

innovations

IN PROCESS CONTROL



SHUTDOWNS, TURNAROUNDS AND OUTAGES

Performance targets are missed on three-quarters of shutdowns, turnarounds and outages, but Emerson's approach reduces the risk of failure. Full story on page 4.



Welcome to innovations

Making a difference

“Emerson’s systems engineering and project management experience were crucial to delivering the project on time, and its technology is now ensuring continued efficient and reliable power generation.”
Giovanni Bonanini, TME Contract Director

Automation technology and services from Emerson have helped ensure the successful start-up and operation of a waste-to-energy plant in Bydgoszcz, Poland. The new plant enables the region to dispose of waste effectively and helps Poland meet its obligations under the European Union’s 2020 climate and energy directive. The municipal waste incineration facility, operated by Międzygminny Kompleks Unieszkodliwiania Odpadów (MKUO) ProNatura, will generate 100,000 megawatts-hours of electricity per year from 180,000 metric tons of household waste. During winter months the facility will also provide an additional

27 megawatts of thermal energy to the local district heating loop. Emerson was engaged early in the project by Aster, a joint venture between Astaldi and TME, with its automation experts providing control system design, engineering and commissioning services. To optimise operations, MKUO ProNatura will use Emerson’s Ovation™ distributed control system to oversee plant equipment and processes, including boilers, steam turbine, water heating system, and balance-of-plant operations.

Learn how the Ovation system can help ensure plant availability and profitability at [EmersonProcess.com/IM921](https://www.emerson.com/IM921)

“Emerson’s integrated and synchronised systems have allowed us to achieve closer process control for increased productivity, giving full visibility of our production processes to our customers and enhancing our relationship with them.”

Johan Desimpelaere, Technology Operations Manager, JSR Micro

JSR Micro NV manufactures a range of polymer based products at its Leuven plant. The company sought a Manufacturing Execution System that could be integrated with the existing control system to facilitate improvements in the KrF and Multilayer manufacturing processes. As part of a 14-month project, Emerson installed its Syncade™ Smart Operations Management Suite alongside the existing DeltaV™ distributed control system. Emerson was responsible for design, engineering, installation, commissioning, testing and start-up. The Syncade system was able to integrate real-time plant

floor data with business processes, decisions and asset management. The Syncade system allows finer and more precise control of polymer production through synchronisation with the DeltaV system. It also allows JSR Micro to offer customers full visibility of the production process with detailed digitised batch records and customer audit trail tracking immediately available, a process that previously could have taken weeks.

Find out how to improve manufacturing execution at [EmersonProcess.com/IM922](https://www.emerson.com/IM922)



Given the critical importance of shutdowns, turnarounds and outages to enable plants to operate safely and efficiently, it is remarkable that 74% of these fail to meet their performance goals. 40% of all turnarounds miss their schedule and or budget targets by 30% or more. On average durations are five days longer than planned, with an average cost impact of \$2 million per day late.

Deficiencies in scope evaluation, planning and implementation contribute to these missed targets. These misses result from issues such as budget and time constraints, lack of skills and resources and insufficient asset health data. This creates unnecessary work, under- or over-ordering of parts, schedule overruns, missed opportunities for technology and process improvements, and trips after start-up.

By ensuring that the scope is accurately determined, work is precisely planned and project execution is streamlined, companies can maximise the efficiency of their plant turnaround. Emerson’s vast experience and expertise can help your plant to achieve these improved targets.

In this edition of Innovations in Process Control we talk about which measures plants can take to extend the intervals between their turnarounds without compromising safety and legal compliance. It explores why turnarounds should be regarded as an opportunity to further improve the return on investment of your capital projects by implementing operational, safety and reliability improvements, and it gives an idea of what ‘the turnaround of the future’ will look like.

