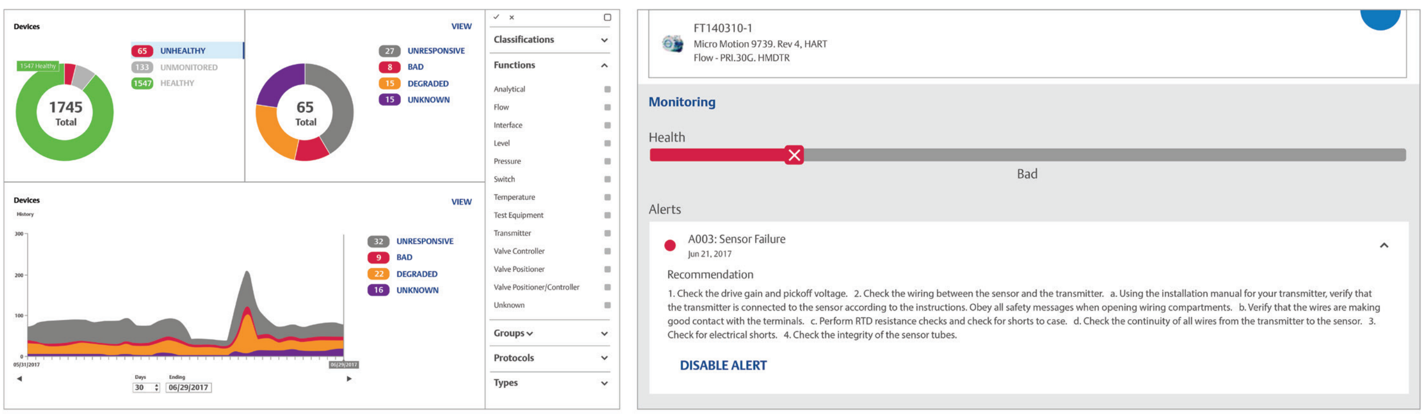

Figure 1. Having a tool to assist in finding nuisance alarms and either eliminating them or improving them saved the team time and effort.

Finding is Good. Correcting is Better. Reaping the Returns is Best.

The team analyzed and improved device alerts. For example, the team found a sensor that initially alerted for sensor open, sensor failure, device malfunction, more status available, device variable alert, and maintenance required. After situational analysis was complete, that same sensor was adjusted to generate alerts for only sensor open and hot backup active.

Across the board, not only were device alerts reduced on average by more than 60% and tag alerts by 48% (Figures 2 and 3), but the meaningful alerts became much more apparent and action was more easily understood. Note that the blue lines in the figures show the number of daily alerts without reduction-project improvements. Operations and maintenance naturally improved when the alerts shrank, as shown by the green line.

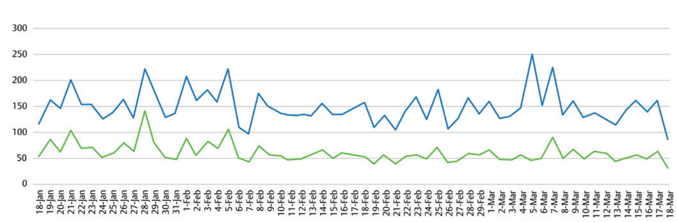

Figure 2. At the end of the project, results showed a 60% reduction in device alerts each day.

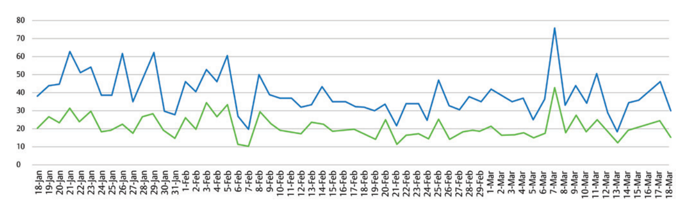

Figure 3. The team reduced tag alerts by 48%.

In addition, the alert categories were enhanced so that the maintenance group could better organize and prioritize maintenance tasks. All results led to a more efficient implementation into the facility's maintenance workflow.

The optimized workflow for maintenance resulted in daily, rather than weekly, device alert review that required 10 minutes rather than 90 and caught issues at an earlier stage when correction is critical. In addition, maintenance correction orders now included the device location, recommended actions, and serial numbers.

Overall, the facility found significant annual control-valves cost avoidance, device alerts reduced on average by 82%, and tags in alert reduced on average by 71%.

Three Key Elements to Creating a Sustainable Reliability Program

A reliability focus helps life sciences organizations drive efficiency and deliver critical medicines to patients.

Life sciences companies operate from a unique position in manufacturing. They are tasked with adapting operations to provide access to therapies that not only enhance but, in many cases, save lives. Continuous improvement is essential because life sciences operations must keep pace with the increase in aging populations across the globe.

At one large-scale bulk drug substance facility, the reliability team needs to carefully monitor reliability and availability to maintain the peak efficiency necessary to fulfill the needs of patients who rely on the plant for essential medicines.

