PROCESS TECHNOLOGY

AUTOMATION + CONTROL + INSTRUMENTATION

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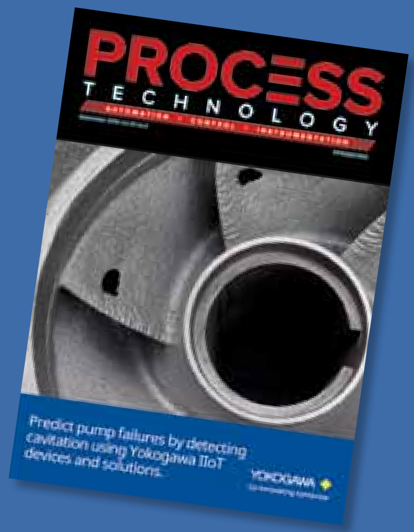

Digital transformation in asset management has led to a revolution in how plant equipment is managed on site. The step change from preventive maintenance to predictive maintenance has realised huge savings in the maintenance budget and minimised plant shutdowns. In fact, unplanned shutdowns are almost eliminated. This has been achieved through the rapid deployment of IIoT systems across industry, both at the edge and in the cloud.

For example, cavitation is one of the biggest causes of pump wear and failure. Typically, cavitation is not detected until it is too late. Using Yokogawa's edge computer (STARDOM) and the EJX smart pressure transmitter, it is now possible to detect cavitation before it causes damage to the pump. Using cloud-based dashboards, operations are informed of any issues with pumps and motors through an intuitive web interface.

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CYBERSECURITY IN INDUSTRIAL CONTROL SYSTEMS

IMPLEMENTING COUNTERMEASURES

Daniel DesRuisseaux, Director, Industry Cybersecurity Program Schneider Electric

The threat of cyber attack will continue to plague industrial systems, so it is better to implement countermeasures and improve them over time than to wait.

Industrial control system (ICS) operators recognise the need to improve cybersecurity, but many lack the understanding of how to start the process. End users attend cybersecurity conferences and webinars, or read articles in the trade press and learn about specific cybersecurity topics — like threat detection or defence-in-depth architectures. Many are tempted to start to take concrete steps to improve security — but it is critical to first create a detailed plan prior to acting. Once a plan is created, a defined deployment process should be followed.

Security lifecycle

There are several standards that touch on industrial cybersecurity. ISA/IEC 62443 is a major standard for ICS that is backed by both end users and equipment vendors. It is written to be applicable across industrial segments and has been accepted by many countries, and defines the cybersecurity lifecycle — a powerful framework used to secure an ICS. The cybersecurity lifecycle is a process consisting of four major phases as depicted in Figure 1:

- **Assessment Phase:** Analyse the ICS; organise assets into zones and define communications conduits between the zones; define vulnerabilities, calculate risk and prioritise based on relative risk.
- **Implementation Phase:** Input from the Assessment Phase is used to create detailed security requirements. The requirements are in turn utilised to design and implement countermeasures, including technology, corporate policies and organisational practices.
- **Maintenance Phase:** The organisation actively monitors the ICS, responds to incidents, performs maintenance tasks (back-up, patching, etc) and manages change.
- **Continuous Improvement:** Lessons learned from incidents are analysed and necessary changes are implemented. Periodic audits are conducted.

This article will focus on the Implementation Phase, as it is critical to the successful deployment of countermeasures.

Output of the Assessment Phase

At the conclusion of the Assessment Phase, the team should have created the following documents:

- Architecture diagrams
- Network diagrams
- Asset inventories
- Vulnerability reports
- Zone and conduit drawings
- Risk analysis report

The documents produced as a result of the Assessment Phase are key to initiating the Implementation Phase of the security lifecycle.

Implementation Phase

The Implement Phase comprises a variety of sub-tasks. One of key factors that will influence success of the overall effort is the creation of a strong project team. The design and implementation of security countermeasures is a complex project and should be managed as such. Activities should be planned, documented and executed throughout the Implementation Phase.

The project team should consist of personnel with knowledge of the process, the OT control network and the IT network. A strong project manager should be assigned to manage the project team.

Security requirements

The first step in the implementation phase involves the definition of requirements. Examples of requirements include features tied to the specific countermeasure (firewall, IDS, SIEM, etc), and requirements that must be supported by all components that comprise the system. Examples of system requirements include regulatory requirements, monitoring requirements, configuration requirements, environmental requirements and access control requirements. For example, all elements in the system must be able to output log data in a specified format, or all elements must interface to a defined network clock to ground log information.

Requirements are captured in cybersecurity requirements documents. There can be multiple requirements tied to an overall project. The requirements document should capture all requirements, and should also define detailed use cases.

Design specification

The requirements document specifies features that the system must support, and the design specification details how the system addresses the requirements. Multiple design elements can be tied to each requirement. The design document typically contains a variety of sections to clearly define how the system works, including architecture diagrams, network diagrams and use cases.

Creating a detailed project plan

Once the design is complete, the project team will create a detailed project implementation

plan. The plan will fully define the overall project, and should include the following sections:

- Project goal
- System scope
- Project deliverables
- Budget
- Resource requirements
- Dependencies
- Risks
- Schedule

Implementation

Securing a system typically requires the combination of two major efforts: hardening industrial components and deploying security appliances.

It is important to note that system hardening alone is not enough to protect an ICS. Additional employee training and corporate security policies are additionally required. Examples include policies that restrict employee access to critical locations and prevent the attachment of memory sticks to ICS equipment.

System hardening

Hardening refers to a process of securing a system by reducing its attack surface. An ICS is composed of a variety of devices including, databases, software applications, networking equipment, PLCs and drives to name a few. Each of these devices can be individually hardened.

Software hardening

Software hardening can refer to both OS and software application hardening. Techniques include patching software, removing or disabling unnecessary services/protocols and configuring proper access controls. Software hardening guidance is available from a variety of sources including National Institute of Standards and Technology (NIST) and security guidelines from automation equipment manufacturers.

Device hardening

In an ICS, devices refer to products with embedded software that is involved in the industrial process. Examples of devices include PLCs, DCS systems, HMIs, drives, sensors and I/O. Hardening techniques will vary by device. Examples include enabling logs, changing default passwords, installing firmware updates, disabling remote programming changes and disabling unused services/protocols. Device hardening guidelines are available from NIST and ICS vendors.

Network hardening

A network comprises a variety of elements, including switches, routers, firewalls and gateways. Network devices can be hardened using many of the same techniques discussed earlier — installing firmware updates, changing passwords and reviewing logs. There are a few techniques specific to networking equipment, including disabling unused physical switch ports and using protocols to validate that elements can connect to the network. Network hardening guidelines are available from NIST, the US National Security Agency (NSA) and network equipment providers.

Deploying security appliances

Hardened devices cannot by themselves effectively secure a system. For example, a traditional industrial system consists of a PLC, an HMI, a management workstation and some drives. Each of the devices can be hardened to reduce its attack surface, but additional security appliances may be required to secure the system. Some examples of security appliances are:

- **Firewalls:** Use rules to control incoming and outgoing network traffic. Firewalls can be hardware or software based.
- **Intrusion Detection Systems:** Can be host or network based. They monitor events occurring in a system and detects possible incidents. Incidents generate alerts that are forwarded to the system administrator.
- **Security Information and Event Management (SIEM):** Used to aggregate logs from ICS equipment and generate reports that are valuable for troubleshooting and compliance purposes.
- **Data Diodes:** Enable more stringent network segmentation by restriction traffic flow to a single direction.
- **Certificate Authority:** An appliance that issues digital certificates, which are used to authenticate individuals or equipment and secure protocols.

The process tied to the effective deployment of security appliances is influenced by the appliance in question. For example, the process to deploy a firewall will differ from the process used to deploy an SIEM. The process can be divided into five major phases, so to better illustrate concepts, we will walk through each of the steps assuming that we are deploying a firewall.

Select the security appliance

Device selection is influenced by the risk assessment and the end system architecture created as part of the Implementation Phase, as well as the security requirements document discussed earlier. The team uses the information to select the technology and ensure that the necessary features are supported by the appliance. A secondary task associated with selection involves determining where the appliance will be placed in the network and determining if the existing architecture will change.

As an example, let's assume the team needs to deploy firewalls. The team would have to determine the locations where the firewalls would be placed to segment the network, and determine the firewall requirements for each placement. There are a variety of firewall types, including stateful inspection firewalls and deep packet inspection firewalls. Each firewall type has different capabilities, so detailed requirements designed to guide selection would be developed for each prior to selection.

Install and configure the security appliance

Once the appliance is selected, the team works with the organisation to have it installed. In this stage key stakeholders in the organisation are informed and consulted, and an installation schedule is created.

We will again use a firewall to illustrate the process. The firewall would be installed in the network and firewall policies designed and configured. Configuration includes the creation of Access Control Lists which define source and destination addresses, port numbers and packet flow direction. Additional deep packet inspection rules can be created for specific protocols.

Test the security appliance

Once the appliance is installed, it should be tested — a test plan should be written and

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> AN ICS IS COMPOSED OF A VARIETY OF DEVICES INCLUDING, DATABASES, SOFTWARE APPLICATIONS, NETWORKING EQUIPMENT, PLCS AND DRIVES TO NAME A FEW.

approved by the organisation in advance of testing. Test results are documented and any tests that have failed should be reviewed and addressed or waived by the organisation.

For a firewall, examples of areas that would be tested include device performance, interoperability and logging. In addition, there may be specific features that should be tested, such as the ability to filter specific protocols.

Deploy the security appliance

Once the appliance has been tested, it can be formally deployed. During this phase, key departments will be notified that the appliance is operational. Additional monitoring may be required to insure the appliance is not impacting network performance, and device configuration files should also be backed up.

Plan for ongoing appliance management

In the final phase, the team plans for ongoing maintenance of the appliance. The maintenance phase will require the appliance to meet corporate security rules. Key issues addressed in this phase include patching, the ability to track and verify configuration changes, and auditing.

Access control

Access control refers to policies and technologies implemented to control access to control networks. Properly implemented access controls define techniques to create, modify and remove user accounts. Features typically associated with access control include role-based access control, multi-factor authentication, session locking and concurrent session control.

Remote access

A critical task to consider when securing an ICS involves effectively managing remote access. Remote access provides significant operational benefits, but it also introduces significant risk as it provides a path for individuals outside of the facility to access the control system.

Several variables can impact the design of remote access solutions, including:

- Role of users
- Quantity of users
- ICS nodes accessed
- Security level of accessed elements
- Performance requirements
- Regulatory and policy restrictions
- Services

Some examples of remote access best practices include using two-factor authentication for access, encrypting traffic travelling through untrusted networks, enabling on-demand session termination and requiring corporate-owned laptops that meet company security policies for access.

There are a variety of technologies available today for secure remote access. Users must evaluate security features, potential risk and cost to select the best alternative for their application.

Acceptance testing

Applications may require additional system cybersecurity acceptance testing prior to implementation. Acceptance testing can take place at the factory, at a staging site or both.

Cybersecurity acceptance testing is designed to accomplish two objectives. The first objective verifies that the system meets cybersecurity design requirements. In this phase, the testing verifies that the security settings of ICS devices are properly configured, that security appliances are properly installed and configured, that detection appliances are operational and able to identify and report events and that access controls are properly configured and effective.