Discover how Emerson can help your company to improve its turnaround performance at [www.EmersonProcess.com/STO](https://www.emerson.com/STO) or contact us today via [EmersonProcess.com/Europe](https://www.emerson.com/Europe)

Roel Van Doren
President Europe
Emerson Automation Solutions

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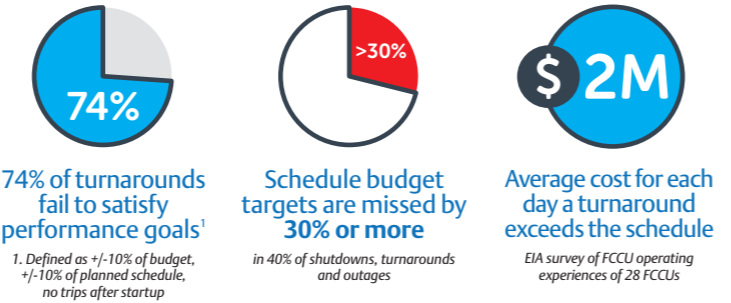
To achieve performance targets there are three areas of difficulty – determining scope, planning correctly and executing successfully.

Reduce risk with your next shutdown, turnaround, outage



Around three-quarters of all shutdowns, turnarounds and outages fail to achieve their performance targets.
Navè Orgad, Director, Lifecycle Services, Europe,
 explains how Emerson can not only help you reduce the risk of failure, but also implement operational improvements to help you achieve top quartile performance.

Shutdowns, turnarounds and outages are the largest maintenance expense for plants and a significant cost increase may occur due to schedule overruns. A US Energy Information Administration survey of fluid catalytic cracking unit operations found that, when turnarounds exceeded scheduled shutdown periods, the average cost was \$2 million per day. With the stakes so high, it is vital that turnarounds are planned and executed successfully. However, a report by Asset Performance Networks states that 74% of all turnarounds fail to meet their performance goals. So what causes such a high failure rate and how can the risk be mitigated?

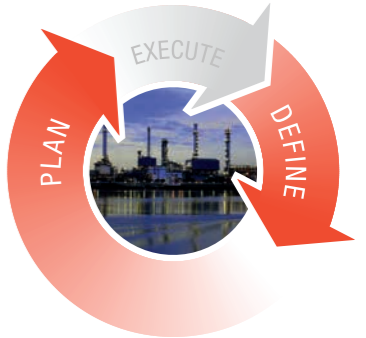


There are three main areas of difficulty with turnarounds – determining the necessary scope of work, planning the project correctly and executing it successfully to achieve time, budget and quality performance targets. Companies often struggle to execute successful turnarounds due to budget and time constraints, a lack of necessary skills and resources and insufficient asset health data and interpretation. Poor scope assessment, such as failing to recognise which equipment needs maintenance and repair, can lead to unidentified issues with critical assets or overlooked processes. Poor planning can cause the schedule to overrun, costing millions of dollars. Poor workmanship during execution can increase maintenance costs and potentially cause a safety incident, unplanned downtime and affect production and profitability.

To help overcome these issues, reduce risk and conquer complexity, Emerson adopts a focused approach, providing confidence that turnarounds will be completed on schedule within budget and meet agreed targets. Early engagement is critical and Emerson’s involvement begins with lifecycle services experts meeting with plant management to set performance goals and business objectives.

Before shutdown, an Emerson team performs a comprehensive plant walk-through. During which they will conduct diagnostic testing, assess the condition of plant assets, predict potential failures and determine which valves, instruments and equipment must be repaired or replaced and also determine the optimal level of maintenance to be applied. This enables Emerson to refine the project scope, support the development of a suitable schedule and provide execution planning expertise.

Emerson can perform a pre-shutdown performance evaluation that identifies and prioritises the plant’s most significant opportunities for operational improvements. These will increase plant reliability, safety and efficiency, provide a significant return on investment and help achieve top quartile operational performance.



During execution, Emerson provides experienced technicians to conduct all necessary repairs and replacements. This is supported by on-site parts and quick shipping services for increased flexibility for unplanned maintenance, providing peace of mind that each phase of the process is performed thoroughly and accurately. Emerson also delivers start-up support to expedite the process and ensure that production is achieved as quickly as possible and avoid setbacks.