When the plant opened, product demand necessitated a 12-day cadence for production. Today, that pace seems almost lethargic compared to the 4-day cadence operations currently runs. As demand for product has increased, plant staff has been expected to make more product with the same amount of equipment, and that pace continues to increase. The plant is currently working toward a 3.5-day cadence.

What the organization has achieved is not "the impossible." With the right focus and dedication, any organization can not only meet high standards for reliability, but also begin setting them. Three key elements of the organization's reliability program should be critical considerations for any organization trying to get a strong reliability program off the ground.

Element One: Corporate Culture

To reach a 4-day cadence, the team needed to develop a sustainable corporate culture around reliability. Success meant having everyone on board, from the highest levels of management to each employee on the plant floor. Creating this culture began with performing site and equipment criticality assessments and using the results of those studies to develop short- and long-term goals for reliability improvement.

Generating Buy-In

The reliability team focused heavily on staff outreach to encourage buy-in at all levels of the plant. The site champion offered regular presentations to build awareness of the move toward a reliability culture. These presentations were coupled with monthly reliability forum meetings, where the reliability team presented failure rate statistics and showed staff the results of condition monitoring. As time went on, staff could see these values improve and began to see that a commitment to reliability monitoring meant that problems impacting their workflows were being addressed, ultimately saving them time and frustration.

Key personnel also built support within management. The reliability team delivered regular reports to management detailing reliability metrics on failure rates for different plant areas. Those numbers would frequently make their way up the management chain, often all the way to corporate management. The metrics showed the direct connection between high failure risk and decreased efficiency, illustrating for management that the reliability initiative was directly tied to cadence goals. As the program began to mature, management could see the results, increased efficiency, and profitability of continuing on the reliability path, and became strong champions for the program across the corporation.

Element Two: Dedicated Resources

In many cases, when a plant undertakes a reliability effort, management simply asks the maintenance engineer to add reliability to that individual's other tasks. Starting a reliability plan in this manner is setting it up to fail. The reliability team knew that reaching a 4-day cadence would add some new job duties for many people on the plant floor; however, the team ensured that new duties were spread across multiple individuals, and that those same people had access to the equipment and training they needed to make reliability work.

The Right Tools

The first step to increased efficiency was putting the right tools in the hands of technicians. Emerson wireless vibration monitors and wireless acoustic monitors were placed on critical equipment throughout the plant to ensure that no deviation is missed on any of those machines. To supplement that constant online monitoring, less critical equipment is monitored using AMS 2140 handheld machinery health analyzers during regular rounds.

Collected automation data is a key lever for efficiency. All information is analyzed using the DeltaV™ distributed control system (DCS) and multiple installations of AMS Device Manager, coupled with AMS Machinery Health Manager. The reliability team has quickly learned that smart diagnostics are critical not only in helping perform predictive and preventive maintenance, but also to avoid unnecessary maintenance on sensitive items such as valves, helping eliminate the chance of unintentionally introducing problems where none existed.

Helping Staff Help Themselves

A key part of improving plant reliability was offering training to help people be prepared to use their tools and their critical-thinking skills on the plant floor. The reliability team offers certified reliability training to plant personnel and encourages cross-departmental training to help people understand how their efforts impact other groups.

Not surprising, as personnel began to see results from reliability programs, the training became quite popular. Currently, the plant has more training volunteers than seats in the training room to accommodate them. It did not take long for the staff to understand that the more they learn, the easier their jobs become.

Element Three: Understand How Small Wins Help the Big Picture

Getting an organization to support a reliability program means identifying small wins and drawing attention to them. Small wins on the reliability spectrum are the bread and butter of reliability-based efficiency improvement. Celebrating these wins is crucial to driving momentum for a reliability culture.

One area in which the plant saw big gains early in its reliability program was planning and scheduling. The reliability team set out to understand plant processes and find the right maintenance strategies to improve predictive and preventive maintenance in those areas. Key to success is knowing the correct mean time to repair for each piece of equipment. Knowing how long repairs should take and comparing those averages against actual field repairs can be very revealing. If repairs are taking too long, it is essential to determine why:

- Do technicians have the right tools?
- Do technicians have the right parts?
- Is there a recurring problem that the technicians are missing?

Another change that had a significant impact on plant efficiency was having maintenance and repair operations (MRO) in order so that technicians are prepared for problems as they arrive. Critical components to have in place are:

- Storeroom organization and restock policies
- Detailed repair procedures in easy to access locations
- Thorough training for staff
- Adequate staffing for each job
- A clean, up-to-date, and fully functional computerized maintenance management system (CMMS)

Such changes may seem insignificant, but they have helped the reliability team achieve more than 98% schedule adherence in planning and scheduling. The team also managed to eliminate approximately 400 hours per year in wasted work time. This improvement translates into real world results.

Sustaining the Momentum

To maintain momentum, the organization performs business continuity planning every year. The corporate group lays out strategic products that are critical paths, and the reliability team performs a high-level FMEA of site processes around each of those products. A gap analysis tells the team where there are risks and what they need to do to ensure that they can meet production and delivery requirements.