The second objective focuses on proving that the system is robust. In this phase, penetration testing is conducted to ensure that the system can resist attacks. The system will be scanned for vulnerabilities, and the system will be challenged by a variety of attacks. There are many published accepting test guidelines and best practices that can be used as references to create detailed test plans. Documentation detailing the test plan and results is required prior to the release of the system to operations.

Conclusion

The threat of cyber attack will continue to be an issue plaguing industrial control systems for the foreseeable future. IEC 62443 standards create a framework that allows operators to strengthen system security. The key first step in the process is the Assessment Phase, which enables end users to analyse their system and understand which threats to address first. Countermeasures are deployed in the Implementation Phase, and the process outlined in this article can be of assistance through this process. The key is to stop waiting and avoid analysis paralysis — it is better to begin to implement countermeasures and improve them over time than to wait.

**Daniel DesRuisseaux possesses over 25 years of diverse experience in engineering, sales and marketing roles in high-tech companies. He presently serves as Cybersecurity Director for Schneider Electric's Industrial Division. In this role, he works to insure the proper and consistent implementation of security features across Schneider Electric's industrial product portfolio.*

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Smart manufacturing in action

Redesigning the process has led to 84% more floor space at the Kani factory.

Mitsubishi Electric's Kani factory in Nagoya, Japan, which produces motor starters and contactors, was facing a number of significant challenges, not least the sheer number of product variations and possible configurations in its product range — approximately 14,000. Demand from customers for greater choice had served to dilute the volumes of each particular product, despite overall product quantities increasing substantially.

In the past, manual production at the Kani factory had given way to totally automated assembly lines, which were ideal for mass production with few product variations where high yields could be realised at high speed. However, one problem lay with the fact that many individual components were required to be in stock and ready for the manufacturing process — without which the lines would not be able to run for any appreciable length of time.

For various reasons, substantial numbers of assembly lines had been optimised to produce a limited range of products, and these would come to a standstill when components ran out. In such a scenario it became difficult and uneconomical to produce small batches.

The solution was to employ engineering know-how built up over many years and combine this with a vision of integrated manufacturing — known as the Mitsubishi Electric *e-F@ctory* concept.

The initial major challenge was to find the root cause of any inconsistencies. This task involved several approaches, from analysing existing data or collecting new data sets for fresh eyes to review, to looking for links between data that on the surface could appear unlinked. Studying existing processes, as well as the methodology, revealed that natural, normal, organic growth in the production process had inadvertently led to inefficiencies.

Looking for a resolution to this issue led to a re-evaluation of the need for 100% automated lines, which were not necessarily the most efficient. Restoring some human elements to the process could potentially reduce manufacturing anomalies.

Further observations revealed that the automated parts feeding of some larger components not only created a bottleneck, but led to the parts feeders consuming large volumes of space — which could, under some conditions, result in minor damage to the components. The damage was not enough to cause an issue, but enough that the engineers were dissatisfied with the quality level being achieved.

Conversely, the automation of some tasks which had, in the past, seemed impossible, now looked possible through a combination of technologies. An example of this thinking concerned the misalignment of certain screws during the assembly process. The automation system, unaware of the misalignment, would try to insert the screw and cause damage to the entrance of the hole.

Two technologies helped to overcome this problem: robotic vision and combining rotational drives for inserting the screws using torque sensors. As a result, the hole can now be located easily and aligned correctly every time. The torque sensor confirms the absence of misalignment and that the screw is tightened to the correct level. The increased use of vision systems, checking for correct assembly and alignment, has also helped to increase the number of right-first-time products.

Another, simpler idea was to etch a matrix code on the body of each product and track it through the various stages. Now, as the product arrives at a workstation, its code is read and the appropriate processes and parts applied. At the end of the manufacturing cycle, each product then has a traceable manufacturing history, making it entirely possible to track the history of individual issues.

By redesigning the process and reintegrating the human element, a single line, which comprised two 35 m-long segments occupying some 280 m^2, has been reduced to a cell of just 44.1 m^2. This 84% reduction in space means that the productivity of each square metre of production hall has been increased through greater utilisation. Even though a single new cell cannot produce the same volume and speed of units as the original fully automated line, it is now possible to deploy up to 6 cells in almost the same space. In turn, total productivity density is much higher due to three key factors: a wider variety of products can be manufactured in smaller batches; one stoppage does not halt the whole of production; and the total number of production lines has increased.

The end result, much to the satisfaction of the Mitsubishi Electric team at the Kani factory, is effective optimisation of both machine and human resources, as well as the production process and space — a true productivity gain.

Mitsubishi Electric Australia
www.mitsubishi-electric.com.au

EDGE AI AND MACHINE VISION PC

The AAEON BOXER-6841M Series has been built for both edge AI and machine vision applications. The controller is available in six different configurations, with four edge AI models featuring PCIe(x16) slots for the installation of Nvidia GPUs and two machine vision models fitted with a pair of PCIe(x8) slots for frame grabber cards.

BOXER-6841M models are available that support either Intel Core i desktop or Xeon server-grade CPUs. All models support up to 32 GB of DDR4 ECC or non-ECC SODIMM memory, as well as two 2.5″ drive bays, and feature five GbE LAN ports, four USB 3.0 ports, two HDMI ports, dual mSATA slots and an additional PCIe(x1) slot. The machine vision models can also support up to five COM ports to support legacy devices.

The four AI models can be fitted with up to 250 W GPUs. To support the high power requirements of these GPUs, AAEON has designed the BOXER-6841M models with two 12 VDC power inputs. This feature lowers costs and makes the system more stable by reducing the level of wasted heat that would be produced by a single 24 V input.

Because the BOXER-6841M is a series of computers rather than a single machine, computing power and features can easily be selected to meet users' image processing requirements.

Interworld Electronics and Computer Industries

www.ieci.com.au

WIRELESS MONITORING PLATFORM

DeltaBlack is the latest member of ETM's range of 3G and 4G monitoring platforms, based on the previous ETM 9140 model, sharing its architecture and code base.

Designed for general industrial monitoring applications, the DeltaBlack has seven configurable inputs, analog output (4–20 mA, 0–10 V), digital outputs (voltage-free contacts, voltage) and a relay output. The device is also able to send custom SMS alerts to multiple numbers and has the ability to upload data to ETM's IoT Cloud Dashboard.

All ANZ 4G/LTE and 3G frequencies are supported, and the unit comes in a DIN rail mounting case, with a 6–36 VDC supply. Preconfigured for the most common sensor types, the unit has a wide operating temperature range and LED status indications.

SIM and data plans are available.

ETM Pacific Pty Ltd

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PANEL PC SERIES

Backplane Systems Technology presents Winmate's P-Cap Open Frame Panel PC Series, the IB70 and IK70, available in screen sizes from 15″ to 23.8″.

The IB70 ships with an Intel Celeron Bay Trail-M N2930 to deliver an efficient, low-power-consuming device. The IK70 is said to ensure high performance due to its 7th Generation Intel Core i3/i5/i7 CPU, making it easy to handle multimedia content.

Engineered with system extendibility in mind, which is a crucial demand for integrators to handle the various needs of many industries including retail and hospitality, the IB70 and IK70 come with several I/O interfaces. The IB70 includes two GbE LAN interfaces, three serial ports, a USB 3.0 port, three USB 2.0 ports, a VGA (female) port, Line out, Line in and Mic in. The IK70 provides two GbE LAN, two serial ports, four USB 3.0, a HDMI 1.4 port, one DP 1.2 port, a Mic in and a Line out. Such construction gives the two panel PC series enough system expandability for retailers to add multiple external devices to the kiosks, such as card readers, cameras, printers and more.

The panel PCs are tailored with a powerful data handling ability and peripheral support to fulfil the operational needs of smart retail and other IoT-related applications. Both series carry a slimline design with open frame housing to minimise space restraints while giving a stylish look. A user-friendly, multitouch experience is offered by the P-Cap multitouch screen that allows any individual to operate the device.

Backplane Systems Technology Pty Ltd

www.backplane.com.au

SONIC IMAGER

Equipped with an array of microphones for an expanded field of view, the handheld Fluke ii900 Sonic Industrial Imager is desiged to enable maintenance teams to quickly and accurately locate air, gas and vacuum leaks in compressed air systems; even in noisy environments.

Specifically designed for noisy production facilities Fluke's SoundSight technology is said to be simple to learn and easy to implement. The 7″ LCD touchscreen overlays a SoundMap on a visual image for quick leak location identification. The straightforward, intuitive interface allows technicians to isolate the sound frequency of the leak to filter out loud background noise. In a matter of hours, the team can inspect an entire plant, even during peak operations. Users can quickly and easily identify the air leak repairs needed to ensure efficient operations and reduce utility bills.

Images can be saved and exported for reporting purposes.

Fluke Australia Pty Ltd

www.fluke.com.au

FLOATING ROOF MONITORING USING RADAR TECHNOLOGY

PART 1

Manual inspection of floating roofs on storage tanks is time-consuming, expensive and potentially unsafe.

The world's first floating roof storage tank was built in 1923 and it is estimated that today more than half of all storage tanks are of this type. Safety, economy and effectiveness were the driving forces behind the innovation back in the day, and the key reasons for using floating roofs have remained the same ever since:

- Reducing product loss through evaporation.
- Increasing safety by reducing risk of fire.
- Protecting health and environment by decreasing vapour releases.

Now, almost one hundred years since their introduction, using floating roofs is common practice and the benefits are well known. But making the roof float — and adding all the mechanical solutions that are needed to do this safely (eg, adjustable roof legs, rolling ladders, sealing systems, drain pipe swivel joints and many others) — has inevitably introduced risks that are not present in

fixed-roof tanks. Thus, for all their benefits, floating roofs are also one of the most common root causes of tank incidents.[1] For plant managers focused on efficiency and safety, this should be cause for concern.

With ever tightening regulations for emissions and safety, floating roofs are expected to become even more common in the future. Paired with a shrinking workforce and constant drive for efficiency, this becomes a challenge for tank operators. Floating roofs require thorough periodic inspections, but still root-cause failures risk going unnoticed until they escalate into an emergency.

Risks and mitigation

The floating roof is a common cause of tank incidents because it is the 'moving part' of a petroleum storage tank. Although incidents involving floating roofs may not always result in what could be called a serious accident, they always result in a business interruption and are usually quite costly in terms of financial and operational impact.

Even something seemingly trivial as derailing of the stairs leading down to the tank roof has a big impact on the normal operation. Derailing can happen early if the roof starts to tilt.

Ensuring safe operation of floating roofs is thus a critical action to improve safety and efficiency at petroleum storage facilities. For example, industry data indicate that rim fires occur at a rate of about 1–10 per 1000 tank years.1 In other words, in a facility with 100 tanks, 1–10 rim fires can be expected over a period of 10 years.

The International Association of Oil & Gas Producers (IOGP) has investigated the incident frequency of floating roof tanks[2] and summarises that each year, approximately:

- 1 in 625 tanks will have liquid spilled on the floating roof
- 1 in 900 floating roofs will sink
- 1 in 8300 tanks will develop a full surface fire.

