

# VALVE



FALL 2024

Valve Basics: Solenoid Valves

Infrastructure Growth  
to Continue

Total Cost of Ownership

## Rising Use of FPSOs Requires More Severe Service Equipment

VOLUME 36 | NUMBER 4 | VALVE-MEDIA.COM

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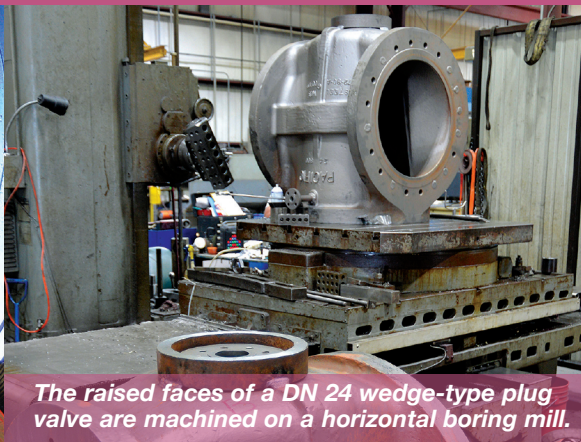
## Latest Launches

- Real-time valve monitoring
- High-pressure severe service check valve
- Wireless 8-channel transmitter

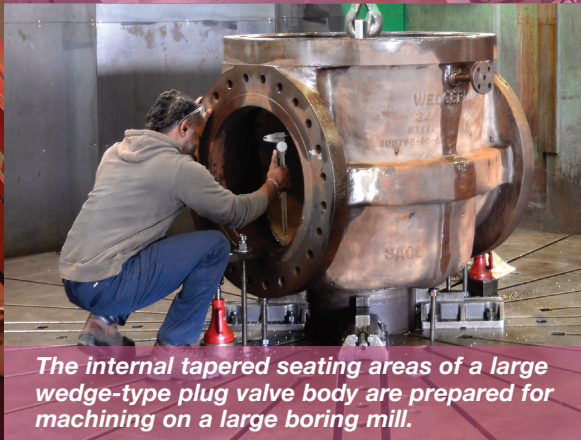
# Rising-Rotating Plug Valve Repair & Service



*The seating areas of a DN 30, wedge-type plug valve are weld-repaired, prior to machining and grinding.*



*The raised faces of a DN 24 wedge-type plug valve are machined on a horizontal boring mill.*



*The internal tapered seating areas of a large wedge-type plug valve body are prepared for machining on a large boring mill.*

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The largest boring mills in our machine tool inventory can machine plug valve tool components of any size or material, while our grinding machinery is capable of handling valves of up to NPS 24 for both internal and external grinding. The machining department features 20-ton cranes, while the adjacent assembly area is served by a 40-ton crane.

Weld repairs are often required on these plug-type metallic valves. The United Valve welding department is led by our in-house welding engineer and features both manual and mechanical welding processes. All of our 200+ welding procedures are created and qualified in accordance with ASME Section IX, as well as approved by many, even stricter end-user specifications.



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# Connection, Learning and Innovation: The Power of Industry Events

**Walking through** the International Manufacturing Technology Show (IMTS) in September was a refreshing reminder of how manufacturing is evolving. The technology on display — from cutting-edge automation to AI inspection tools — showcased the future of manufacturing: working smarter, not harder. With workforce challenges and global competition, this message has never been more relevant.



Everywhere I looked, automation and smart manufacturing were front and center. Robots, cobots, and conveyor systems were highlighted showing how they can take over repetitive tasks, freeing up skilled operators to tackle

more complex challenges. And companies told me that AI won't mean the elimination of jobs, in fact the opposite may be true. Employers need people to understand workflows and program robots and cobots to gain the most efficiencies. AI was another star of the show, streamlining everything from inspection to data optimization — topics we'll dive deeper into in future issues.

October took me to the VMA Annual Meeting in Park City, Utah, where I had the pleasure of connecting with VMA members from across the U.S. and Canada. These face-to-face interactions are invaluable, as they spark new ideas and deepen my understanding of the industry's needs. I'd love to hear more from you — whether it's story ideas, case studies, or news about your latest products. Drop me an email with your thoughts.

If there's one takeaway from these events, it's that stepping out of our daily routines to network and learn is crucial. Whether at a trade show, workshop or conference like the VMA Hydrogen + Energy Valve Summit or Valve Forum next spring, these opportunities open doors to fresh ideas, valuable connections and a renewed focus.

So, as we head into the fall and holiday season, I encourage you to get out there, connect and see what you can discover. It's a great way to recharge and come back to your work with new insights and to always keep learning.