If an organization understands its failures and failure recovery, processes will be back up and running before they impact performance. Understanding of these concerns will also naturally lead to prevention of catastrophic failures in many cases, as the organization will fix small problems before they develop into large ones. Small changes have played a big role in the organization's ability to maintain 97% plant availability.

Why Pursue Reliability in the Life Sciences?

Life sciences organizations strive to demonstrate excellence in reliability in order to meet the goal of constantly innovating so that they can provide more and better medicines to patients in need. When these organizations run a lean, reliable business, they gain the capacity to invest in new research and development to deliver life sciences innovation. A strong reliability plan is key to a central focus on serving the patients across the globe who rely on life sciences organizations for lifesaving and life-enhancing medicines.

A Rapid Response and Recovery from an Unexpected Shutdown

Completed installation in a weekend.

Avoided potential safety issues.

Replaced failed protection system before deadline.

A U.S. petrochemicals and specialty chemical facility produced 60,000 barrels per day. Th refinery drove operations to minimize production downtime and maintain reliable machinery function.

While down for a turnaround, the controls team decided to perform preventative maintenance on the vibration protection system. Examination showed that at least one card in the monitoring system was completely dead. The team could not proceed with diagnostics because the system would not communicate. Restart timing was threatened because without the vibration monitor, they did not have diagnostics to tell them if operating the compressor would be safe.

The facility's team requested service for the vibration monitor, but the original manufacturer did not answer the call for assistance.

Teams Come Together as Hidden Issues Arise

The refinery turned to one of Emerson's impact partners for assistance with a quick return to operation. The impact-partner team located an AMS 6500 ATG protection system to replace the other manufacturer's vibration monitor and brought in an Emerson installation expert.

Only three days from the refinery's first phone call to the Emerson partner, the parts and personnel were ready to replace the monitor and perform testing. During commissioning of the AMS 6500 system, Emerson detected that the surrounding machinery had issues that had been masked by the previous monitoring system.

While Emerson's team commissioned the monitoring system, the refinery team used the down time to their advantage to perform maintenance on the other machinery issues.

Starting Up with Time to Spare

The refinery and the Emerson teams collaborated and completed the installation over a weekend. Because the solution was commissioned and complete before planned, the facility began production ramp up earlier than expected.

Day-to-day maintenance work also became easier for the team because the 6500 ATG protection system software interface was the same for the AMS 2140 Machinery Health Analyzer, which they regularly used for route data collection and analysis.

Moving forward, the facility plans to connect the AMS 6500 ATG protection system with AMS Machinery Manager and use embedded predictive diagnostics to better monitor the compressor.

"During commissioning, some components needed replacement. Although the job was not in the original scope, Emerson finished it without delaying startup. Installation went so fast we had extra time."

— DCS Team Leader

Stepping Up to Reliability

A step-by-step guide to improving and centralizing asset performance maintenance.

Global specialty chemical manufacturers employ a wide range of people, processes, and equipment, making them an obvious place to find subject matter experts (SMEs) and to start new initiatives. When one large specialty chemical company realized that maintenance had become ready for improvement, the reliability team was mobilized to develop a game-changing capital project initiative.

The new initiative has been wildly successful. Not only has the organization streamlined maintenance and dramatically improved predictive technology at a key facility, the reliability team's site has also begun the process of operating as a maintenance hub: providing expert services to other sites across the North America region. This centralized maintenance plan allows the organization to lower costs by eliminating third-party service contractors and delivering more objective, company-centered, holistic support.

Success is never simple, however, and the reliability team has learned many new strategies along the way. Specifically, there are four key steps that were critical to the current success of their capital project initiative. Following these steps should help any organization looking to improve reliability, regardless of size, budget, or industry.

Step One: Assess What You Have

Knowing where to start is often the biggest obstacle keeping large scale projects from getting off the ground. Taking stock of available resources takes the guesswork out of starting a project. Successful initiatives are built on a strong foundation.

The project team started by gathering utilities data from different units across the facility so that the organization could provide metering in order to bill individual production units. This utilities data was transmitted using a *Wireless*HART® network.

Having the *Wireless*HART network in place opened many options for improving reliability. The network covered the majority of the site, which delivered the capacity to transmit critical data over long distances, and to collect that data in a single, centralized control center. This was where the project team caught the first glimpse of what their endeavor would eventually become.

An additional established asset that proved to be critical to success was a strong relationship with both the IT department and the automation supplier. Taking advantage of IT's expertise allowed the team to leverage that group's knowledge and skills to design, secure, and test multiple local area network (LAN) and wide area network (WAN) configurations, opening options for the growth of the reliability program.

The team's relationship with its automation supplier, Emerson, also proved to be a critical foundational element for the project. The reliability team chose to work with many products from the same supplier because doing so delivers seamless integration. Individual components of the automation system were designed to work as an integrated whole, so the team never had to worry that complex project design would compromise success. This allowed the project to expand from plant-wide, to facility-wide, to region-wide.