Preventing and mitigating floating roof incidents is in fact relatively simple — in theory. The standard way to reduce the likelihood of incidents is to routinely and thoroughly inspect the floating roof. This includes measures such as opening manways into pontoon compartments to inspect inside and perform atmospheric testing, inspecting roof legs and vacuum breakers, ensuring proper function of the rolling ladder, checking and testing accessible parts of the seals, checking for corrosion in all seams and welds, and many other tasks. In short, it is an extensive job that needs to be carried out regularly and according to the facility's safety and maintenance directives.

Unfortunately, such inspections are often not carried out on a regular basis. Reasons for this can be:

- Safety hazard for operators to climb down to the floating roof.
- Extensive permit process to gain access.
- Management does not understand the likelihood or consequences of an incident.
- The inspection activity detracts from bottom line.
- Not enough operators to prioritise this job.
- Operating parameters are not right for inspection (eg, if the tank is in service, it is preferred to enter the roof when the tank is full).

Not performing inspections routinely will cause problems at a later stage. When inspections are not carried out, less-critical faults that could have been repaired are not discovered. As time passes these will then escalate into more serious events.

In the end this leads to operators being caught off guard by a sudden emergency, instead of having solved the issue by scheduling a repair as part of routine maintenance. It is in fact rare for serious incidents to happen suddenly without there being warning signs that could have been discovered earlier.[3]

The escalating nature of floating roof failures and the difficulty of inspection becomes an even larger cause for concern when

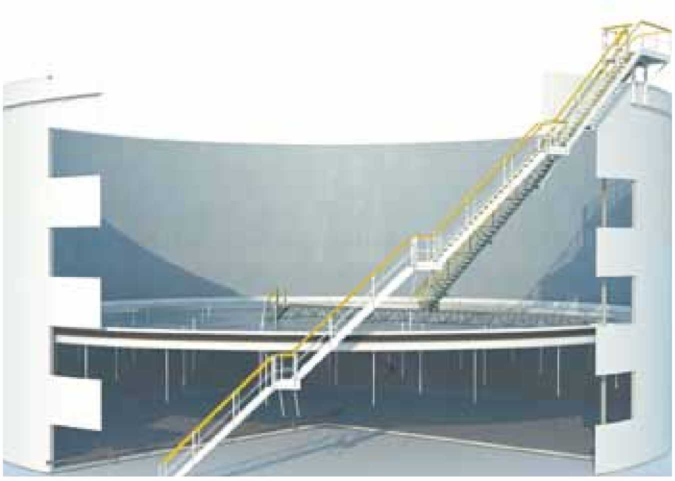

Figure 1: Cross-section of a tank with a floating roof.

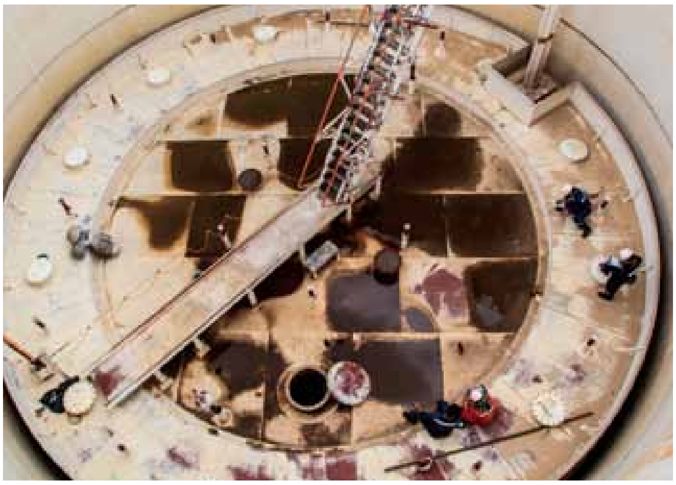

Figure 2: Inspection and maintenance of a floating roof.

paired with the challenges of the bulk storage industry today:

- Stricter emission regulations call for tighter rim seals, which increases the risk of the roof getting stuck.
- Unwavering focus on safety means inspections in the field are increasingly regarded as risky.
- Costs and business consequences of a fire or similar incident are steadily rising.
- There are fewer and less experienced personnel as the most senior go into retirement.

It is clear that something must change. The time is ripe for automation to come also to the floating roof. An automatic floating roof monitoring (AFRM) system means operators can be certain that their floating roof tanks are working as intended. It extends continuous, around-the-clock monitoring to the roofs, and automatic alarms connected directly into the control room give immediate notice if a floating roof shows abnormal behaviour.

Automatic floating roof monitoring

Such an automatic monitoring system detects how well the roof is floating. Specifics vary depending on which technology is used, but in general it is about measuring if and by how much the roof is tilting. A roof tilting more than normal is one of the early indicators that something is amiss; eg, a pontoon may be punctured, there may be liquid pooling on the deck or there may be vapour trapped under the roof. An AFRM system can give early warning that the roof is outside of normal operational parameters, which should result in sending personnel out for inspection.

Radar gauges are the standard instruments for level measurement in bulk storage tanks, a proven technology used for decades in terminals worldwide. Radar gauges are also very suitable for detecting tilting of floating roofs. Three or more radar gauges are placed evenly around the perimeter of the roof. Gauge data is sent to the control room and the operator interface software, where roof tilt is tracked by automatic comparison of the distance measurements. Alarms can be configured to warn the operators if the tilt exceeds a predetermined value, indicating the roof is not operating as normal.

A further benefit of using radar for floating roof monitoring is that it offers two different options for installation. Either a non-contacting radar solution or a guided wave radar solution can be used depending on what is most suitable for each tank.

Summary of options

AFRM with non-contacting radar

In the case of AFRM with non-contacting radar, the gauges are typically attached to the tank shell at the top of the tank. Three non-contacting radars mounted 120° apart around the edge of the tank allow the gauging system to determine the level or tilt of the roof by comparing the three measurements.

AFRM with guided wave radar

If guided wave radar is used, the radar gauges are installed directly on the top side of the floating roof itself. Three or more guided wave radar transmitters are installed in nozzles spaced evenly around the roof perimeter, and the rigid probes of the transmitters penetrate through the roof and into the liquid below. In the same way as for non-contact radars, the three measurements are compared to determine the degree of tilt of the roof.

In Part 2

Whether non-contact or guided wave radar is preferred varies site by site or even tank by tank. In Part 2, the two options are discussed and compared in more detail.

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Emerson Automation Solutions
www.emerson.com/au/automation

DATA ACQUISITION SYSTEM

The Dewesoft IOLITE data acquisition system has two fully redundant EtherCAT bus systems that work in parallel. The primary bus is used for synchronised data acquisition via DEWESoft X software and the secondary bus can be used in two ways: as a low-latency front-end interface for real-time controllers or as a redundant data acquisition bus system for critical application input slots and amplifiers.

The IOLITE chassis can be configured with up to 12 slots, each featuring high-quality input amplifiers, including the 6xSTG, a universal analog and strain gauge amplifier that is compatible with Dewesoft smart interface DSI adapters, the 8xTH isolated thermocouple amplifier, a 32-channel digital input and the 32-channel digital output with watchdog.

Each IOLITE system is equipped with a redundant power supply. If the primary power supply fails, the system will be powered by a secondary power supply without any interruption or system shutdown/restart.

A feature of the IOLITE is it allows the operator to acquire and monitor the data in daily operations while tuning the control system. Apart from monitoring the input channels on the data acquisition bus, the system can also monitor the outputs from the controller.

The system comes in a standard 19″ rack chassis (4U height and can host up to 12 IOLITE modules) or a standalone aluminium chassis providing eight slots for IOLITE input and output slices to be installed.

Metromatics Pty Ltd

www.metromatics.com.au

SIGNALLING DEVICES

Pepperl+Fuchs offers a comprehensive range of high-performance signalling products suitable for a wide range of industries and applications. The range of audible, visual and combination devices as well as call points has been certified for use throughout the world in gas and dust explosion-hazardous areas.

A wide range of different brightness and volume options makes it easy to find the right choice for individual applications. The signalling devices are manufactured from corrosion-resistant aluminium or glass fibre-reinforced polyester (GRP) making them suitable for use in harsh industrial environments. The signalling devices are suitable for wall, ceiling and floor mounting to ensure that they can be mounted in the most suitable location for any project.

Pepperl+Fuchs (Aust) Pty Ltd

www.pepperl-fuchs.com

RETAINING FIXTURE FOR COBOTS

The Lean Robotics retaining fixture for cobots from igus is produced by injection moulding and has a uniform size. The retaining fixture can be installed in seconds with a Velcro strip and is available in three options to allow the universal safe guidance of cables for data and energy.

The Lean Robotics retaining fixture is attached directly on the robot in two steps: place the Velcro around the robot arm and fix it. Due to the Velcro fastener, the user has the opportunity to use the new retaining fixtures without any tools on any robot of their choice, and due to the flexible plastic, they can also be installed on another cobot at any time.

The retaining fixture is available in three versions: the standard version has two continuously adjustable Velcro straps in a universal size and a rubber lining inside, so that the straps are fixed on the arm without the risk of slipping. This option is also available with a mounting bracket with and without strain relief. In a third option, the retaining fixture can also be equipped with a protector for additional security. The retaining fixtures are suitable for use with the triflex R series TRC/TRE/TRL 30, 40 and 50 as well as for all commercially available protective hoses with different diameters.

Treotham Automation Pty Ltd

www.treotham.com.au

KVM DRAWER WITH KVM SWITCH

The RACKMUX 4K KVM drawer with built-in 4K HDMI USB KVM switch combines a rack-mount 4K x 2K LCD monitor, keyboard, touchpad mouse and a 4K HDMI USB KVM switch in a space-saving 1 RU industrial strength drawer.

Each RACKMUX-4K17-N-xHD4K consists of a compact, heavy-duty tactile keyboard with 17-key numeric keypad, a three-button touchpad mouse, and a forward-folding 17.3″ TFT/LCD monitor that supports resolutions to ultra-HD 4K x 2K 3840 x 2160 at 30 Hz. The LCD screen automatically shuts off when in the closed position. Torque-friction hinges prevent the monitor from wobbling, springing or slamming shut.

The KVM drawer features an integrated 4-, 8-, or 16-port 4K HDMI USB KVM switch, which allows a user to control up to sixteen ultra-HD 4K x 2K 30Hz USB computers. Dedicated internal microprocessors emulate keyboard and mouse presence to each attached CPU 100% of the time so all computers boot error free.

Constructed with rugged steel and a durable powder-coat finish, the rack-mount drawer is designed to be a one-person installation job. It is adjustable to various rack depths from 610 mm deep to 40″ 1016 mm deep. The drawer locks into place when open to prevent it from sliding in and out of the rack.

Interworld Electronics and Computer Industries

www.ieci.com.au

Process technology advances syngas production

Image courtesy of Leigh Creek Energy.

Leigh Creek Energy is using the latest process control and automation technology for its flagship Leigh Creek Energy Project (LCEP), located 550 km north of Adelaide.

LCEP is an in-situ gasification (ISG) project converting coal from its solid state into its gaseous form. This process results in the generation of synthetic natural gas (syngas) containing methane, hydrogen and other valuable components. The syngas can be either used to produce electricity directly or further refined into a variety of products including synthetic methane and ammonia.

To obtain information to inform the design for a potential commercial facility, Leigh Creek Energy established an ISG demonstration facility. This involved the construction of an above-ground plant and the establishment of a below-ground single ISG gasifier chamber. A pilot plant was commissioned and operated for the 90-day trial period to produce syngas, allowing for the technical and environmental performance of the process to be analysed.