Emerson’s strength is its breadth of offering in terms of experienced personnel, extensive planning and execution services, technology used within the project work scope and on-site parts availability. This is backed with Emerson’s track record of successfully completing complex and large-scale turnarounds, meeting targets and implementing changes that create operational improvements.

Visit EmersonProcess.com/IM914 to discover how Emerson can help you achieve successful turnaround planning and execution.

Managing the risk of extending turnaround intervals



Access to asset health information helps in planning turnarounds more effectively. Jean-Luc Goutagny, Director, Reliability Solutions Europe, explains how best practice

reliability coupled with online condition monitoring technologies helps to extend intervals between turnarounds, without compromising plant safety, compliance and operating efficiency.

Extending intervals between shutdowns, turnarounds and outages may be highly desirable and financially beneficial, but achieving this is far from straightforward. Current intervals are governed by insurance, regulatory compliance and warranty requirements. Extensions could compromise these elements, reduce plant reliability and performance and increase the risk to plant and personnel safety. How then do top quartile performers maximise intervals whilst remaining safe, compliant and efficient?

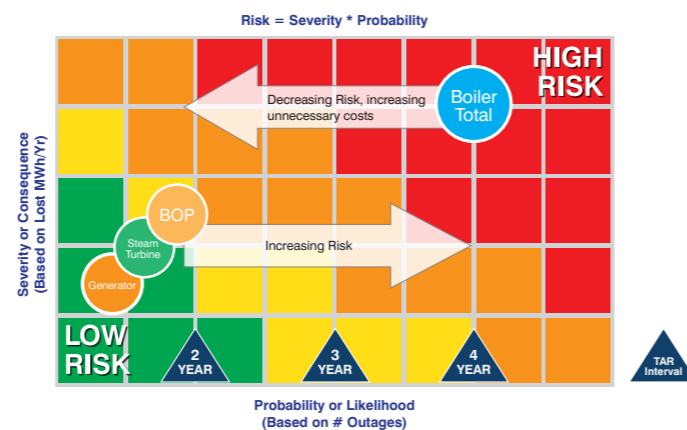
Risk is represented by severity multiplied by probability. There is little control over the severity or consequence of a failure, but the number of occurrences can be reduced by developing processes that focus on maintaining equipment reliability.

To extend interval periods, an operator must demonstrate effective risk management by analysis of asset failure rate data, historic asset condition reports and other data sets. They must also define revised maintenance and reliability strategies and prepare a safety case to justify the extension.

Maintenance procedures must become predictive rather than reactive, with measures to identify potential equipment failures. Emerson recommends a reliability centred maintenance (RCM) and risk based inspection (RBI) approach, together with inspection and condition monitoring to address the potential for equipment

failure. RCM and RBI are analysis techniques which focus on critical equipment and produce a priority ranking for inspection based on the probability and consequence of the equipment failing. This ranking can be used to optimise turnaround intervals, while mitigating risk levels.

Predictive maintenance activities enable resources to be directed where and when they are best needed and allow more effective spare parts management. Sustaining good asset health provides significant cost reductions, with preventive based maintenance 29% less costly than a run-to-failure approach, and predictive maintenance 42% less costly than preventive maintenance.



By continuously monitoring the condition of machinery and automation, maintenance can be performed when indicators show that it is required, rather than at predefined intervals which may introduce potential for increased risk. When plants engage Emerson as a turnaround partner, they can take advantage of our full suite of condition monitoring tools and reliability services. Emerson is uniquely capable of delivering reliability and helping clients move towards top quartile performance, through consulting and engineering, which guide the application of reliability technology and maintenance actions to mitigate failure risks, and extend turnaround intervals.