Step Two: Decide What You Can Do Right Now

Once the reliability team had taken stock of its resources: an established *Wireless*HART network, strong IT infrastructure and support, and easy automation integration, the next step was to use that information to determine and implement the scope of the reliability project.

The organization spent a lot of time and money sending SMEs to take samples in the field, bring those samples back, and download and review the data. SMEs spent far more time collecting data than they did analyzing it, simply because of the time involved in collecting data over a large facility. Project personnel wanted to spend less time collecting and analyzing samples. Working with the automation supplier, the team implemented tools and strategies that let software take care of some of the anomaly conditions around the facility.

To meet those goals, the organization installed an asset management solution using AMS Device Manager and AMS Machinery Manager to communicate with the AMS 6500 Machinery Health Monitors and AMS 2140 Machinery Health Analyzers that technicians use to collect data. This allowed the maintenance team to collect data more quickly—in many cases automatically—and to analyze it more efficiently.

To be more proactive in the front end to get a better level of service, the reliability team also implemented Plantweb™ Optics. A part of the Plantweb digital ecosystem, Plantweb Optics is an asset performance platform that enables automated workflows—helping to bring new insight into the health and performance of assets, ultimately allowing teams to focus on exceptions to make better decisions faster. Plantweb Optics functions as a reliability switchboard, collecting asset data from the plant's device manager and machinery manager, and using that data to deliver easy-to-interpret device health notifications to the right people at the right time.

Using an asset management platform provided a wake-up call that wasn't always comfortable. After initializing the system, the team discovered that more than 70% of assets had less than 60% health. Because SMEs were previously spending so much time taking samples, much of the information that could have been gathered from those samples and used to improve asset health was lost or unnoticed before the equipment displayed serious problems.

Automated, persona-based delivery of device health is changing that paradigm. Now, as soon as device health reaches a specified threshold, stakeholders are notified—in the control center or in the field—by the asset management platform. This allows more efficient coordination of work schedules, technician hours, ordering of parts, and other elements of the maintenance process. Users have the right information when they need it, and can spend time fixing problems, rather than finding them.

The new reliability program has also helped the reliability team meet the goal of more accuracy in trip detection. For example, the fan motors on boilers are variable speed driven. During startup, there is significant vibration, but when the fans come up to speed, that vibration levels out. In the past, this was an issue, because a specific vibration reading at slow speeds may be normal, but the same reading at high speed may be quite serious.

The only choices used to be either put up with nuisance alarms, or shut the alarm off entirely and risk an unexpected failure. However, the new system provides more options. Instead of having a technician randomly collect a sample at 75% speed one day and at 20% speed another, the team has set automatic sample collection based on load. This more granular control not only delivers more accuracy in collected data, but also allows the reliability team to collect more samples across a wider—but controlled—range of conditions, opening the door to trending of data.

Step Three: Build on Success with Pilot Programs

For the reliability team, the success of the capital project initiative is only the beginning. Now that the facility is operating with greater efficiency and reliability than ever before, the team is beginning to increase its reach to expand these successes to other sites throughout the region as part of a second project phase.

To be of service to other sites, subject matter experts at the primary site must be able to perform as well as or better than the third-party vendors the remote sites are already using. As organizational insiders, the internal reliability team can offer service customization that third-party vendors simply can't match.

Remote service began with expanding the reliability team's reach to two facilities in nearby states. Working closely with the IT department, the team extended its process data network (PDN) across the corporate WAN to collect asset data from AMS 9420 Wireless Vibration Transmitters at both locations.

One facility originally needed an energy monitoring solution like the one the reliability team implemented in the primary plant. Because the equipment and *Wireless*HART network used to implement that system were nearly identical, it was possible to add those assets across the WAN to the central monitoring center. With this connection configured and verified, it was very easy to then add vibration monitoring elements in the remote location, allowing the team to contract that service as well.

At the other out-of-state facility, remote monitoring started with vibration. Extending the PDN over the WAN to monitor vibration at the remote facility allowed the central reliability team to show the value of its services. As a result of this success, the remote site extended its contract with the central reliability team to cover energy monitoring as well.

When SMEs detect a potential failure at either site, they can talk with planning to coordinate work schedules, then mobilize technicians and order parts. Ultimately, they reach out to the remote plant and notify them of the problem and its solution, then arrange for a technician to perform the repair.

Extending the PDN to include other sites monitored centrally is streamlining service, increasing efficiency, and saving money; however, the team has seen other benefits that are not as obvious. As they perform more vibration and energy monitoring across the region, SMEs collect more valuable data that the engineering group can use in big data and analytical projects.

With the data from these projects, the organization is already using internally developed analytical models to monitor chillers and air compressors. The infrastructure of networks, servers, and data historians that has been put in place as part of the initial capital project initiative directly feeds these analysis engines that are essential to growth.

Step Four: Plan for the Future

The initial capital project doesn't stop with the successes of today. Extending the PDN to allow centralized monitoring of two plants in the region is exciting, but the central reliability team's goal is to provide services to the entire North America region.