The challenge at hand was to design the ISG process and keep the pilot plant running continuously without any stoppages. ATSys, a Rockwell Automation Recognised System Integrator, was commissioned to develop the electrical implementation and control system for the plant.

The ISG process is a chemical conversion from solid coal to gas. For the reactions to commence, air is introduced through the inlet well, and an initiation device is used to create very high temperatures. As the temperature and oxygen concentration reach optimum levels, a series of reactions convert the solid fuel into syngas, which is then extracted through the outlet well.

The area in the coal seam where the gasification takes place is referred to as the gasifier chamber; the reactions that form syngas typically occur at temperatures of between 900 and 1200°C. Given the process, safety and environmental considerations for the plant, the choice of control and automation system requirements was of paramount importance.

"We selected Rockwell Automation hardware and software for this project because it has been proven to be reliable, and we could be confident that the technology would be fit for the purpose of this project," said Andre Tassone, Managing Director, ATSys.

The Rockwell Automation PlantPAx distributed control system delivered plant-wide control and optimisation for the plant. By using a common automation platform, the PlantPAx system provided seamless integration between critical process areas of the plant. In addition, the Allen-Bradley CompactLogix controllers together with PowerFlex drives with Safe Torque-Off delivered a fully integrated architecture. The Integrated Architecture solution allowed all equipment to seamlessly integrate over Ethernet into the controllers, allowing fast control with detailed diagnostics for this critical application.

Reducing engineering time associated with installation and commissioning was a key priority for the project. The PlantPAx Library of Process objects is a predefined library of controller code (Add-On Instructions), display elements (global objects) and faceplates that let users quickly assemble applications with proven strategies, rich functionality and known performance.

"By using the PlantPAx Library of Process Objects in the Leigh Creek project, we were able to reduce the engineering and testing time involved," said Phil Galbraith, Principal Control Systems Engineer, ATSys. "We also decided to design all the equipment on skids to reduce installation time on site."

The FactoryTalk product suite provided real-time visibility into the system for monitoring and controlling the plant. FactoryTalk View SE was used in a redundant configuration for visualisation and control on a pair of PCs running in the control room onsite, helping to ensure ongoing operation for critical control and monitoring functions. FactoryTalk Historian SE and FactoryTalk VantagePoint were used for logging of historical data and visualisation on a cloud-hosted system.

The platform also enabled the capability for remote access to the production data. In addition to having access to real-time data, it was critical to log data for analytics and reporting, analyse trends, investigate inefficiencies and monitor environmental KPIs.

The Leigh Creek Energy Project ended up exceeding expectations, resulting in the production of commercial syngas with a peak flow rate of 7.5 MMcf/day — higher than anticipated for the ISG process. In addition, the pilot study demonstrated that Leigh Creek Energy has operated the ISG gasifier safely through data analysed from surrounding environmental monitoring wells before, during and after the trial.

The data recorded reveals that the size of the gas resource is significant, making this resource one of the largest undeveloped, uncontracted and undervalued gas resources within the East Coast gas system in Australia. Unlocking the value of such a significant energy resource will provide Leigh Creek Energy with the foundation to progress the project to the next commercial stages.

Rockwell Automation Australia
www.rockwellautomation.com/en_au

TAKING THE NEXT STEP IN PROCESSING OPTIMISATION

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Maximising shareholder value: this seems to be the end goal of any publicly listed company (and so it should: the shareholders are the owners after all). But what does this mean in a processing plant on a mine site? Often, the processing of an ore body is a value maximiser step — a necessary operation that needs to be as efficient as possible to minimise waste, and in turn to reduce the amount of ore required to be mined for one tonne of product. For a mine that extracts millions of tonnes of ore a year, a small improvement in processing can deliver amplified results in the pit. This means the operation can be lower on the cost curve, making the business more resilient during a downturn and freeing up more cash for further improvements and expansions.

After commodity prices peaked in 2011 and the world outlook has become increasingly uncertain, many mining operations have implemented a continuous improvement project in some form to maintain profitability levels. As we have seen in in 2019, most mining businesses have successfully completed these projects, with production costs per tonne in some operations less than half what they were during the 'Mining Boom'. This is reflected in the value growth of the mining industry — revenue in 2018 has increased 25% over 2011 levels even though some commodity prices have fallen since then.

As these improvement projects have concluded, many mining operations have noticed it is difficult to continue optimisation initiatives. This is due to many factors, including the current skills shortage and high staff turnover. To move into the next step of process optimisation, a different toolkit is required to be used as it gets increasingly harder to squeeze the last few percent out of the existing processing capability.

Due to advances in technology over the last few years, there have been many equipment manufacturers and automation solution providers that have crafted innovative solutions to assist plant operators to extract as much performance as possible from their operation. Building upon the more established Advanced Process Control (APC) technologies including Multivariable Model Predictive Control (MPC), the integration of innovative technologies such as artificial intelligence (AI), Industrial Internet of Things (IIoT) and machine learning creates even more efficient and interconnected solutions for plant operators. Traditionally, mining processing has lagged in terms of technology adoption compared to other heavy industries such as oil and gas, which is a demonstration of how much latent optimisation capacity is still present within all mine processing operations around the world.

However, these advanced control philosophies are only as good as the data going into them. 20 years ago, most sources of data were a single variable being fed into the SCADA system from instrumentation or sensors in the field. Recent developments in digital communication protocols and self-verification software have enabled many additional variables to be sent to the control or monitoring platforms. The tremendous increase of data available for analysis has enabled leaps in potential plant availability, utilisation and yield improvement. These smart sensors are now also being able to be connected directly to a cloud platform for further analysis, reducing the complexity and cost of the overall architecture — simplifying optimisation projects even further. With MPC for example, further optimisation would be able to occur due to the increase of information available to be fed into the optimisation software, even if it was previously utilised during a prior innovation project.

The addition of process optimisation on top of the organisational change that the mining business has implemented is this next step in maximising shareholder returns. Once a mining operation has implemented a culture of continuous improvement and operational discipline, the analysis of the data that is available will lead to the knowledge of where to focus improvement efforts next. This will in turn amplify the benefits brought by machine-led optimisation initiatives. Accurate and complete data for every sub-process in the processing plant is the best way in which each individual part of the mine can be optimised individually, leading to a much more efficient process as a whole.

Taylor McKertich is the Industry Manager for Mining, Metals, Oil and Gas with Endress+Hauser Australia. He has extensive experience in the mining processing sector, focusing on process improvement, operational excellence and engineering improvement solutions.

CLAMP-ON FLOWMETER FOR GASES

The Katronic KATflow 180 clamp-on flowmeter for gases is ATEX approved and has the ability to perform clamp-on measurement of gaseous flow at low pressures and in metal pipes.

Clamp-on measurement of gas has, typically, been limited to high pressures, plastic pipes and 'ideal' installations. The KATflow 180 gives results right down to atmospheric pressure even in metal pipes, including steel.

A gaseous medium dampens an ultrasonic signal far more than a liquid, making non-invasive flow measurement of gases far more difficult. The effect reduces as pressure increases, resulting in a 5 bar lower pressure limit at which conventional transit time measurements using shear waves can be made. Katronic's Lamb wave transducers are excited at the resonant frequency of the pipe material, making the pipe wall act as both emitter and receiver of the ultrasonic pulses, multiplying the effective transducer area for a higher signal strength and a better signal-to-noise ratio.

A stronger signal means that the KATflow 180 is better able to compensate for the attenuation of the gas, and Katronic has developed advanced signal processing techniques to analyse the measured data and deliver an accurate measurement.

The KATflow 180 is able to measure in pipes from 25 mm to 1.5 m diameter, with flow rates of 0.1 to 75 m/s and pressures of 1 bar up to unlimited maximum. It is designed to be capable of being mounted permanently in an ATEX Zone 1 or 2 hazardous area, with a robust housing and non-intrusive programming.

AMS Instrumentation & Calibration Pty Ltd

www.ams-ic.com.au

WIRELESS WEATHERPROOF ACCELEROMETER

The G-Link-200 is a battery-powered wireless 3-axis accelerometer with a rugged, weatherproof enclosure. This battery-powered wireless accelerometer provides low noise waveform data and is suitable for vibration, impact, motion and tilt applications. Additionally, derived vibration parameters allow for long-term condition monitoring and predictive maintenance.

These accelerometers offer DC to 1 kHz bandwidth with an adjustable range of ±2/4/8g (G-Link-200-8G) and ±10/20/40g (G-Link-200-40G), as well as a low noise density of 25 $\mu g/\sqrt{Hz}$ (G-Link-200-8G) and 80 $\mu g/\sqrt{Hz}$ (G-Link-200-40G).

The devices have programmable high- and low-pass digital filters, an onboard temperature sensor (±0.25°C) and a tilt sensor (±1° accuracy, <0.1° precision).

The G-Link-200 operates with an adjustable sampling rate of up to 4 kHz, and has continuous, periodic or event-triggered operation. The LXRS protocol allows lossless data collection, scalable network size and node synchronisation of ±50 µs. Outputs include acceleration waveform data, tilt or derived vibration parameters (velocity, amplitude and crest factor), with data logging up to 8 million data points and a wireless range up to 1 km.

Encased in an IP67 weatherproof enclosure with a stainless steel base, the devices have an operating temperature range of -40 to +85°C.

Metromatics Pty Ltd

www.metromatics.com.au

GUIDED WAVE RADAR INSTRUMENTS

ABB's LWT300 series level instruments are designed to eliminate the need for the high levels of technical expertise traditionally required to operate guided wave radars. Instead, the expertise has been embedded into the measurement device, making it easier and simpler to use.

The LWT300 series, comprising LWT310 for liquids and LWT320 for solids level measurement, builds on the legacy of the MT5000 series of guided wave radars. Now including the ABB's LevelExpert algorithm, the instruments can automatically differentiate between the actual measured level and false signals. Operators simply need to enter installation data and basic process conditions and LevelExpert does the rest.

Baseline mapping and echo selection are no longer required as the LevelExpert cuts through the noise and automatically reports the right level. Because readings are taken automatically, there is no longer any need for multiple manual adjustments by the operator.

The LWT300 series is designed to perform at temperatures up to 204°C, under process pressures reaching 207 bar, and to comply with the SIL2 certification for functional safety. This makes the measurement devices suitable for use in a wide range of applications including industries where safety is a priority such as oil and gas; petrochemical; chemical; power generation; water and wastewater; and pulp and paper.

ABB Australia Pty Ltd

www.abbaustralia.com.au

SAFE RADAR SYSTEM

The Pilz safe radar system comprises the LBK System safe radar system from Inxpect and the Pilz PNOZmulti 2 configurable small controller.

Up to six radar sensors are supported. In the event of a fault or when the protection zone is violated, PNOZmulti ensures that the reaction that is triggered is safe. The safe radar system solution can be used up to SIL 2, PL d, Category 2.

The safety-related functions covered by the system solution include the detection function, ie, when a machine is switched to a safe state as soon as a danger zone is violated, plus the restart interlock, which prevents the machine from starting automatically if there is anyone in the danger zone.

The layout of the protection zone can be flexible. The protection zone can be set up as wide or narrow, depending on the size of the area to be monitored. A wide protection zone covers a horizontal opening angle of 110° and a vertical opening angle of 30°. A narrow protection zone has an opening angle of 50° horizontal and 15° vertical. The actual protection zone of the sensor depends on the height at which the sensor is installed and the inclination (horizontal/vertical) of the sensor. A maximum depth of 4 m can be set.