Cheers,  
Heather

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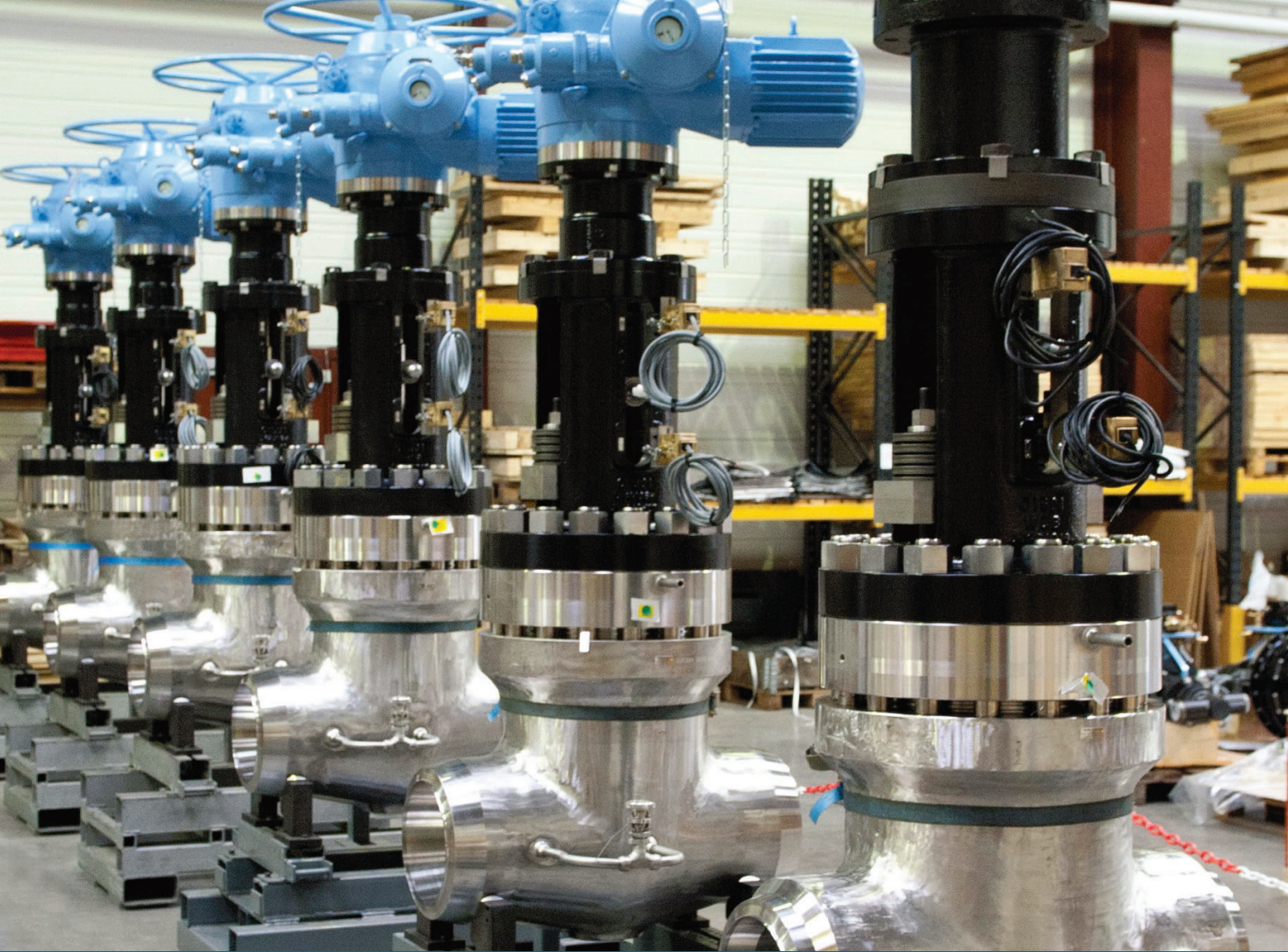
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# INDUSTRY NEWS

## Alfa Laval to Supply First Systems for Ammonia-Fueled Marine Vessels by End of 2025

Alfa Laval is working to decarbonize the marine industry to meet net-zero targets. The marine sector, which accounts for nearly 3% of global carbon emissions, has seen the emergence of a new fuel landscape, with ammonia destined to become one of the future low-carbon fuels of choice. As a front-runner in enabling ammonia, Alfa Laval says it will be ready to supply its first fuel systems for ammonia-fueled vessels by the end of 2025.

In partnership with Swiss engine

designer, WinGD, Alfa Laval has delivered two test systems for WinGD's ammonia-fueled engines, including a fuel valve train and a vent treatment system.

The Alfa Laval FCM Ammonia fuel supply system design will be validated by the end of 2024, with the first marine delivery expected by the end of 2025.

As a zero-carbon fuel, ammonia is



anticipated to become an important component in the marine industry's efforts to reduce its carbon emissions, holding significant promise to meet the International Maritime Organization's (IMO) 2050 strategy.

## Agreement for Small Modular Reactors to Power Data Centers

X-Energy Reactor Company, LLC (X-energy) announced its collaboration with Amazon to generate and deliver more than 5 gigawatts of new power projects across the U.S. by 2039, representing the largest commercial deployment target of small modular reactors (SMRs) to date. The partnership will support future carbon-free projects that will use X-energy's Xe-100 advanced SMRs as well as long-term power

purchase agreements to power Amazon operations, including energy-intensive data centers. Amazon's Climate Pledge Fund and other supporters will invest approximately \$500 million in Series C-1 financing round for X-energy to help commercialize the technology and bring it to market.

Through its collaboration with Amazon, X-energy plans to build one of North America's first grid-scale advanced nuclear reactors with Energy Northwest in Washington state, initially supporting one four-unit, 320-megawatt (MW) high-temperature gas reactor plant with the option to increase that project to 12 units and 960 MW.

X-energy's Xe-100 is a Generation IV, high-temperature gas-cooled reactor optimized to deliver 320 megawatts of electric output. The reactor can provide clean, reliable and safe baseload power to an electricity system or support various industrial applications.

## Vertex Energy Announces Startup of Mobile Refinery Hydrocracker

Vertex Energy, Inc. announced the start-up of the Mobile, Alabama, refinery hydrocracker in conventional service and initial production volumes of higher value finished products for the fourth quarter of 2024.

The hydrocracker reconversion project began following the completion of final processing of renewable feedstock inventories and was executed as part of a previously planned catalyst and maintenance turnaround.

In conventional service, the Mobile Refinery's hydrocracker utilizes vacuum gas oil as feedstock to produce additional volumes of higher value refined products, including gasoline and diesel.

The Mobile refinery has preserved renewable fuels production capabilities should future market conditions warrant.