The reliability team is building a collection of subject matter experts on every technology in the central location so that one day, the other sites will never have to worry about where support will come from. The team plans to provide video assistance to remote sites as soon as they can get the technology in place. SMEs monitoring remote sites from the central location will be able to work with maintenance technicians on location via video conferencing, so sites won't have to wait for a more experienced technician to travel to their plant. This will both speed repairs and quickly expand the network of experts, as technicians across the continent will gain valuable hands-on experience working directly with SMEs from the central monitoring center.

In addition, the team plans to use Plantweb Optics to run the facility's variance program. The collaboration tools available in Plantweb Optics will assist operators with their rounds. Users walking through the plant will be able to take pictures of problems they see, and be sure that the notification of the problem will be routed to the right people. Whether a user spots a trip hazard that needs to be resolved, an outage on a light post, or poor drainage and standing water on a walkway, it will be fast and easy to route the problem notification, along with a picture of the problem, to the people who need to know.

Making Things Happen

Tackling a capital project initiative was no easy task, but the results speak for themselves. The reliability team's desire to function as a beacon—operating the central reliability center as a hub for the entire region—is quickly becoming a reality. Critical to making this happen has been demonstrating the benefits of a strong predictive maintenance program for colleagues across the continent. The organization continues to strive to always have the best possible asset health. At the heart of this goal is quick dissemination of data and rapid, organized response. The team needs to prove to customers and potential customers that it is providing a quality service, and that quality starts in the central facility. By leveraging the tools that they initially had available, coupled with new tools that have become available only recently, the reliability team has revolutionized the way the organization cares for its assets, and is ready to roll that success out to the entire company.

Peak Protection During Peak Hours

State-of-the-art protection system helps energy company keep the lights on.

Every company has critical equipment it relies on to perform day-to-day operations. For power companies, this equipment tends to be the turbines that are responsible for supplying energy to the grid. Organizations constantly rely on these essential components; however, they are most critical in peak seasons, such as the surge that comes with running cooling systems in the summer. At these peak times, both equipment and the people running it are under more pressure than ever to provide peak performance.

One North American company operating a plant producing energy in the United States generates power by burning natural gas and then recovers the energy from the hot exhaust gas to generate additional electricity and meet peak demand. Ensuring that nothing goes to waste, the organization then provides low pressure exhaust steam from the steam turbine to a local chemical manufacturer for its use, resulting in very efficient creation of electricity.

The Need for Reliable Equipment

The commitments that the energy company has made to consumers and its chemical partner require that the organization's most critical assets be monitored at all times. An undetected flaw in the system could be disastrous, with a potential result of a critical turbine failure, causing long outages and requiring expensive repairs.

In order to avoid the dangerous results of such a flaw, the reliability team relied on its initial machinery protection system for decades. Though the system was old, the plant's skilled operators and technicians knew its quirks and limitations, and were able to accommodate them. However, when the manufacturer of the protection system notified the team that the system had reached end-of-life and would no longer be supported, they knew they had to find a replacement.

Making the Change

Fortunately, the reliability team had been in the process of making a switch to different vibration analyzer years before the end-of-life notice arrived for the legacy machinery protection system. The organization had already purchased several AMS 2140 portable analyzers to allow additional functionality in route-based data collection and to deliver snapshots of vibration data to analysis software. The team had been very happy with this equipment, and already had a good deal of experience with its operation.

In addition, the organization was in the final stages of selecting Emerson's Ovation™ distributed control system (DCS). The timing of the two decisions meant that the team would be able to implement the new control system and the new machinery protection system in the same year. They knew that integration between two Emerson products would be seamless, which meant the transition would be as simple as possible. As a result, the organization decided on the AMS 6500 for its new machinery protection system.

Seeing the Benefits

Making the move to a new protection system allowed the reliability team to have a common supplier for both protection and predictive monitoring solutions. This means one point of contact for nearly all machinery health equipment. The primary benefit was an increase in speed of response to service issues; the reliability team no longer had to figure out exactly who to call when they had a question. The team also simplified the path to rapid service. Emerson is intimately familiar with the system's configuration and capability, as they were part of the design and implementation process. When a problem presents itself, the responding technician doesn't have to spend precious time becoming familiar with the system.

The adaptability of the new machinery protection system allowed the power company to keep its existing sensor system in place; as a result, the organization was able to save money on implementation and installation. The reliability team also saved a great deal of time not having to plan and install new sensors.

Close work with the automation supplier during implementation also presented less obvious benefits. Working closely with experts who knew the systems they were implementing rubbed off on operators and technicians. The opportunity to work with these experts, coupled with the ease of use of the new system has made some of them feel that, even after only a short period of use, they are more knowledgeable about the new system than they were about the previous one.

More Data for More Transparency

Another key benefit the reliability team noticed immediately after the upgrade was the ability to easily connect to the raw data ports on the AMS 6500 and use machinery health software for review and historization of predictive data such as waveforms, spectrums, shaft orbit, and shaft centerline plots. The team has access to far more data than they ever had before, and it provides the flexibility they need to monitor turbines much more closely.