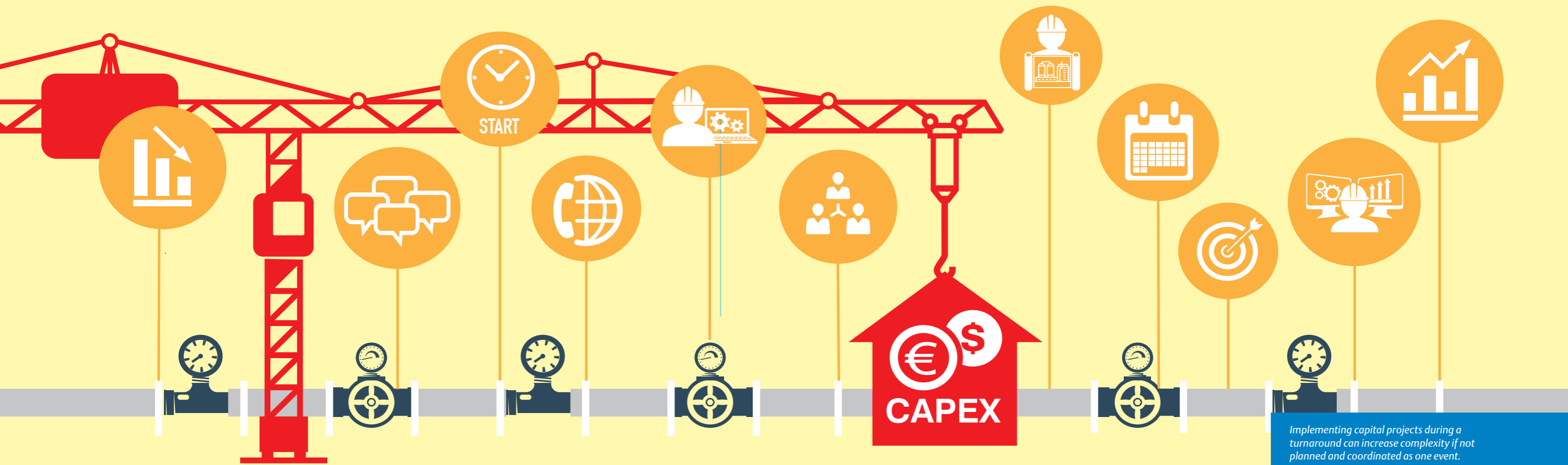
Maintenance must become predictive rather than reactive, with measures to identify equipment failures.

For critical assets such as compressors or turbines, Emerson's online machinery monitoring solution, which combines API 670 protection with prediction monitoring, can help to maintain a safe operating environment and foresee events ahead of the protection system engaging.

Emerson's field device diagnostics solution can ensure that process control devices are monitored and perform advanced diagnostics to enable maintenance to be planned when there is a significant deterioration in performance. Wireless solutions can be provided for remote environments lacking available cable infrastructure.

For assets such as small pumps and motors, Emerson offers a route-based portable solution to collect data and provide vibration analysis for problems such as misalignment and balancing. To gain a holistic view on all assets, combining data from each of Emerson's reliability solutions enables better-informed maintenance management decisions to be made.

Visit [EmersonProcess.com/IM916](https://www.emerson.com/en-us/process/im916) for more on how Emerson can help you safely maximise turnaround intervals.



Implementing capital projects during a turnaround can increase complexity if not planned and coordinated as one event.

Taking advantage of turnarounds to improve operational performance



Shutdowns, turnarounds and outages have traditionally been focused on returning equipment to a performance level close to its original

design effectiveness, but as Marcelo Carugo, Senior Director Global Refining and Petrochemical Industries at Emerson explains, they also provide an opportunity to increase plant availability and reduce operating costs.

The traditional purpose of shutdowns, turnarounds and outages has been to ensure that plant equipment can be repaired or adjusted where necessary, so that it returns to a performance level close to its original design effectiveness, with minimum offline time. While this remains the core reason, this scheduled period of downtime also provides an opportunity to increase ongoing plant mechanical availability and reduce costs through improved operations analysis and control – without having to increase the duration.