## Westinghouse Submits Safety Design Report for eVinci Test Reactor

Westinghouse Electric has submitted its eVinci Microreactor Preliminary Safety Design Report (PSDR) to the Department of Energy's National Reactor Innovation Center (NRIC). Westinghouse is the first reactor developer to reach this milestone in support of siting its test reactor at NRIC's Demonstration of Microreactor Experiments (DOME) test bed at Idaho National Laboratory (INL).

The PSDR is a major milestone in the recently completed Front-End Engineering and Experiment Design (FEEED) process that Westinghouse began in October 2023. The PSDR provides comprehensive safety and operational reference materials prepared by the dedicated eVinci team and follows DOE-Idaho's approval of the eVinci Safety Design Strategy.

The eVinci microreactor builds on Westinghouse innovation to bring carbon-free, safe and scalable energy for a variety of applications, including providing reliable electricity and heating for remote communities, mining operations, industrial centers, data centers and defense facilities, and soon the lunar surface and beyond. The eVinci works essentially as a battery, providing the versatility for power systems ranging from several kilowatts to 5 megawatts of electricity, delivered for 8-plus years without refueling. It can also produce high temperature heat suitable for industrial applications, including alternative fuel production, and has the flexibility to balance renewable output.



## Flowserve Completes Acquisition of MOGAS Industries

Flowserve Corporation, a provider of flow control products and services for the global infrastructure markets, announced that it has completed the acquisition of MOGAS Industries. This transaction helps strengthen Flowserve's presence in mission-critical severe service valves and associated aftermarket services.

"We welcome the MOGAS team to Flowserve and look forward to leveraging our industry-leading scale to expand the MOGAS severe service portfolio and aftermarket services to



customers around the world," says Scott Rowe, President and CEO of Flowserve. "This acquisition accelerates growth under our 3D strategy and enhances our valve aftermarket business with MOGAS' large installed base."

Flowserve intends to fully integrate MOGAS into its Flow Control Division segment.



## Kairos Power and Google Sign Power Purchase Agreements

Under the agreement, Kairos Power will develop, construct and operate a series of advanced reactor plants and sell energy, ancillary services and environmental attributes to Google under Power Purchase Agreements (PPA). Plants will be sited in relevant service territories to supply clean electricity to Google data centers, with the first deployment by 2030 to support Google's 24/7 carbon-free energy and net zero goals.

The innovative, multiplant agreement will support technology development by extending Kairos Power's iterative demonstration strategy through its first commercial deployments. Building on progress from

the early iterations, each new plant will enable continued learning and optimization to support accelerated commercialization.

Google's deep commitment to decarbonization makes it a clean energy development leader. Since 2010, the company has signed more than 115 agreements totaling over 14 gigawatts of clean energy generation capacity. The additional generation developed under this multiplant agreement with Kairos Power will complement Google's existing use of variable renewables, like solar and wind, and help them reach their ambitious carbon-free energy and net zero goals.

## World's First 1 Gigawatt Off-Grid, Hydrogen-Powered AI Factory Data Center

Data Center-as-a-Service pioneer ECL, which unveiled the world's first off-grid, sustainable, modular, built-to-suit data center on June 20, 2024, announced that it will build the first fully sustainable 1 gigawatt AI Factory data center — ECL TerraSite-TX1 on a 600+ acre site east of Houston, with Lambda as its first tenant. The initial phase of TerraSite-TX1 will be delivered in the summer of 2025 at approximately \$450 million, with 50 megawatts of data center capacity to be utilized by data center cloud and AI cloud operators. The entire 1 gigawatt site will be constructed for approximately \$8 billion, with funding to be provided by ECL and financial partners.

ECL has made breakthrough strides in addressing critical challenges in the data center industry, as exemplified by the launch of ECL-MV1 — now in full production — the world's first off-grid, hydrogen-powered modular data center that operates 24/7 with zero emissions, minimal noise and a negative water footprint, replenishing water to the community. It offers a 10x increase in energy efficiency with a power usage effectiveness (PUE) of 1.05 and a 7x improvement in data density per rack, which is ideal for AI high-density demands.

## Chevron-Hess Merger Clears FTC Review

Chevron Corporation has announced the Federal Trade Commission (FTC) completed antitrust review of the company's merger with Hess Corporation, satisfying a key closing condition for the transaction.

Completion of the merger remains subject to other closing conditions, including the satisfactory resolution of ongoing arbitration proceedings regarding preemptive rights in the Starbuck Block joint operating agreement.

## People In the News

**Gilmore** Appoints **Matt Cort** as President. Cort joins the company from Emerson where he was vice president of the pressure relief valve business unit. Cort's other positions at Emerson included product management, marketing and strategic planning.



**Black & Veatch** has announced that **Ashley Davidson** has joined the company as senior vice president and chief marketing officer (CMO).

Davidson most recently served as vice president and head of global marketing at Royal Philips, an \$18B Dutch multinational company, with responsibilities of marketing for its global portfolio of emerging technology, healthcare and sustainability solutions powered by data science and artificial intelligence. Before that, she held marketing executive roles of increasing responsibility for 22 years.



## ARI-Armaturen Acquires Warren Controls

ARI-Armaturen Albert Richter GmbH & Co. KG, a European valve-industry company, has acquired Warren Controls Inc., a control valve company based in Bethlehem, Pennsylvania. The acquisition is part of ARI's strategic plan to expand its presence in the U.S. and strengthens its position as a global player in the valve industry.

The acquisition of Warren Controls brings a wealth of experience and ex-

pertise in the control valve industry, which complements ARI's existing capabilities in the U.S. The acquisition will also enable ARI to expand its product portfolio and offer its customers a wider range of products and services.