The reliability team also added a Modbus TCP interface to the DCS in order to improve visibility for the protection system. Now, operators can see sensor health and all the trip points in the shutdown system right from the DCS in the control room, an option they did not have with the legacy protection system.

Finding Hidden Problems

Most importantly, implementation of the new protection system expanded visibility of critical assets, alerting technicians to a serious problem the previous protection system had been missing. In the decades it had run, the previous system had never detected a problem with the rotating equipment. Within the first week of activation, the AMS 6500 successfully tripped (protected) the unit.

During a common startup situation, the protection system detected high vibration on the large shaft attached to the turbine blades. The shaft had bowed from the weight of the blades while the unit was not in operation. Technicians were able to fix the problem by extending the time on the turning gear and then performing a monitored standard startup. Had the unit been allowed to start with a bow in the shaft, the machine could have torn itself to pieces causing hundreds of thousands of dollars in loss as a result of downtime and repairs.

Additionally, the organization is also seeing issues in its hardware that the reliability team couldn't detect with the legacy system. Since implementation of the new protection system, operators have noticed a channel alarm that they are in the process of isolating. The problem is likely due to a field wiring or sensor issue that the team can easily repair; however, the previous system didn't identify the problem at all. Now that the team has notification that an issue exists, they can track it down and fix it.

Going Forward

The implementation of a new protection system at the power plant has shown just a small glimpse of what can be done with the new maintenance systems. Having implemented such a robust system, the organization is now positioned to easily and cost effectively add even more features that will help predict hardware failures. The reliability team plans to add continuous online monitoring, allowing them to track PeakVue™ waveform data for determining the exact health of all equipment at any time, and providing the data necessary to make sound business decisions about when to bring equipment down for maintenance. The team can also add performance monitoring, which will deliver the ability to track the efficiency of turbines.

Peace of Mind

While the identification of a fault in the turbine system potentially saved nearly $30M in production losses, the true value comes in the peace of mind gained by knowing that the organization's employees and its critical assets are always protected by a state-of-the-art vibration monitoring and shutdown system. Even though the organization has great people on site who are qualified to call shutdowns on devices, the most skilled operators can't be available all the time to make the call, and even the best people make mistakes. With the protection system in place, the organization doesn't have to worry about having someone make the wrong decision. No matter who is on site, and no matter what the incident, the team can feel confident knowing that if there is a problem, their Emerson systems are protecting their critical assets.

Using Tools You Might Already Have to Avoid Compressor Failure

What's a gold mine? Simple. Rediscovering a tool in your garage that you had forgotten about or looking at a well-used tool and repurposing it for another function.

They might seem small, but these kinds of finds in an industrial setting can be significant wins. If your facility uses handheld machinery health analyzers and specialized software (such as Emerson's PeakVue™ methodology) to determine valve health, you probably have the tools you need to assess compressor leak detection and health. You have the power — starting now — to cut down on consultant visits, improve machinery efficiency, and avoid unplanned shutdowns.

A new application of existing tools can simplify processes for technicians, without expertise in analysis, to determine compressor leaks by using vibration analysis tools and techniques.

Recognize the Situation

If a compressor's efficiency is low, it might be experiencing blow by, which could happen as the result of worn piston rings or poor seals. Without specific data, however, you don't know the degree of damage and you can't be sure if you should schedule a shutdown. As a result of lower compressor efficiency, your process will suffer.

Regular expert consultant visits to assess compressor health can bring value at the time they occur or if they can predict machinery failures, but your facility might be experiencing compressor inefficiency between those visits. Performing the data gathering and analysis in-house could be your solution.

Repurpose Your Tools

In traditional machinery route data collection and analysis, a technician uses a handheld machinery health analyzer to gather machinery vibration data and analyze conditions. In general, the handheld enables a facility to monitor a broad range of machinery from variable speed equipment, complex gearboxes, and high-speed compressors. Then the specialized analysis software traditionally takes that data a step further to filter out traditional vibration signals to focus on impacting.

With inventive use of data and analysis tools, a maintenance team can use the machinery health analyzer and the specialized analysis software to discover whether gas is escaping a compressor and then assess the mechanical reliability of that compressor.

This new method looks at analysis software from a different perspective, by examining high-frequency flow turbulence instead of an impact event. In this situation, analysis software is used to gain a kind of ultrasonic reading for vibration.

The specialized analysis software then uses the route data to give a deeper analysis by generating a polar plot. Simply looking at the plot, a technician without vibration analysis training can see if something in the compressor had changed for the worse (Figure 1).

After collecting the data and reviewing the plots, the technician can perform preliminary troubleshooting and can work with the maintenance team to call in an expert if needed. In short, this procedure produces information that gives field technicians an early warning to avoid an unplanned shut down.