Within industries such as refining, turnarounds have become a strategic time when companies implement capital improvements. In most cases this period presents the only opportunity to do these improvement projects. Many CEOs of refineries are currently reinvesting up to 30% of their additional margins in capital expenditure projects for operational, safety and reliability improvements, and implementing these projects without any additional downtime.

Increasingly other process industries are realising the benefits of adding capital projects to the scope of the turnaround.

For many plants, it is during the period running up to a turnaround that budgets for capital projects and improvements are assigned. The required increase in turnaround budget for capital projects can be relatively small, but may have an extremely high incremental return on investment, making it an appealing proposition.

Automation projects

Plant managers should look upon the turnaround as an opportunity to change their requirements and expectations from simply ‘fix it’ to ‘improve it’. The turnaround should be considered as an opportunity to improve the functionality of the automation technology at the plant and provide a platform for sustained incremental additional value, although this should not be to the detriment of the project objectives.

It is important to understand that implementing a capital project during a turnaround can make matters more complicated, if not planned and coordinated as one event. Increasingly, process plants execute larger capital projects during turnarounds, adding to already complex project management and logistical challenges, especially if both activities are considered as separate events rather than coordinated as one.

Adding simultaneous capital projects can make matters more difficult to control due to:

- Resource conflicts - the technicians you were counting on using to install new field instrumentation have been assigned to other tasks.

- Uncoordinated efforts - a group of control valves you were planning on rebuilding are being replaced as part of a new reactor installation.
- Unanticipated issues - your turnaround craftsmen cannot work on one unit because capital project scaffolding is blocking access.

Best practice

Key to the success of this strategy is a systematic examination of the potential improvements early enough in the planning process to permit them to be approved, budgeted and implemented within the shutdown period. Considerations must include:

- Plant/project objectives and drivers.
- Potential enhancements – current and future.
- Establishing the predictable total cost of ownership and total lifecycle costs.
- The risk to operations mitigation.

Emerson not only provides automation expertise and asset diagnostics for turnaround planning and safe execution, but can also identify opportunities to improve operating performance and asset reliability. Emerson considers the customer’s pains and presents solutions, which support the economic justification to implement them during the turnaround.

For more on how Emerson can help integrate a capital project within a turnaround go to EmersonProcess.com/IM915



Wearable technology can connect workers with experienced engineers, maintenance and safety experts.

Turnarounds of the future



Plant managers are always seeking ways to enhance the efficiency and reduce the duration of shutdowns, turnarounds and outages.

Ben Bishop, Integrated Operations Centre Manager at Emerson, looks at some developments that will help shape the turnarounds of the future.

The process industry continues to be challenged to achieve more with less, and turnarounds have gained focus as a target for optimisation. Increasing worker efficiency through collaboration and improved work practices will become vital as skilled engineers retire and plant locations become more remote. Under pressure to optimise availability and maximise profitability, plants will push for ways to safely extend intervals between turnarounds, while simultaneously shortening the duration. Technology advancements will enable smarter turnarounds by creating improvements in the scope definition, planning and execution of projects.

Prediction and machine learning

Improved scope definition requires greater and more accurate asset health data to determine inclusion and prioritisation. Predictive maintenance is already a cornerstone of top quartile maintenance programmes, but it will soon be possible to ascertain, with a high degree of certainty, when an asset will fail and therefore exactly when it should be repaired or replaced. Condition monitoring provides one set of data, but a more holistic approach to equipment health that includes machine data and process performance information, will be used to establish the economic case for servicing equipment. Pervasive sensing

supports plant-wide Industrial Internet of Things (IIoT) and will provide greater insight into machine performance and process performance. The proliferation of sensors will lead to vast amounts of new data, yet plants will have fewer experienced engineers to interpret it. This will force a greater reliance on big data modelling tools, like machine learning, to perform asset data analysis without human intervention.