The acquisition of Warren Controls Inc. was subject to regulatory approvals and was completed in August 2024. Financial terms of the acquisition were not disclosed.

From left to right: Johann Austin, COO of Warren Controls, Thomas Gössling, CFO of ARI, and Ray Yaros, CEO of Warren Controls.



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# The National Board of Boiler and Pressure Vessel Inspectors

The National Board is driven by the vision of global uniform safety of boilers, pressure vessels, and other pressure-retaining items so that no person may experience the devastation of pressure equipment failure.



BY: VALVE MAGAZINE EDITORIAL TEAM

**National Board of Boiler and Pressure Vessel Inspectors**, often referred to simply as National Board or NBBI, was established in 1919 to “promote safety for life and property through uniform construction, installation, repair, maintenance and inspection of pressure equipment.”

Today, National Board’s membership oversees adherence to laws, rules and regulations relating to boilers and pressure vessels and are the chief boiler inspectors representing most U.S. major cities and states and provinces in Canada. Its materials are also being used in other municipalities in cities and countries around the world as the gold standard in pressure vessel safety oversight.

Training and certification are a large part of the role NBBI plays in industry, offering classroom and online training programs for inspectors and pressure equipment professionals. And NBBI administers three accreditation programs for inspection organizations: Authorized Inspection Agencies (AIA), Federal Inspection Agencies (FIA), and Owner-User Inspection Organizations (OUIO).

Accredited inspection organizations are authorized to employ National Board Commissioned Inspectors for in-service inspections and inspections of repairs and alterations performed by NBBI R and NR accredited companies. Accreditation of these inspection organizations involves a thorough evaluation of an organization’s quality system manual to ensure compliance with NBBI’s accreditation requirements. More than 5,000 repair organizations in over 60 countries use the NBIC to perform repairs on pressure-retaining items


The Board also publishes the internationally recognized *National Board Inspection Code*, its flagship publication, that governs and maintains rules for pressure equipment. The

NBIC is adopted into law by most U.S. and Canadian jurisdictions and is the basis for the National Board’s four accreditation programs, R, VR, NR and T/O. More details about each of these designations can be found in the online version of this article.

The National Board also maintains records of pressure-retaining products that are registered by individual manufacturers who meet a set of requirements. Registration with the National Board indicates that a pressure-retaining item is constructed in accordance with the *ASME Boiler and Pressure Vessel Code* and is inspected by a qualified National Board Commissioned Inspector. The NB Mark is used by manufacturers to identify items registered with the National Board.

NBBI operates an international testing facility for pressure relief products. It is the only independent ASME-certified flow lab in the world today, located outside Columbus, Ohio, at the organization’s headquarters.

The National Board is the ASME designee to conduct shop reviews of organizations for the ASME Certification mark with V, HV, UV and UD designators. It is also an ASME Designee for Valve Selection and Test Witnessing. For this function, representatives from the National Board are assigned to visit company sites to select production sample valves for testing at National Board- and ASME-accepted labs.

Kim Beise, former chairman of the Valve Repair Council, has been a longtime contributor to the organization. Beise says, “The work that the National Board does keeps the boiler and pressure vessel industry safe and reliable.” The industry is grateful for the contributions of professionals like Beise. 

*Editor’s note: Much of this article is directly excerpted from the National Board’s website. All excerpted content is copyright of The National Board of Boiler and Pressure Vessels.*



# My Gratitude for All Involved

The fall issue of *Valve*, appropriately, is published during the Thanksgiving season here in the U.S. This issue also follows VMA's 86<sup>th</sup> Annual Meeting, which is when I have the honor of recognizing all the individuals who contribute to VMA. This season and always, I am truly grateful to all of our members and the VMA staff for all that they do to ensure that VMA provides the most value to our members.

This year, VMA recognized Andy Duffy of Emerson, with the prestigious Person of the Year Award and Mitch Anderson of Bray International as the Service Award recipient. Both individuals embody the essence of what the awards recognize — contributions that benefit the individual, membership, greater industry and the companies each person works for. With so many retirements and other changes in our industry, what stands out with both winners is their willingness to mentor and share their knowledge. Read more about the Awards in VMA News.



I'm also grateful that each person — whether a member or the VMA staff — is a pleasure to work with and is committed to moving the VMA and our industry forward. Also during the Annual Meeting, the VMA leadership reviewed some of the successes and activities of VMA over the last year. These included a more user-friendly member resource library to access information on regulations, government requirements, technical information from presentations and more. We spent a lot of time educating our government leaders about the importance and value of many PFAS substances used by our industry to ensure that our products perform as intended and keep air clean, employees safe and other positive outcomes. Additionally, VMA continues to provide fantastic platforms to educate and provide industry networking through many events. None of this would be possible without VMA's staff or members who volunteer their time and expertise.

***I'm also grateful that each person is a pleasure to work with and is committed to moving the VMA and our industry forward.***

At the end of the summer, VMA held its Market Outlook Workshop. The Workshop is unique in that it is held in conjunction with members of the Hydraulic Institute. In addition to the great networking across the flow control industry that takes place with both valve and pump manufacturers and distributors, the speakers address and provide insights into the end-use markets applicable to both groups. For those unable to attend this time, check out the article in this issue, and plan to attend next year!

As always, if you'd like to find out more about VMA, please contact me at [hrhoderick@vma.org](mailto:hrhoderick@vma.org).