The overall area of the application can be increased if six sensors are connected in series and arranged at a maximum distance of 2.5 m apart, allowing up to 15 m to be monitored.

Pilz Australia Industrial Automation LP
www.pilz.com.au

FREE CHLORINE SENSOR

The Memosens CCS51D amperometric sensor from Endress+Hauser measures free chlorine in drinking water, process water, water and wastewater treatment, cooling water and all utilities requiring clean and treated water. The device features a membrane design that provides a fast response time, helping plant operators run their disinfection processes quickly and efficiently, while also saving on chemicals.

The sensor's convex membrane is made from dense, dirt-repellent material that prevents soiling and makes it resistant to biofouling. Ultrasonic welding of the membrane to the sensor cap ensures its integrity, preventing dilution of the electrolyte and thus a drift of the measuring signal. This guarantees long-term stable measurements and gives water plant managers the security that the disinfection process is running smoothly and that the required disinfection results are achieved.

The device is equipped with Memosens technology, allowing for direct commissioning of new sensors without further calibration. During ongoing operation, plant operators can pre-calibrate sensors in the lab, swap them into the process with plug and play, and thus continue measuring faster. Finally, non-contact data transmission eliminates all measurement errors or failures caused by humidity or corrosion.

Memosens CCS51D is connected to the Liquiline multiparameter transmitter that can serve up to eight sensors simultaneously, and the Flowfit CCA250 flow assembly offers mounting space for a simple installation of the additional pH sensor.

Endress+Hauser Australia Pty Ltd

www.au.endress.com

PRESSURE SENSOR

The model A-1200 pressure sensor is designed to be used for pressure monitoring or as a PNP/NPN switch, especially in intelligent machines.

The sensor can be easily integrated into series production, is easy to configure and can be supplied with preset parameters on request. The IO-Link interface continuously transmits all measured values and information from the integrated diagnostic function, which monitors the measurement quality of the device. In addition, a 360° LED display (green, yellow, red) gives visual information about the instrument status. The pressure sensor also offers a blinking function that can be controlled via IO-Link, which enables its location to be clearly identified during maintenance.

The product is available in a variety of versions, including a more robust one for measurement applications in harsh environments. This variant of the sensor is shock-resistant up to a load of 1000g and designed for medium temperatures from -40 to +125°C.

WIKA Australia

www.wika.com.au

OUTDOOR SAFETY LASER SCANNER

The SICK outdoorScan3 is an IEC62998-certified safety laser scanner for outdoor use, making possible the degree of automation of outdoor industrial processes which is already expected from indoor industrial environments. Despite various weather influences, the product can protect stationary and mobile applications without additional protective devices.

The device's optimised optics cover causes weather effects to roll off. It is almost always upside down, which means that no particles or water remain on the device collar.

The unit also offers a PL d safety level in accordance with EN ISO 13849-1 and self-diagnosis, as well as features that a safety sensor needs for outdoor use. Additional features include a protective field range of up to 4 m and a scanning range of up to 275°. The operating temperature range is -25 to +50°C, and quick and simple commissioning is possible with the Safety Designer engineering tool and diagnostic options via the display.

Due to SICK's outdoor safeHDDM scan technology, the laser scanner operates well in sunlight with an illumination intensity of up to 40,000 lux. In addition, the intelligent software algorithm detects rain and snow, easily filtering out these environmental influences — rain up to a precipitation intensity of 10 mm/h. In fog, the device detects all obstacles due to its fogSight fog function.

SICK Pty Ltd

www.sick.com.au

ULTRASONIC FLOWMETER FOR BIOGAS

KROHNE has updated the OPTISONIC 7300 Biogas ultrasonic flowmeter for the measurement of dry and wet (raw) biogas with variable composition. Besides the standard temperature sensor, it now features a pressure sensor that can be ordered optionally with the flowmeter and comes mounted on the flow tube.

In combination with the integrated flow computer, the additional sensor provides for advanced biogas measurement: since the methane content of biogas may vary, it may be required for the operation of the biogas facility to know the exact methane content in a methane/CO_2 mixture. Here, a temperature sensor in combination with the measured velocity of sound enables direct measurement of methane content via calculation of the molar mass. By using an additional pressure sensor, OPTISONIC 7300 Biogas can also provide calculation of gas flow volume to standard conditions.

For temperature measurement, KROHNE offers the OPTITEMP TRA-P10 Pt100 sensor with OPTITEMP TT22 C (Ex-i) or an Ex-d temperature sensor with OPTITEMP TT30 C transmitter. The optional pressure sensor is an OPTIBAR P1010 (Ex-i) with 0–1.6 bar range. The OPTISONIC 7300 Biogas is available in line sizes DN50, 80, 100, 150 and 200.

KROHNE Australia Pty Ltd

www.krohne.com.au

SIGNAL CONDITIONING

GETTING THE MOST FOR YOUR MONEY

Acromag, Inc.

The importance of taking care in selecting a signal conditioner cannot be understated — a wrong choice could cost more in time and money in the future.

A variety of plant, process and instrumentation engineers, along with systems integrators, regularly face the difficult task of shopping for signal conditioners. Their goal is to obtain the highest quality conditioner for the lowest possible price. Sound simple enough? Well, it isn't. Few of the decisions that must be made are of the black and white variety. Most involve various shades of grey. The problem is, the selection of the wrong shade can result in the purchase of inadequate equipment, or equipment that will quickly become obsolete.

Pre-purchase system planning that includes a clear definition of the system requirements is the first step in the selection process. As a minimum, you should determine sensor input, type of output, isolation needs, power requirements, physical dimensions and acceptable performance criteria.

Accuracy, linearity and repeatability

Overall system accuracy is only as good as the least accurate device in the loop. This is typically the sensor or mechanical-to-electrical interface. If the sensor, for example, is only 0.5 to 5% accurate, you probably don't need extremely precise signal conditioning. Likewise, if your sensor is very accurate, you may not want to hinder system integrity with low-budget signal conditioners.

Accuracy, linearity and repeatability specifications are described in many different ways. Accuracy specifications should include the

combined effects of repeatability, hysteresis, terminal point linearity and adjustment resolution. They should also indicate worst case or peak error of the device at the reference conditions (eg, temperature, 25°C; power, 24 VDC; and output load, 250 ohms).

If a sensor isn't part of the device, the accuracy specification probably won't include sensor error. Knowing the maximum combined errors of a device at reference test conditions allows you to test units against manufacturer specs, and helps estimate total system accuracy.

The terms repeatability and hysteresis reference the attributes of a conditioner output as the input is varied up and down. A conditioner output yields a different value for the same input depending on which direction it came from (due to components, transformer core losses, potentiometer shifts and so on). An accuracy specification that includes the combined effects of these two characteristics implies that the output is always (repeatable) within the stated percentage from the ideal point.

> **OVERALL SYSTEM ACCURACY IS ONLY AS GOOD AS THE LEAST ACCURATE DEVICE IN THE LOOP.**

Terminal point linearity and adjustment resolution imply that a device has endpoint calibration and can be adjusted at the endpoints to within the stated specification (Figure 1). Essentially, terminal point linearity allows calculation or error E (accuracy) as a function of output span using the following equation:

$$E = \frac{(\textit{measured output value} - \textit{ideal output value}) \times 100}{\textit{output span}}$$

A typical accuracy rating is less than ±0.1% of output span. This means that a linear conditioner, calibrated with a 1–5 VDC output (4 V span), has an output within ±4 mV from the ideal point (4 V span x 0.001). Because the accuracy specification should include repeatability and hysteresis, the output should always be within ±4 mV of the ideal. If accuracy, linearity and repeatability are specified separately, you may have to combine the individual ratings to form a complete accuracy specification.

Adjustability (zero/span)

Conditioners with adjustability can compensate for signal differences, and the ability to do so is usually worth the extra cost (typically $100). Adjustability can be accomplished in hardware or software. Some applications have no software so it must be available in hardware. In other applications involving computers, such as data acquisition and control, it isn't possible or practical to perform all the adjustments in software, so hardware flexibility is a must. The capability to trim and calibrate hardware allows conditions to change without affecting other devices. In addition, host processors don't get burdened, and system accuracy isn't compromised.

For example, let's say you are evaluating two signal conditioners. Both feature 1–5 VDC outputs and are accurate to ±0.1%of output span (4 mV). One is non-adjustable and accepts a 0–100% input and has up to a 50% span adjust capability.

After defining your requirements, you decide that the input range you are interested in is 0–50% input. The second unit will have no problem calibrating and yielding a full range output while keeping

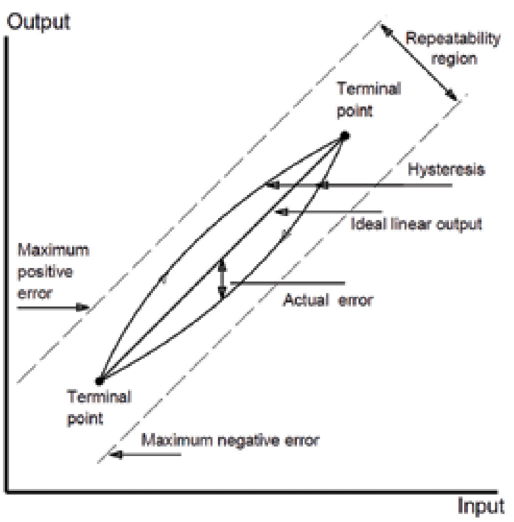

Figure 1: Accuracy diagram shows nonlinear signal errors.

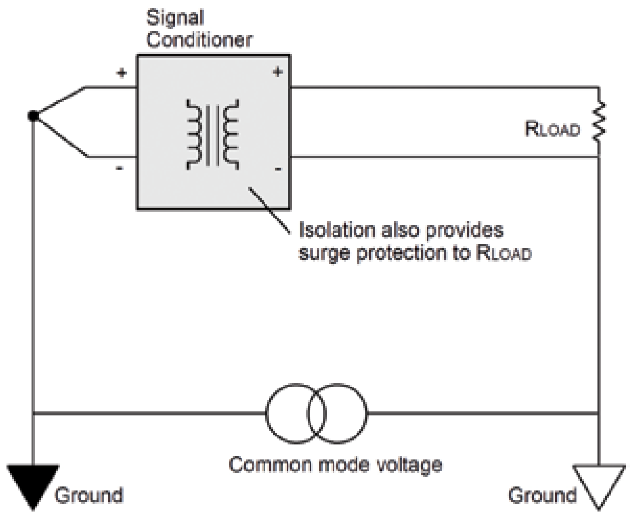

Figure 2:.A signal conditioner breaks up ground loops.

the ±0.1% accuracy rating. The first unit, however, is non-adjustable and will only yield 1–3 VDC (2 VDC span) for 0–50% input. Now, 4 mV out of a 2 VDC span is 0.2%. Hence, the first unit was not only inflexible, but turned out to be twice as inaccurate as the second.

In the real world, sensors do not necessarily provide convenient endpoint signals (eg, 0.00 mV through 50.0 mV), but approximate values such as 6.37 mV through 49.8 mV. This gives adjustable signal conditioners two advantages: they can scale a signal with inconvenient end-points and optimise performance by calibrating out errors due to the sensors or the system (eg, voltage drops, other devices and so on).