Reducing complexity

As plants and processes increase in complexity, automation will bridge the knowledge gap created by the loss of experienced workers. Ease-of-use will be fundamental to both software and instrumentation design. In order to reduce the complexity of turnaround planning and execution, plant operators will turn to a single vendor company to support the maintenance, replacement, and upgrade of a greater variety of automation technologies. This will include hardware and software of control and safety systems and the full range of control and measurement devices.

Wearables and industrial augmented reality

Workers performing both pre-shutdown walkdowns and executing tasks during the turnaround will need to be more efficient and effective. The use of industrial augmented reality and wearable technology will help to achieve this. Intelligent digital systems worn on the human body, such as smart helmets or glasses, enable workers to see an augmented reality – computer imagery overlaying

supplemental digital information into their view of the real world. The headgear uses cameras and sensors to collate data about the worker's environment, and can display information to improve task efficiency, such as electronic work instructions and safety advice. This enhanced view enables a non-expert worker to successfully complete a complex task with improved accuracy and speed. These devices also contain navigation technology, enabling guidance to the location where work is to take place.

Wearable technology can also connect workers with experienced engineers, maintenance and safety experts and support staff via a remote Integrated Operations Centre. The technology will allow the experts to see a first-person-view through the eyes of the man on-site, leading to better guidance and specific instructions to complete tasks correctly. The remote expert will even be able to annotate directly in the local worker's field of vision. Leveraging this world-wide pool of expertise increases efficiency and safety, as it permits fewer workers to be required on-site in 4D (dull, dirty, dangerous and distant) locations.

Taking control of your valve maintenance



Valves are critical to safe and efficient plant operation and therefore must be maintained to the highest levels. Sergio Zaghen, Fisher Service Manager at Emerson,

describes how valve monitoring and efficient maintenance is essential to the success of a shutdown, turnaround or outage.

A typical medium-sized refinery will have around 2500 control valves installed. These are critical to safe and efficient plant operation. During a turnaround, efficiency in servicing these devices plays a vital role in the overall success of the project. Unlike most other automation technology, valves come into direct contact with process fluids and are thus subjected to much tougher service conditions, including the effects of erosion and corrosion. If a valve is not performing correctly it affects the control loop and can lead to increased process variability, which can cause process alarms or plant trips, reduced plant capacity and the need to slow down the process or switch to manual operation.

Valve monitoring, diagnostics and maintenance are crucial to continued safe and efficient operation. Many valves cannot be removed whilst a unit is operational, so turnarounds present the main opportunity to perform maintenance and overhauls. In large turnarounds, with limited time and resources to perform the work, identifying problematic loops and pinpointing exactly which valves need maintenance is crucial.

Predictive maintenance

The established method has been to service valves based on their period of operation. Depending on the plant's size and the way maintenance is organised, that could mean 800-1000 valves serviced during a turnaround. That is a significant task and with plants now looking to reduce downtime periods, improvements are essential.

It is no longer necessary to service a valve based on its period of operation. It is possible to use historical data and predictions on future behaviour as the basis for establishing

which valves need servicing. By analysing historical data over a reasonable time period, it is possible to spot trends such as increased or reduced friction, and use this information to pinpoint what work needs to be performed, and what parts are required.

Digital valve controllers and diagnostics software enable users to monitor valve condition and performance online, to collect and trend performance data over time, and to better predict or plan valve maintenance. Valve condition can also be analysed during the pre-turnaround walkdown by various means, including:

- Visual inspection. As simple as this is it can help to determine the physical status of the valve (corrosion, excessive leakage from packing, etc.), as well as operational issues (valve jerking, excessive cycling, etc.)
- 475 Field Communicator – a hand-held device which provides advanced diagnostic and troubleshooting capabilities in the field and on the bench.
- ValveLink™ software – a configuration, calibration, and diagnostic tool that allows maintenance and operations personnel to monitor valve health and performance online and spot problems before they affect the process.
- Valve Seat Leak Detection – this requires a valve to be closed for a short period of time, but with pressure maintained to one side of the valve. This method can quickly locate and accurately quantify through-valve leakage on valves that cannot be stroked during the walkdown.