Heather Rhoderick, CAE  
President

## VMA and VRC Annual Meeting Elicits Positive Attendee Experiences

This section of Valve provides readers with a look into some of the key issues and activities VMA is actively addressing. Members can contact VMA for more detailed information. To learn about becoming a VMA or VRC member, contact VMA President Heather Rhoderick at [hrhoderick@vma.org](mailto:hrhoderick@vma.org)

The Valve Manufacturers Association (VMA) celebrated its 86th Annual Meeting October 2-4, 2024, in Park City, Utah, with strong attendance and positive reviews from attendees. Attendee evaluations from the event indicated that all in attendance were satisfied or extremely satisfied with the peer networking and speaker quality and topics.

The event offered industry leaders a valuable platform to explore how global manufacturing, political and economic outlooks may impact the industry's future. Attendees heard from experts on transforming business operations for increased profit, the business landscape in India, and regulatory and trade compliance topics. Also shared were successful strategies to retain and attract employees, and examples of AI usage, including concerns about cautions when using AI to protect intellectual property. A deep dive into the mining industry was presented from a local mining company employee.

The Annual Meeting provided many opportunities for networking and relationship building. Industry leaders and peers connected during social activities, fostering deeper collaboration across the sector.



VMA and VRC members network during cocktail hour. All images provided by VMA.



Gil Welsford (ValveMan), Matt Thiel (AUMA) and Seth Guterman (American Valve) discuss employee engagement, AI and other topics at the Annual Meeting.

## VMA Business Meeting Provides a 2024 Review and Look Ahead to 2025

During the Annual Meeting, the VMA held its annual Business Meeting, where VMA's leadership presented key activities from 2024 and 2025 plans.

Andy Duffy, VMA chairman of the board, Emerson, and Heather Rhoderick, VMA president, reviewed some key highlights since the last Business Meeting. These included:

- Submitting proposals to have industrial valves/actuators/controls identified as a "currently unavoidable use" of PFAS (per- and polyfluoroalkyl substances) so our members can continue to manufacture, distribute and ship products as they have been doing.
- Providing education on technical, manufacturing and business topics at three events.
- Reaching over 100,000 readers online through Valve articles.
- Monitoring and communicating updates on regulations and legislations impacting our members.
- Creating a user-friendly online resource library for members.

Kirk Wilson of Flowserve, VMA Executive Committee member, highlighted the coming year. The VMA will focus on ongoing government affairs activities due to the increasing number of regulations and legislative activities affecting the industry. Additionally, events and education continue to be important with the Valve Forum, Hydrogen + Energy Valve Summit, VRC Valve Repair Seminar and the VMA/VRC Annual Meeting all scheduled for 2025. Other key focus areas include developing new products and information on market trends and valve industry statistical data; increasing member engagement and services; growing VMA membership; and, reviewing and updating the strategic plan for the next few years.

VMA members can find more information on the Business Meeting in the VMA Members Resources Library.

## Congratulations to VMA's Membership Award Winners

VMA is excited to announce and congratulate the 2024 Person of the Year and Service Award winners!

The Person of the Year award is VMA's highest honor and is given to one individual annually. The winner truly possesses a passion for the industry and shares their knowledge with others to help advance the VMA and the industry at large.

Andy Duffy, Vice President of Discrete Automation at Emerson, was recognized in 2024 for his leadership over the past year and throughout his career. Most recently, Andy has been instrumental in guiding the VMA through several changes to benefit our members including launching the PFAS Workshop, highlighting sustainability at the Hydrogen Valve Summit and helping relocate the VMA office. He also led efforts to coalesce the membership on steps to take around PFAS activities.

Mitch Anderson of Bray International Inc. received the 2024 Service Award. Mitch has been an Education and Training Committee member, presenting both in person and virtually for the Valve Basics program and offering webinars. He also helped with government affairs efforts and other VMA events, always sharing his expertise.

Heather Rhoderick, VMA's president, stated: "VMA strives to serve our member companies and contribute to the growth and innovation of the U.S. and Canadian industrial valve industry globally. We could not do that without the exceptional efforts of individuals like Andy and Mitch, and we are honored to have them help lead the Association. Congratulations to both!"



Andy Duffy (left) and Mitch Anderson (right) receive their awards from VMA President Heather Rhoderick.

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### Save the Date

Don't miss any of these events!

Visit [vma.org/events](http://vma.org/events)

**April 8, 2025:** Hydrogen + Energy Valve Summit — Orlando, FL

**April 8-10, 2025:** Valve Forum Conference & Exhibits — Orlando, FL

**June 2-3, 2025:** Valve Repair Seminar — Pasadena, TX

## VRC Members Gather and Plan for 2025

This year marks the 35<sup>th</sup> anniversary of the Valve Repair Council (VRC). At this year's Annual Meeting in Park City,



Utah, we recognized the longstanding service of Kim Beise, CEO of Dowco Valve Company, as chair of the VRC Board of Directors. We welcomed Chris

Jones, director of final control services at Midwest Valve Services, as the incoming Chair of VRC.

Three days of programming and networking made for a very productive conference, including a constructive VRC Business Meeting where members discussed several opportunities for the Council's growth and engagement. In the coming months, members will be surveyed on several operational topics and invited to a virtual end-of-year review.

When planning for 2025, be sure to mark your calendars for the Valve Repair Seminar, which will offer a day-and-a-half of education and a facility tour from June 2-3, 2025, in Pasadena, Texas.



Kim Beise (Dowco) receives a ceremonial gavel from Chris Jones (Midwest Valve Services), to recognize his years of service to the VRC. Source: VMA

## VMA Welcomes New Members

VMA welcomes Precision Spray & Coatings as a supplier member. The company specializes in high-velocity oxygen fuel (HVOF) coating services and advanced chrome plating solutions tailored to meet the unique requirements of its clients. In business since 2010, they are based in Houston, Texas. Find out more at [precision-houston.com](http://precision-houston.com)



VMA welcomes Rotork as a member. Rotork is a global provider of mission-critical flow control and instrumentation solutions for the industrial actuation and flow control markets, including oil and gas, water and wastewater, power, chemical processing and industrial applications. In business since 1957, Rotork currently serves 170 countries. Find out more at [rotork.com](http://rotork.com).