Here are a few additional advantages of signal conditioner adjustability:

- As time goes on, components age and drift. The ability to calibrate and maintain a conditioner increases its useful life.
- An adjustable conditioner also saves CPU number crunching time if you expect to make all adjustments using a software program. It eliminates the need for additional end-point calculations. Software programs are convenient for trimming and scaling. However, depending on the end points, scaling may introduce significant signal resolution and accuracy.
- The ability to adjust zero and span on the conditioner allows conditions to change without affecting other devices, burdening host processors and affecting system accuracy.
- Signal conditioner adjustability also reduces device inventory; the more flexible the unit, the less need there is to stock unique modules.

Isolation

Isolation in a signal conditioner means not having a direct electrical connection (or low impedance path) between two or more points (or circuits). The two primary components used in signal conditioners to provide isolation are transformers and optical couplers. Both devices transmit signals from one circuit to the other (via the transfer of magnetic or optical energy), and both have very high impedance paths from input to output.

There are two main reasons why you might need isolation: to break up potential ground loops and to protect equipment from high voltage surges and spikes (Figure 2).

The four possible combinations of isolation in signal conditioners include:

- **Input:** The input is isolated or floating from the output and power with no connection to earth ground, and the output and power share the same common. The conditioner can be connected to a grounded system, and is typically used when bringing signals in from the field to a grounded system.
- **Output:** The output is floating and the input and power are common with one another. It is used when sending signals from a grounded system to the field.
- **Three-way (fully):** Input, output and power are completely isolated from one another. Signal conditioners with full isolation can interface with three separately grounded systems.
- **Power isolation:** Input and output signals are common with one another and isolated from the power common. Power or three-way isolators provide protection from power sources grounded differently than signal sources.

Once you've justified the need for isolation, you must determine required voltage ratings and interpret the specifications. Isolation specifications should carry two ratings: continuous and breakdown (maximum). Don't be misled between the two when comparing technical data sheets.

Continuous refers to the amount of differential voltage (also known as common mode voltage) that can be present between the two isolated circuits on a permanent basis. Typical ratings for conventional conditioners are 250 VAC or 354 VDC.

Breakdown ratings refer to the high common mode voltages that conditioners can withstand for short durations before isolation barriers start breaking down. A common rating is 1500

VAC for one minute without breakdown, which, when properly designed and tested, will accommodate most applications.

Ratings should be in accordance with established guidelines from an accredited approval agency such as Factory Mutual (FM), Canadian Standards Association (CSA) or Underwriters Laboratories (UL). Under CSA guidelines, a conditioner claiming a continuous isolation rating more than 250 V must be tested at two times the rated voltage plus 1000 V for at least one minute without breakdown. And remember: conditioners with isolation may handle stated ratings when new, but factors such as ageing, dust build-up and general environmental wear can degrade and break down isolation barriers. In general, though, units designed, rated and tested according to established guidelines provide better lifetime performance and an additional margin of safety.

The benefits of isolation in a signal conditioner are well worth their \$50–\$100 extra cost. Typically, most applications need isolation when transmitting signals from one place to another. If you are not sure of the type you may need, consult an application engineer or technical support person. And when shopping in the market, ask how the ratings are achieved and verified.

Surge withstand capability

Surge withstand capability (SWC) — which is the ability of a signal conditioner to reject high voltage and frequency electrical interference — should be considered wherever signal conditioners are to be located. Typically, a unit receives a standardised high voltage (2 kV crest), decaying high frequency transient, synchronised to the line frequency (Figure 3). During testing, this signal is applied to the input/output terminals and across any isolation barriers for about 10 seconds. A conditioner with SWC protection will not be harmed by these bursts and is more reliable in the field.

RFI/EMI

The increasing need for reliable communications in factories and plants means that more and more industrial electronic equipment may require built-in radio frequency interference (RFI) immunity. At the same time, this equipment's susceptibility to the electromagnetic interference (EMI) effects of inductive load switching relays and noise induced by heavy operating equipment (Figure 4) must also be considered. Unfortunately, there's a very good chance you won't know you need RFI/EMI protection until somebody keys up a radio transmitter near your device or mounts it in a noisy electrical environment, and the output readings become erroneous.

Devices with RFI protection should specify a rejection range of frequencies at or exceeding 10 V/m field strength. Common bandwidth ranges span from 27 to upwards of 900 MHz for some portable radios.

There are two commonly used methods to reduce the effects of RFI. One is to enclose the circuit in a metal box tied to ground that has filter capacitors across the input terminals (Faraday shield). The other approach involves a combination of inductors, filter capacitors, component placement and PC board manufacturing techniques to minimise the effects of RFI.

Both approaches are valid and yield similar performance. However, the latter allows the use of durable, low-cost plastic housings instead of expensive metal enclosures. In addition, it provides the ability to remove covers and calibrate equipment in the field under RFI and EMI conditions.

Reducing the effects of RFI requires considerably more effort than EMI. RFI is transmitted to all parts of the circuitry and is easily coupled into the amplifier circuits. EMI is primarily coupled through input wiring and may be clamped and attenuated through circuit techniques.

Manufacturer testing for EMI at the output verifies the conditioner is protected from noise spikes. If you find the device lacks EMI protection, you'll have to go the do-it-yourself route with external surge protectors or diode clamping.

Packaging

Signal conditioners come in a variety of packages including DIN rail, hockey-puck enclosures, general-purpose NEMA 1 type enclosures, NEMA 4/12 and 19″ rack-mountable card cage systems. Different applications require different styles of packaging. Low-volume needs tend to require standalone enclosures whereas high-volume needs are best met by high-density packaging (rail mount or rack mount). If real estate is a constraint in your system and packaging styles are a priority, then knowing what is available will be to your advantage.

Electrical connections and wiring methods also vary with packaging. In some cases, the effort of busing power to multiple standalone units can be drastically minimised by using

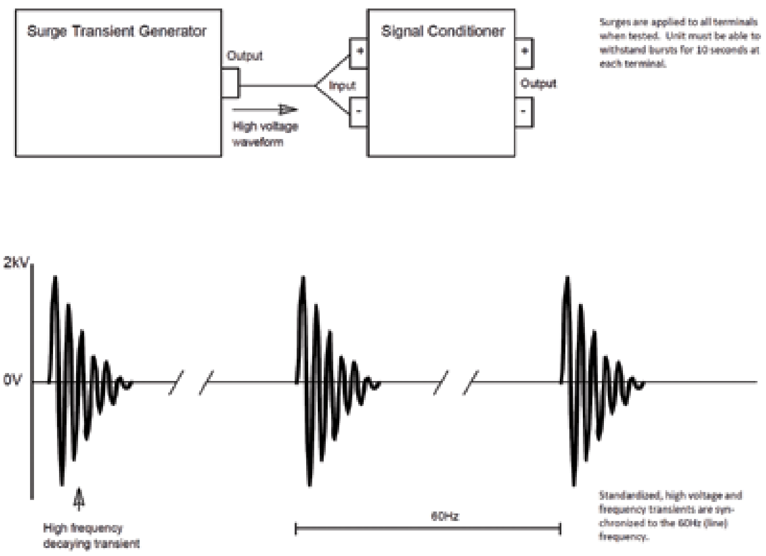

Figure 3: Signal conditioners should be tested to ensure their ability to reject high voltage and frequency surges.

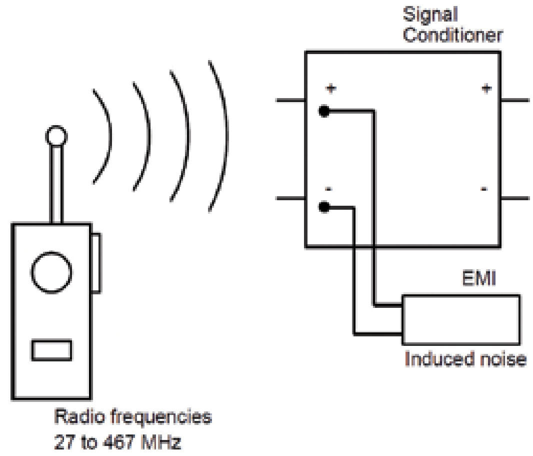

Figure 4: RFI/EMI can cause serious measurement errors.

card cage or plug-in backplane systems that bus the power for you. These systems allow the user to bring power to only one terminal block and internally bus the power to all associated channels. In addition, they separate the electronics from the wiring terminals and allow the removal or replacement of a module without rewiring.

Other forms of packaging lend themselves to a more modular approach. DIN rail packaging, for example, is an expandable, optimised way to mount any quantity of signal conditioners that use conventional wiring methods. Card cage and backplane systems can be cost-effective when most of the channels or points are fully utilised. Standalone units are cost-effective for low quantity needs; if they are designed in a modular fashion, the price per point becomes evenly distributed as quantities increase.

Knowing your quantity needs, anticipated growth needs and available space can help save dollars on your signal conditioner purchases. Many manufacturers offer the same signal conditioners in a variety of packages, so you should explore all packaging options.

Repairability

As with all purchases, you should consider future requirements and repairability when selecting signal conditioners. For example, products using insertion technology are easier to repair and maintain than potted, disposable surface-mount packages. Knowing how devices are manufactured will help you determine their repairability. If a conditioner can be repaired and maintained rather than discarded, you will save a lot of money in years to come.

In summary

The importance of comparing specifications and features before selecting a signal conditioner cannot be emphasised enough. Accuracy, adjustability, isolation, SWC, RFI/EMI, packaging and repairability should all be involved in your price vs performance equation. If you take these specifications too lightly, you could pay dearly in time and money in years to come.

Metromatics Pty Ltd
www.metromatics.com.au

MAGNETIC MIXER

The Alfa Laval LeviMag mixer delivers low-shear mixing, gentle product treatment and easy cleanability.

Capable of operating at a broad range of speeds, these magnetic mixers feature a specially designed four-wing impeller that delivers high pumping efficiency.

These features are designed to safeguard product integrity, provide full drainability and ensure efficient mixing down to the last drop because the mixer can be run dry. The open mixer design enables full coverage during CIP processes, making the removal of product residues more efficient.

The LeviMag mixers are said to offer ease and convenience of servicing. Levitating bearings contribute to reduced costs, improved product safety and more uptime. High-strength, stress-tolerant male bearings minimise the generation of wear particles that can contaminate the product. Low-wear female bearings are also a feature.

An UltraPure version is also available for biotech and pharmaceutical manufacturers. It complies with requirements for operation in demanding sterile applications.

The mixer comes with the Alfa Laval Q-doc comprehensive documentation package. To assist in validation, qualification and change control, it provides full transparency of sourcing, production and supply chains — from raw material to delivered equipment. Q-doc also provides full traceability of all product contact parts.

Alfa Laval Pty Ltd

www.alfalaval.com.au

PROFIBUS TESTER

The Softing Profibus Tester 5 is an all-in-one tool for testing bus physics, bus communication and cabling, and is available to rent from TechRentals. It is suitable for installation, set-up and commissioning, documentation, acceptance testing, network optimisation, preventive maintenance, troubleshooting and laboratory tests. The instrument is a combination of a signal tester, storage oscilloscope, protocol analyser, master simulator and cable tester.