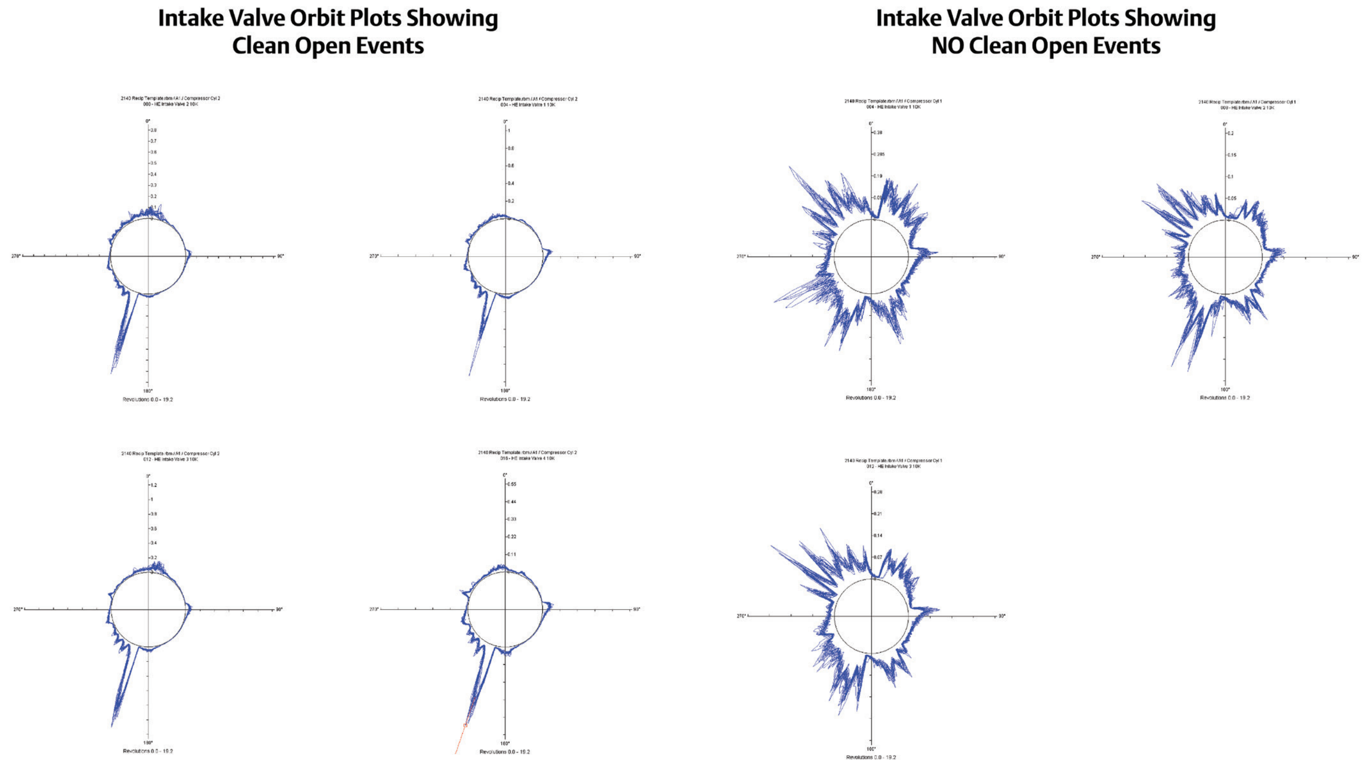

Figure 1: The polar plot on the left shows healthy compressor-valve operation with clean open signatures on both intake and exhaust events (intake only shown here). The signature on the right indicates leaking rings or gas blow by — as seen by the limited crisp open events, among other indicators.

A Real Success Story

Each quarter, a chemical manufacturer in the United States invited a consultant to collect and analyze data about the health of their reciprocating compressors. But the maintenance team noticed that compressors had issues between the consultant checks.

The team knew that if they could predict machinery failure and schedule shutdowns, they would not need to run compressors until leaks and bypasses sapped compressor and process efficiency. Their goal for a reciprocating compressor assessment method was to add no additional hardware or software and use no additional expertise.

As they considered using the new technique, they wanted to be able to compare the new-technique results with traditional methods. The facility asked a consultant to perform a traditional recip trap test using the traditional industry tools. That consultant group provided a full analysis and report.

Then the manufacturer used their own machinery health analyzer and the specialized software to perform the new technique. They then compared the consultant's results to the results obtained using the new technique. The results mirrored those of the traditional recip trap analysis.

The outcome proved to the maintenance team that from a mechanical reliability standpoint, they had all the tools they needed to obtain the same accurate results as was provided in the traditional programs.

Potential Savings

The company now performs their own data gathering and analysis with the same route tools they have successfully been using for years.

Driving toward Fewer Surprise Shutdowns

In an environment where one asset failure can mean hours or even days of downtime and lost revenue, predictive maintenance and well-planned machinery health management play key roles in helping assure that production continues even with ever-present potential failures from machinery vibration. Fortunately, today's predictive maintenance strategies and technology can provide immediate returns on investment.

Process uptime and planning are critical factors for any facility but are especially critical when two automobile production lines depend on each other for materials.