## 2024 William Sandler VMA Scholarship Winners

VMA is proud to present William Sandler Scholarship awards to two outstanding students who are pursuing studies in STEM fields related to our industry, and whose parents or guardians work for VMA or VRC member companies.

**Jack Lambin:** Jack is attending the University of Kentucky where he is working toward a bachelor's degree in mechanical engineering. His father is employed by Crane Nuclear.



Jack Lambin

**Stephanie Mabe:** Stephanie is attending Worcester Polytechnic Institute, pursuing a bachelor's degree in robotic engineering. Her father is employed by EGC Operating Company, LLC.



Stephanie Mabe

VMA and VRC members can find information about the 2025 scholarship at [vma.org/sandlerscholar](http://vma.org/sandlerscholar).

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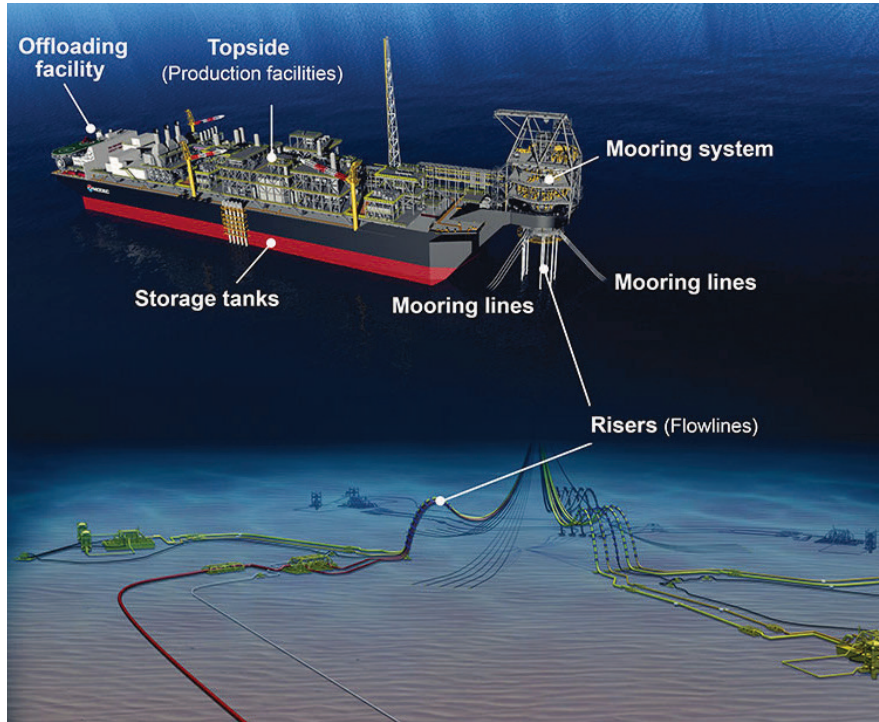
**Valmet**   
FORWARD

OFFSHORE

# FPSO Vessels Demand Severe Service Valves

Rising use of FPSOs requires manufacturers to design valves for the harshest environments, rocesses conditions.