The Profibus Tester 5 is battery operated and includes a graphical display that provides comprehensive test results in an easy-to-understand format, making it suitable for users of all experience levels. It can be used in standalone mode or can be connected to a PC for extended diagnostics. Its test report generation enables both a Quick Test and User-Controlled Test. It also has an automatic baud rate detection from 9.6 Kbps to 12 Mbps.

TechRentals

www.techrentals.com.au

ONLINE CONFIGURATOR FOR E-CHAINS

Designed for quick and easy configuration of complete energy supply systems, the igus e-chain expert is an online tool with which users can design their own ready-to-connect energy chain system in a few steps. The interior separation is made automatically and the user receives information on the durability of the energy chain and cables used. This allows the user to easily choose the most cost-effective system which fits their application and order it directly.

Whether it is an unsupported, gliding or hanging application, the configurator determines the energy chain that is optimally suited. To do this, the user simply has to open the e-chain expert (www.igus.eu/e-chain-expert) select the unharnessed or harnessed cables, enter the application and environmental parameters, decide on the appropriate energy chain from a pre-selection and configure it. In the energy chain configurator, the user can choose from over 1300 chainflex cables tested by igus as well as over 4200 harnessed drive cables. On the basis of the specified cables and the application data such as installation space, movement and environment of the energy chain, the user can choose from a selection of 150,000 e-chain parts for the most effective solution.

An interior separation configurator is used in the online expert, using AI to determine the appropriate interior separation for the defined cable pool. Due to an integrated service life calculation, both for the energy chain and the individual cables, the user can quickly and easily choose the most cost-effective system which safely meets their requirements.

Treotham Automation Pty Ltd
www.treotham.com.au

HYGIENIC SELF-PRIMING PUMP

Alfa Laval's LKH Prime 40 hygienic self-priming pump is claimed to offer high energy efficiency and versatility, as well as allowing for significantly reduced noise levels and easy maintenance. The pump has the ability to reach a flowrate up to 110 m^3/h and head of 115 m. It is also EHEDG certified and authorised to carry the 3-A symbol.

Designed for reliability in cleaning-in-place (CIP) duties containing entrained air, the LKH Prime can also pump product, potentially reducing the capital investment when designing process systems.

Quiet in operation, Alfa Laval LKH Prime is claimed to reduce sound pressure levels by 80% when compared to pumps using traditional pump technologies for CIP/entrained air applications.

The pump is easy and cost-effective to service and maintain. By sharing common parts with the Alfa Laval LKH pump range, LKH prime offers lower cost of ownership and increased uptime.

LKH Prime UltraPure versions are also available for pharmaceutical applications.

Alfa Laval Pty Ltd
www.alfalaval.com.au

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MULTI-PURPOSE DIGITAL PANEL METERS OFFER HIGHER USABILITY

The release of a series of new, advanced WPMZ digital panel meters from Watanabe Electrics is intended to fulfil users' requirements for intelligent instruments.

In the era of automation, industries have put strong emphasis on improving efficiency and quality control in the processing and production environment by using advanced and state-of-the-art sensing instruments. Sensors have been extensively used in the processing line to measure and gather information on process performance, and advanced and intelligent measuring instruments are needed to provide accurate and reliable reading from the sensors.

The release of a series of new, advanced WPMZ digital panel meters from Watanabe Electrics is intended to fulfil users' requirements for intelligent instruments. The WPMZ panel meter offers digital readings that are easy to read as well as an easy-to-operate users interface. The display can also be adjusted to suit lighting conditions, and the display can be rotated by 90° to fit into narrow places. With suitable sensor selections, these units can be used for high-speed applications with maximum aggregate sampling rate of 4 kHz per unit.

The WPMZ series digital panel meters are also programmed with up to ten arithmetic expressions, which can be freely set by cross-keys, to calculate parameters from two input channels. Both the measurement value and the calculated value can be shown in one display. This introduces significant cost and space savings when the instruments are used as display devices in a processing line.

Different types of applications

The WPMZ panel meters are available in four different types to accept various process inputs, including analog, strain, pulse and flow rate. These are intended to cover a broad range of measurement requirements including process monitoring and quality control.

The WPMZ-1 offers DC voltage and current input configurations with an alarm log function. It can be configured to sample data at high speed to capture instantaneous changes in process values that often occur during press or torque measurement. Depending on the sensor used, this unit can be used for measuring almost all types of physical parameters. For example, displacement sensors can be used in conjunction with the WPMZ-1 to measure thickness by utilising the built-in arithmetic expressions.

Offering a waveform display and a multi-hold function, the WPMZ-3 is best suited for applications in quality control. To do this, users must first create a comparison waveform to be matched with the measured value. Measurements can be initiated by an external control function and alarm signals will be relayed if the measured value does not match the comparison waveform. This function offers enhanced efficiency for monitoring quality in constant cycle production environments.

With pulse and line driver inputs, the WPMZ-5 is more suitable for measuring rotational speed such as during the inspection of a motor. On the other hand, the WPMZ-6 is specifically designed for the measurement of flow rate. It can measure simultaneous or integrated flow rate and is particularly useful for the measurement of total flow from tanks. As it can monitor two different flow rates simultaneously, users may be able to monitor the flow difference between the two lines for the purpose of stabilising a mixing process for example.

Benefits for the wider industry

With advances in the development of modern measuring instrumentation, digital displays and metering devices are no longer being used for the sole purpose of displaying results from the sensors. The implementation of an arithmetic function, as well as the WPMZ-3's unique waveform feature, open up the possibility of expanding and optimising digital measurements in a production process.

For more information, please contact Bestech on www.bestech.com.au or call 03 9540 5100.

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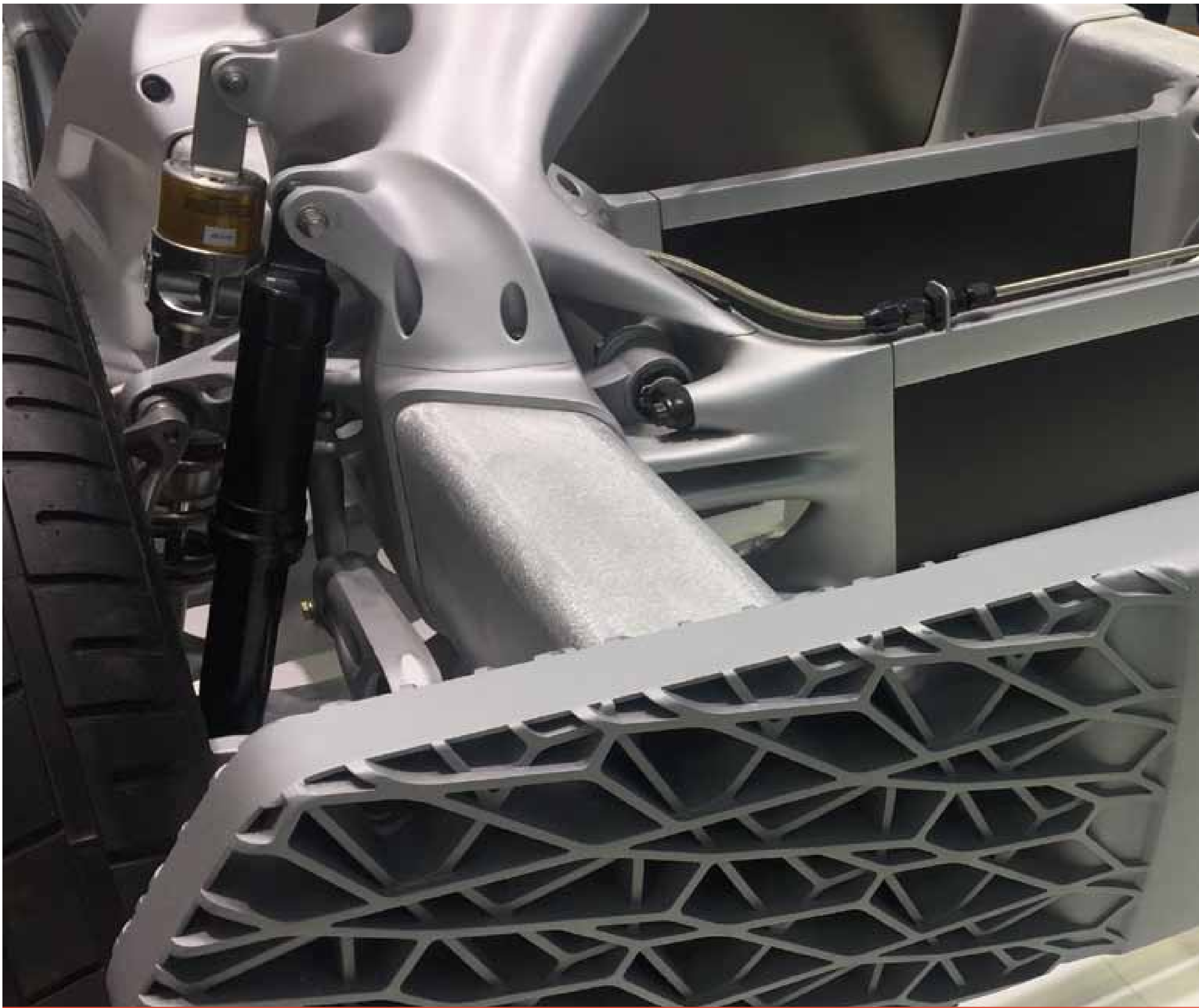

ADDITIVE MANUFACTURING

CHANGING PARTS MANUFACTURING

The uptake of 3D metal printing will have a profound impact on manufacturing in the future.

Additive manufacturing (AM) processes build three-dimensional (3D) parts by progressively adding layers of materials guided by a digital model. There are two distinct processes of metal AM: directed energy deposition (DED) and powder bed fusion (PBF).

Both processes offer advantages in differing situations. For example, DED is often a preferred process for adding functions and shapes to already manufactured parts, small to very large. Here a coaxial nozzle conveys the laser beam, powdered metal and inert gas to direct the deposit of metal. The process of 'building' is layer-by-layer similar to PBF. PBF occurs within 'build chambers', with the size or number of parts limited by the size of the chamber. However, this controlled environment has seen exceptional advances over recent years with the introduction of overlapping and multibeam technology using high-powered lasers to increase machine functionality, as well as effectively speeding up the build process.

The contribution of R&D

The development of AM metal processing, or 3D printing as it is popularly known, has grown out of research and collaboration in universities, national laboratories and industrial research centres. Such dependence on research and development offers a unique pathway to bringing about change in modern manufacturing processes. Progress can be measured in R&D output, or case studies,

Divergent — utilising AM in car production.

that has stemmed from collaborative research between partners in small businesses and PBF machine manufacturers.

The need for standards

Such is the growth of 3D metal printing and the demand for reliable parts — particularly in the aerospace industry — that the development of standards for production has been flagged as a critical area to address. For an emerging, highly technical sector, AM standards will provide the foundational element for the growth of the industry, defining the rules and providing benchmarks for best practice.

One area requiring technical standards relates to the powder melting process (called 'fusion') that occurs in the layer-by-layer build process, to ensure it reaches absolute consistency and reliability essential for structural integrity — particularly in large titanium parts such as those being developed for aircraft.

The automotive industry seems to be heading towards solutions for large-volume parts production, so 'best practice' standards will help quality over long production runs that in turn will speed up automotive production times.