Expertise in execution

Having identified which valves need to be repaired or overhauled, the work must be performed efficiently and to the highest standards. This means not only ensuring that the right parts and tools are available, but that the workers carrying out the servicing have the necessary level of experience and expertise. And when valves are returned into service, those workers must ensure that they are ready for start-up. This includes optimising performance, setting up meaningful alerts, and establishing a baseline reference for future troubleshooting.

Visit EmersonProcess.com/IM905 for more on how Emerson can help you with the monitoring and maintenance of your valves.

Using historical data and predictions on future behaviour can now form the basis for establishing which valves need servicing.



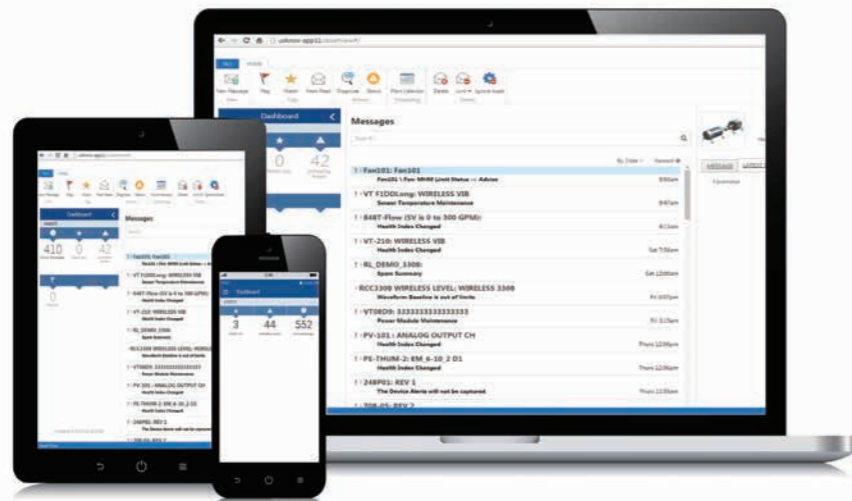
Innovative technologies

Knowing the health of key assets facilitates efficient shutdown, turnaround and outage planning

Process facilities rely upon asset health information to help them make better-informed maintenance management decisions, which is crucial when it comes to effective turnaround planning. Gathering that information is not a problem – in fact, today’s plant personnel can be overwhelmed by data. The key to facilitating better maintenance decisions is to have an effective means of ensuring that from this flood of statistics, appropriate information is quickly delivered to the people who need it and can act upon it.

Emerson’s ARES™ Asset Management Platform helps to solve this challenge, as it marks a shift away from managing data and toward acting on information. With ARES, performance and health information from key field assets is always available, and it enables users to quickly and easily view that data.

ARES collects the information from multiple sensing technologies, offering users a holistic view of the current health status of plant assets. Asset View, a messaging application for ARES, delivers



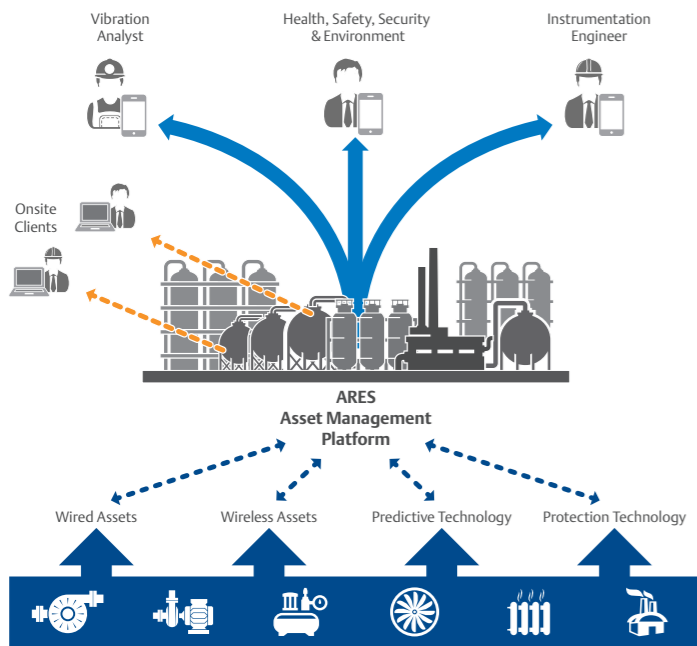
asset health status and alerts in relevant time, providing notifications that are pertinent to a user’s responsibilities and the criticality of an individual asset. This allows users to quickly determine the urgency of an issue.