BY: Rebecca O'Donnell and Teo Arcopinto,  
COMPANY: BAKER HUGHES

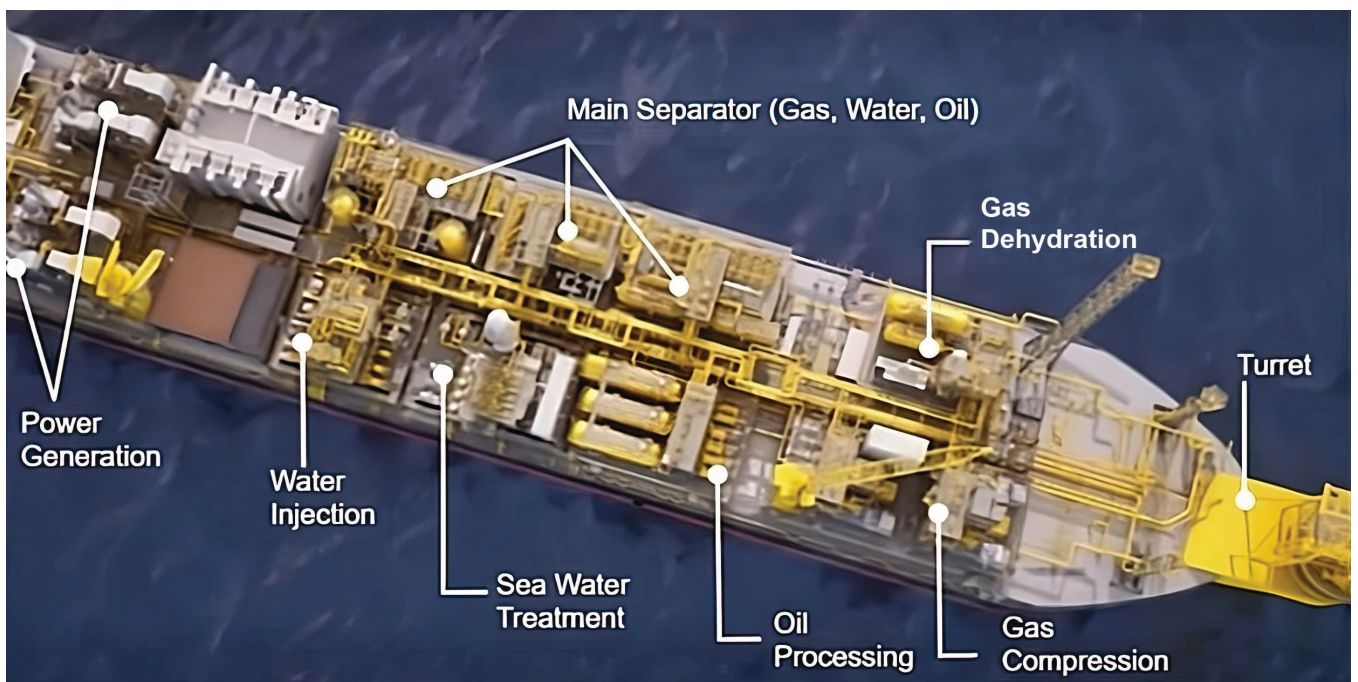


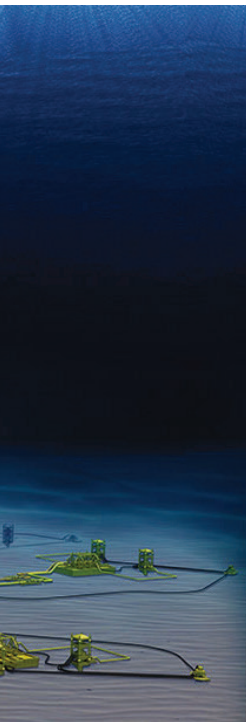
Rendering of the Barossa FPSO. Source: MODEC

Over the past 40 years, floating production storage and offloading (FPSO) vessels have become a cost-effective source of oil and gas production in remote locations. These large vessels are self-sustaining storage and processing facilities on the ocean that generate their own power to prepare crude oil from wells into oil and gas for

pipeline distribution and oil tank transfer. The processes alone are challenging, but on an FPSO, the equipment must also be designed to fit into compact areas and specified for the marine environment.

Overhead view of an FPSO with major functions and process areas labeled. Source: SBM





With the remote location comes the expectation that equipment must last as long as possible and work safely and consistently. Suppliers are expected to design their products with all these factors in mind. Control valves aboard FPSOs are considered a small but critical piece of the process as they are necessary to control flow accurately from one area of the process to another.

If a critical control valve is not working properly, the entire system can be put at risk — but when functioning properly, the processes will run optimally with maximum output. Sizing a critical control valve for offshore applications has multiple challenges — high pressure, corrosion, erosion, cavitation and noise — all the likely culprits in standard flow control challenges. In addition, precautions must be taken for the corrosive environment and remote location if repairs are needed. It is imperative that

when selecting control valves, you find the safest solutions that have extended life cycles, mitigate damage and control processes preventing unplanned down time and maximizing product output.

FPSOs are huge vessels custom built or retrofitted from existing oil tankers. They are advantageous because they can hold both process products and store salable products. The upfront cost can be high, but savings is typically realized over the life of a project. Some of the advantages are: typically up to 50% less set up time than an offshore platform; no permanent piping or infrastructure required, and most importantly, when oil wells are depleted the FPSO can be moved to a new location and reused.

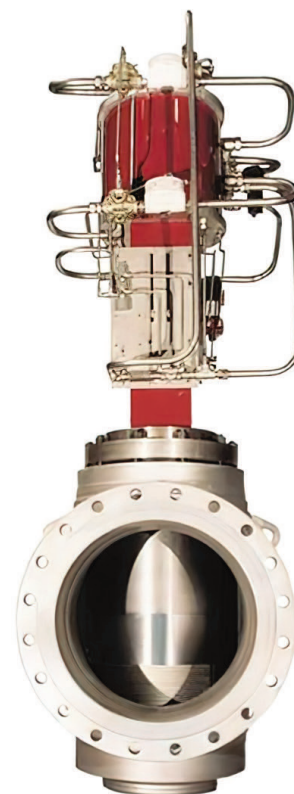
From the bottom side of the FPSOs (above left) there is a network of connections that are anchored to the bottom of the ocean floor by a mooring system which allows for rotation or movement of the vessel as needed. The primary connections are umbilicals and flowlines. The 'umbilical' connections are essentially electrical conductors providing power, control and communication for production. There are also production lines known as flowlines that carry crude oil from the well to risers connecting to the vessel. The flow lines can be used also for injection of seawater to extract oil when reserves are getting low in the well.

On the top side of the FPSO, units are modularized to save space. Wellhead fluid or raw crude is separated for multistage processing, and the raw products are processed as a liquid or gas before being transformed into a final product and stored. Note that ocean water is also used in this process and is either put back into the ocean, treated for use or injected into the oil well.

## Critical Control Valves in FPSOs

Hundreds of valves are required for production and process control aboard FPSOs. Each has a specific purpose, some more critical than others. Our focus in this article is to highlight critical applications, understand the purpose of the valves, process challenges and show solutions that allow operations to function smoothly. While not specifically mentioned, in each application it is assumed that all external components of the valve should include stainless steel accessories, tubing and fittings, to combat the effects of the salty marine atmosphere. Using any materials other than austenitic, austenitic ferritic (duplex) stainless steel or nickel alloy (CRA, corrosion resistant alloy)

could lead to premature corrosion, safety issues and production downtime. Also, it's important to note that with limited space, storing spares onboard for repairs is not feasible. With the nearest valve shop hundreds of miles away, sizing and selecting the right control valve for these applications is key.