Recently, a significant asset failure at an automotive facility inspired a team to investigate remedies that would give more advanced warning of failure and found return on an initial investment in fewer than 24 hours after installation of the solution. Since then, the facility has avoided continued asset failure and days of downtime. Better vibration and machinery health monitoring assisted in other areas of the plant in equally significant and surprising ways.

Collaboration is Key to Consistent Production

The production line is split into several main production areas, including press and plastics as well as a paint shop. Beyond the process areas, the facility includes utilities and power generation.

The production areas must work together in perfect concert to maintain the line as a whole. Plant personnel form solid teams that encourage collaboration. These partnerships and consistent production are integral to success because parts made in one area are used immediately by the next.

If one of the production areas goes down, a limited number of spare parts keeps the main line moving while engineers rapidly fix the problem area before a parts outage causes a main production line shutdown.

A Fine Resolution Uncovered Small but Significant Vibrations

One day during regular operation in the press and plastics production area, a press machine seized triggering an unplanned 56-hour shutdown. The outage provided an immediate opportunity to explore condition-based monitoring. After testing a variety of vibration analysis options, the team found that most could not adequately monitor the vibration conditions due to the forceful stamping of the press.

> To uncover the source of the problem, Emerson's PeakVue technology provided fine enough resolution to enable the team to zoom in on the areas of gearbox vibration between press impacts.

The team sought and found a solution — Emerson's PeakVue™ application — that filtered out the noisy stamping vibration signals to focus on impacting. Impacting is a good indicator of the overall health of rolling element bearing machines in general and, in this case, the press machine.

PeakVue technology enabled the team to analyze circular plot drawings that filtered out repetitive stamping vibration of the press over a long cycle and showed the developing bearing issues. The graphs preserved the peak amplitudes of stress waves that the defective bearings in the press machine gearbox were emitting.

Results showed that for each minute of the press working, there were 12 press impacts. Special software then assisted by filtering the data and producing high-resolution information that enabled the team to see the gearbox bearing issues in detail and found the root cause of the problem.

The AMS 2140 collects route data on the balance of the plant assets while also delivering sophisticated troubleshooting capabilities in the field.

After the gearbox vibration details were seen, issues could be addressed. Now that they are equipped with PeakVue technology, the maintenance team can recognize smaller vibrations growing and are alerted that the equipment might be experiencing problems. Personnel can address the issues before equipment is negatively affected.

News of an Outstanding KPI Spreads

After the press area began using condition monitoring and vibration analysis, other plant areas heard about their success and how they earned the site's best reliability KPIs. The paint department requested a demonstration because they occasionally had fires in fans and were not able to find the source of the issues.

During an Emerson demonstration, the paint shop personnel found a previously undiscovered issue. The Emerson AMS 2140 Machinery Health Analyzer, a portable handheld device, uncovered fan vibrations that indicated three deteriorating bearings.

The paint shop took the fans offline, stripped them down, and saw that the bearings were close to failing, which would have caused unplanned downtime. The early detection enabled them to schedule the time they needed and change the bearings in a planned shutdown.

Success with Predictive Strategy

Now that it's possible to predict failures and be proactive with fixes to the equipment, teams can address issues during planned shutdowns so overall site targets are not affected.

Although the portable handheld analyzers are suited for many vibration assessment tasks, success required more than just a snapshot of conditions. Due to the long lead time for replacement of the critical bearings in the press gearbox, the most effective choice was continuous online monitoring of the press gearbox via three AMS 6500 Machinery Health Monitor systems. The portable handheld analyzer helps anticipate failures in the remainder of plant assets.

Since then the facility has added networked condition-based monitoring software, so that data can be gathered to form a complete picture of conditions. The team can pull information in from sources such as the online and portable vibration-detection tools and use it to perform powerful root-cause analysis.

Building Lasting Results

A return on the condition monitoring investment came in less than 24 hours. Nearly as soon as analysis began for the bearings on the hydraulic pumps and motors of the presses, an issue was found on a hydraulic pump that would have caused a failure and unplanned repair or replacement. Immediately, the pump bearings were changed out and the issues were avoided.

The vibration monitoring has continued to help maintain high quality. For example, during another training session, the team took a rotating sample that showed the equipment had severe enough vibration that it was going to fail. Now after completed training, all shift personnel are fully competent in finding and diagnosing vibration issues on their own. As is so often the case, training is important here because it ensures that the money-saving technologies continue to be used by skilled personnel to gather and recognize valuable information.

After this experience, the facility's teams continue to search for bearing issues, trust the technology, and change out the applicable bearings in a proactive maintenance manner. In addition, since that first day, the maintenance team has checked 264 components and has avoided 15 major breakdowns with significant estimated savings.

The team successfully applied three critical lessons for vibration monitoring success: measure small vibrations early before they adversely impact the process, obtain high-resolution vibration data for early detection, and apply vibration monitoring to areas important to the process success.

Let’s Begin Your Reliability Success Story.

People and organizations strive and succeed each day to keep their facilities operating safely and productively to meet customer and stakeholder needs.

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