ARES allows users to securely access and share key data, with asset health summaries available on traditional desktop PCs, laptops, smartphones and tablets, either inside or outside the plant.

With Asset View, ARES users can immediately see what is happening in the plant from anywhere in the world. Both the mobile and PC/laptop applications provide identical asset dashboards. Users can collaborate by flagging assets and sharing messages, images and documents, and work together to resolve asset health issues before they become production issues.

By providing a secure, flexible and easy-to-deploy platform that communicates with many types of assets, ARES ensures that asset health is published and available to all with minimal effort and in relevant time.

Visit EmersonProcess.com/IM907 for more on how ARES can provide quick and easy access to asset health information helping turnaround planning.



Mobile service centres increase turnaround efficiency

Despite extensive planning, turnarounds always produce unexpected and last-minute equipment, maintenance and replacement requirements. If these are not resolved quickly and efficiently, they can endanger the project objectives, potentially extending the downtime period and increasing costs. To help overcome this, Emerson provides mobile service centres to support all turnaround automation, control and instrumentation maintenance requirements.

The mobile service centres are portable work units that include a range of tools, spare parts and replacement devices. Each service centre is customised to meet the needs of the project, and is stocked with the appropriate equipment based on the scope previously defined during turnaround planning. They also provide a safety net, with additional devices and a host of parts on hand should they be required.

The containers remain on-site throughout the turnaround with the aim of increasing maintenance efficiency and

providing responsive assistance. They are linked directly to a network of service centres and factory inventories, so that should a part not be on hand, it can be accessed and delivered much faster than through the normal procedures.

The mobile service centres are staffed by experienced Emerson service engineers, who carry out repairs, adjustments and recalibrations. Diagnostic equipment enables the service engineers to evaluate and prioritise devices that need attention. The mobile units are self-powered and each has internet access, allowing service engineers to access specifications and technical drawings. This enables them to apply that information when machining or assembling equipment, in order to attain OEM standards.

To learn more about Emerson’s mobile service centres, visit EmersonProcess.com/IM906

Fast delivery keeps your turnaround on schedule

No matter how well a turnaround is planned, it is almost inevitable that a device will be required which wasn’t accounted for when defining the scope. With turnaround periods reducing, but the cost of an overrun increasing, time is a precious commodity. When that extra device needs to be delivered just prior to, or even during a turnaround, speed is therefore all-important.

To help meet this challenge, Emerson offers a range of express manufacture and delivery services with reduced lead times for its broad range of measurement and control products. These can be produced and delivered quickly and reliably anywhere in Europe, with no additional costs, helping maintenance teams to keep projects on track.

The service covers Rosemount pressure and temperature instrumentation and flowmeters; Rosemount™ analysers, transmitters and sensors; Micro Motion™ precision Coriolis flow and density measurement devices; and Fisher valves, selected valve assemblies and parts.

To complement this, Emerson’s emergency parts service has the capability to meet urgent spares demand within 24 hours. The service ensures that parts are delivered faster than factory lead times, enabling turnarounds to be kept on schedule and downtime minimised.

To find out how Emerson’s express delivery services can keep your maintenance project on schedule, go to EmersonProcess.com/IM908 and EmersonProcess.com/IM909



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