Clearly, AM is no longer just for prototyping. Fuelled by the growth of multilaser machines, AM has emerged as a catalyst in reshaping the manufacturing business where development is happening at speeds so fast that standards already struggle to keep up. But standardisation is essential to the industry's success, at least in reducing the trial and error of implementing the technology, reducing the costs of innovation and in turn securing investment.

The current expansion of 3D metal processes exists in two major industries: the automotive industry and the aviation/aerospace industry. The reason for early uptake in these industries lies in the opportunity to reduce production costs by combining several functions into one part, thereby removing the joining process — but more importantly, to improve product functionality by adding, for example, curved cooling channels on critical heat-bearing car parts, which was never before possible.

The critical factor of weight

Different types of metals in powder form can be used to create parts. For example, titanium has proven very attractive to both aviation and aerospace as titanium parts reduce weight, which in turn reduces fuel consumption — a huge cost in flying any craft.

The opportunities of redesigning functionality by combining several parts have also been a huge success, with the most published example of the fuel nozzle developed by GE that combined some 19 different pieces into a single, highly functional and cost-effective item now in use in commercial aircraft. It is not well known, but the first 3D printed component 'took off' in 2014, being a small titanium part under the pylon connecting the jet engines to the wings of an Airbus A350. Since then the number of parts has increased, with a Boeing 747 already utilising six million 3D printed parts.

3D printing technology provides airline companies with entirely new benefits and opportunities, such as the manufacturing of complex components that would not be possible with conventional production methods. It also offers great potential to reduce the cost and weight of aircraft structures. Further, the lower weight means lower fuel consumption, which makes the commercial flights more environmentally friendly and more affordable for passengers.

The material requirements for aerospace are very high, due to the safety-critical nature of parts that must meet standards and performance specifications and be easily replaced after their 'flight life'. A number of aircraft parts manufacturers across Europe and the US are moving into 3D metal part production. So too is the

Figure 1: Thrust chamber of a CellCore rocket engine.

space industry, with a British company in Manchester, Orbex, which launches small satellites, producing the world's largest single-piece 3D printed rocket engine. The engine is claimed to be some 30% lighter and 20% more efficient than any other launch vehicle in its class.

An example is shown in Figure 1, which shows the monolithic thrust chamber of the CellCore rocket engine. The highly complex part shows the advantages and possibilities of AM — it combines integral design (the combination of the numerous individual components into one component) with multifunctional lightweight construction.

Impact on the automotive industry

Racing to take up the opportunities offered in 3D metal printing, the automotive industry represents the largest opportunity globally, with a product value forecast for 2030 of US$148 billion in additive manufacturing. As recent as March 2019, German interests came together to form the Industrialization and Digitization of Manufacturing (IDAM) group. IDAM includes 12 project partners, universities, research organisations such as Fraunhofer, German businesses and car manufacturers including BMW, who are all very serious about 3D metal series production of car parts. The aim is for series production to result in the highest quality, influenced by extreme cost pressures. The additive manufacturing goal is at least 50,000 serial parts produced per year in Germany. The project covers two AM production lines in Bonn and Munich, which include the total process from digital design to the physical process of component manufacture all the way to post-processing.

Development of a series-ready modular production facility for metal 3D printing will establish much-needed standards that are going to be required if forecast production is to be reached.

The thinking around automotive products revolves around safety — in concepts such as driverless cars and environmental issues through the reduction of vehicle dependence on petrol. Kevin Czinger, founder of Divergent, is concerned with sustainability through the production of the Divergent Blade, a two-door sports car. The evolution of building a chassis with 3D metal printing systems with a laser company partner led to developing specific hardware and software to accelerate the scaling of the patented Divergent Manufacturing Platform for cost-effective, high-volume production of vehicles (title image).

In early 2018 the world's largest single 3D printed break caliper was made for the $3 million Bugatti Chiron, the fastest production car in the world. Using an SLM500 system featuring four 400 W lasers with a 500 x 280 x 365 mm build chamber, the component was manufactured with an aerospace alloy, Ti_6Al_4V, taking 45 hours to make. Not only was the finished caliper (Figure 2) much lighter in weight than the previous aluminium part, but once removed from the build chamber it was ready to be installed, removing the costs of part joining and finishing.

Looking ahead

Just how 3D printing will affect manufacturing in the future is yet to be explored, but the airline and aerospace industries along with the car industry are moving forward very quickly. The uptake of 3D metal printing in these industries alone will have profound impact on manufacturing in the future, as lessons learned will pave the way for early adopters in other industry groups. 3D printing machines will become more cost-effective as demand grows and software will provide solutions from design to post-processing, with 3D production becoming as familiar as CNC machining on the manufacturing floor.

Clearly, as production process grows, traditional methods for part supply will be impacted, large inventory holdings becoming a thing of the past as parts on demand will surface, changing supply and logistics as it grows. Thanks to the research institutes and pioneering partners in 3D metal printing, the future of part production across a range of industry groups is looking very bright indeed.

Figure 2: This part for the Bugatti Chiron is the world's largest 3D printed brake caliper.

Raymax Applications Pty Ltd
www.raymax.com.au

Flexible control system for yoghurt plant

Chobani produced its first cup of Greek yoghurt in 2007, and not long after that became the top Greek yoghurt brand in America. The award-winning company has achieved much notice for its rapid rise, innovative ideas and quality products. In 2012 the company opened the largest yoghurt-manufacturing facility in the world. Located in Twin Falls, Idaho, the plant has been expanded twice already, and it now covers more than 130,000 m^2. In late 2017, Chobani broke ground on a third expansion in Twin Falls, for a $20 million global research and development centre.

Chobani is based in Norwich, New York, and employs more than 2000 people. In addition to Idaho, the company has plants in New York and Australia. To help keep production running smoothly, Chobani has been leveraging Ignition software for years. Ignition by Inductive Automation is an industrial application platform with integrated tools for building solutions in human-machine interface (HMI), supervisory control and data acquisition (SCADA) and the Industrial Internet of Things (IIoT).

Chobani uses Ignition at all three of its plants — on filler and packaging lines, for quality control, in asset management, with enterprise resource planning (ERP) and in capital-expenditure project management. "Ignition has really taken Chobani by storm," said Hugh Roddy, Vice President of Global Engineering and Project Management for Chobani.

Ignition has helped Chobani improve efficiency and reduce downtime. "Once we took Ignition on board as one of our enterprise platforms, everything has improved exponentially across the board from an operational standpoint," said Roddy.

The company firmly believes in sharing data with its employees. "Our people want to be involved," continued Roddy. "They want to be part of what we're doing here at Chobani. Having the data from Ignition at their fingertips really helps our employees be more efficient, and it makes them feel part of the team."

"Ignition has been a very good bridge for OT/IT collaboration," said JC Givens, Global Network Services Manager at Chobani. "We've been able to make gateways available to both networks, so whether people are in the office making decisions or on the plant floor making decisions, IT and OT information are both available."

Ignition's unlimited licensing has helped Chobani keep up with rising demand for its product. "Because of the unlimited licensing with Ignition, we can roll out as many clients, as many places as we want, whenever we see the need," said John Furby, Automation Engineer for Chobani.

One advantage is the ability to set up a single HMI for a special need. In one example, Chobani used this capability for a specific location within its new plant. "Previously, operators were having to use a radio to call in, and have someone start each step of the process for them," said Trevor Bell, Automation Engineer with Chobani. "With Ignition, we're able to have a special HMI out there, just for them. Ignition makes it really cost-effective to do a one-off scenario like that."

Chobani also likes Ignition's ability to speed up the development process. "Whenever we can save time in developing an HMI and implementing it, it's really valuable for our team," said Bell. Customisation is easier as well. "Ignition gives us a software system that we can actually develop to our own requirements," said Roddy. Furby agreed. "The template development in Ignition is especially easy," said Furby. "We can make custom data types and custom graphics that we can easily roll out to all of our projects."

Ignition has also freed up operators so they can roam the plant and still have access to data on phones and tablets. "Ignition has given us the ability to be mobile on the plant floor," said Roddy. "Our operators and maintenance people don't have to be running back to the control room. From anywhere, we can control a valve or a pump and get full visualisation of what's happening in the plant, from raw receiving all the way through packaging."

Roddy also appreciates the work of two system integrators Chobani has worked with extensively. "Industrial Networking Solutions (INS) brought Ignition here to Chobani," said Roddy. "We've partnered with INS for five years, integrating Ignition across our sites around the world. With INS and also Tamaki Control working with us on Ignition, it's really brought remarkable results for us here, in a very short period of time."

ESM Australia
www.esm.com.au

AS I SEE IT

WITHOUT SECURITY, SAFETY IN THE IIoT IS OF LITTLE VALUE

As technology progresses and economies of scale continue to work their magic, more powerful microcontrollers are finding their way into smaller, smarter instruments. This additional processing power allows real-time operating systems (RTOS) and network stack software to run and connect the devices to the internet. But while the engineers are basking in the glow of their new IIoT device they fail to notice that they just painted a big red X on their instrument; it has become a potential target.

Imagine that the device has a sensor providing information to a control system. What happens if an electronic intruder is able to make that sensor lie, or for it to be misinterpreted, such that the controller uses incorrect values? This could have implications ranging from having little or no impact, to financial loss, all the way to the loss of life due to a plant disaster. In this case, the instrument manufacturer may have created a SIL-rated device but if you can drive a truck through their security holes, will anyone care how low the PFD is, or how high a Safe Failure Fraction the device has?

One way for manufacturers to address security needs is to look to IEC/ISA 62443 and its seven Foundational Requirements (FR). Based on how well the devices implement these requirements, one of five Security Levels (SL) will be awarded for each FR. Depending on the results of a plant/facility cybersecurity audit, different network zones and segments will be determined to require different levels of protection.

As one would expect, Security Levels start from providing no real protection and move up through protection against attackers with more sophistication, resources, skills and motivation. Depending on the nature of your IIoT device, your security needs may not be very extreme. However, if your device is the last line of defence in a safety system, then your needs ARE extreme. This IEC standard is just one set of recommendations for cybersecurity. Even if an IIoT device is not going to be evaluated against it, it still provides good advice on security features to consider.

The reality is that instrument manufacturers' safety-related devices are designed from the beginning to meet a particular SIL rating. Their hardware and software development and management processes as well as the resulting paper trails must be up to the task to hold up to the scrutiny of audits. Companies that are capable of this level of excellence when it comes to making safe (SIL-rated) devices are also likely to be able to meet the levels of rigour needed to achieve their targeted Security Level.

With every news story about a data breach, hacking or other cybersecurity attack, the stakes get higher. The good news is that, like other engineering areas, risks can be reduced. Using security features present in modern instrumentation will help, but more importantly, ensuring their compliance can go a long way to plugging holes.

I like to believe that people are basically good and want to do their jobs properly — keeping things safe and secure. Therefore, microprocessor-based instrumentation, sensors, control systems and final control elements should be designed from the ground up to enable them in this mission. In today's world, a device performing a critical function cannot reach its safest levels unless it is also secure.

Jonathan Berg is the Software Engineering Supervisor at Moore Industries International, where he manages a team to design and develop embedded software for instrumentation. He has over 20 years' experience in the industry, has spent the last 10 years developing software for functional safety (SIL3) products, and has a keen interest in the evolution of the IIoT.

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