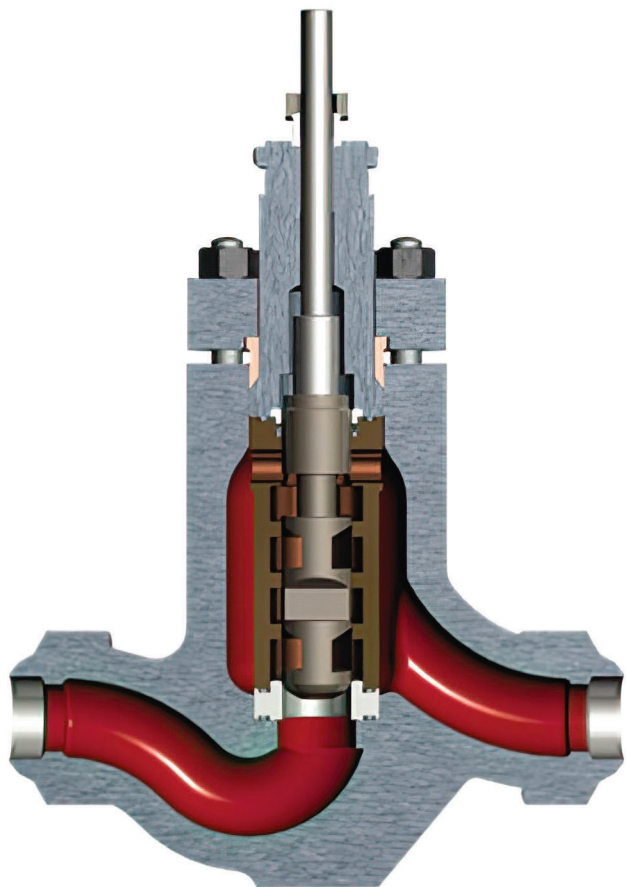


Example of antisurge valve. Source: Baker Hughes

## Antisurge Control Valves in Gas Compression

The production of gas starts with isolating lighter hydrocarbons from crude taken from oil wells. Through several processes of separation using high- and low-pressure steps and cooling, the gas is then ready to be compressed. The process involves expensive compressors, that can only operate between 50 and 100% of rated capacity. Due to fluctuations in the process, compressors can experience surges when the upstream pressure becomes lower than the outlet. When this happens, flow changes direction and can cause major damage to the compressor.

To avoid such occurrences compressor stations are equipped with antisurge control valves to protect compressors. They are positioned downstream of the compressor so that when an upset occurs and there is risk for reverse flow, the control valve can open and decrease the pressure downstream, maintaining flow in the desired direction. To work successfully the valve must open quickly, 1-2 seconds by positioner and 0.5-1 second opening time by solenoid. Antisurge valves must maintain an acceptable noise level (difficult with the high-pressure drops), be comprised of



ASME-rated Lincoln Log valve. Source: Baker Hughes

corrosion resistant materials, and consistently maintain a class V shutoff.

### Cooling Water Valve

With plentiful amounts of seawater available, the FPSO requires large quantities of water for applications to assist in operations, namely for cooling down equipment on the vessel and reinjection into the oil well for production.

Sea water is pumped from the ocean via a sea water lifting pump followed by further treatment including removal of sulfates and air before going through the cooling water valve. The challenge in this application is the high capacity and noise levels. Low pressure globe valves are required to handle high capacities and special trim is required to attenuate noise.

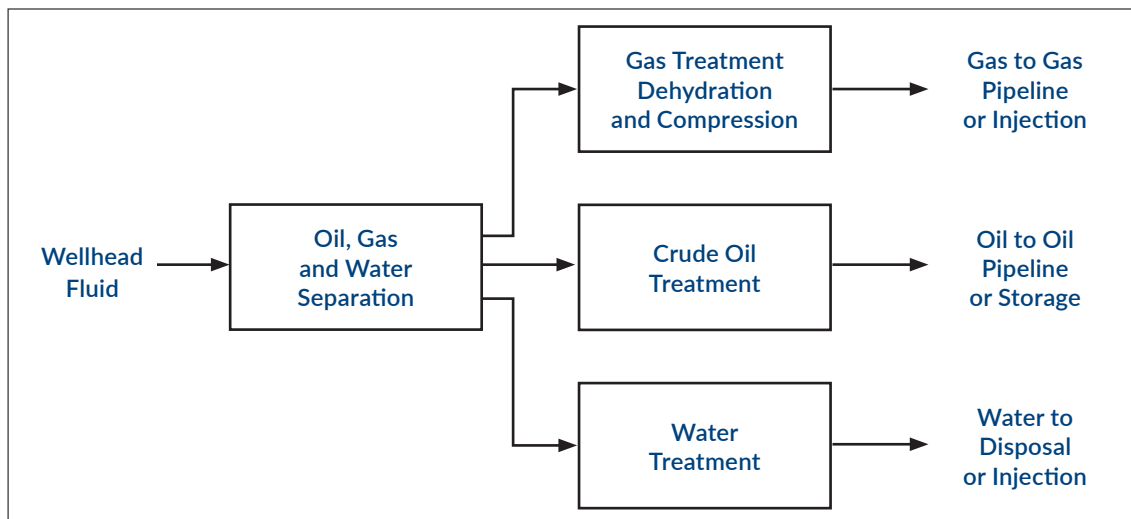
As with every application aboard an FPSO, corrosion is a concern, therefore special materials for the body and trim must be used to mitigate damage. Commonly used body materials such as nickel aluminum bronze, duplex and Hastelloy C are highly effective and have excellent corrosion resistance. A combination of exotic alloys can be used for trim materials to help extend the life and functionality of the valve.

### Sea Water Injection Systems

Sea water injection systems on an FPSO consist of overboard dump valves, pump recirculation and injection to well valves — each type critical to production. Each valve application requires high rangeability and the ability to function with high-pressure fluctuations, cavitation and entrained particles. For example, the overboard dump valve is used for startup of the high-pressure injection pump. Even though it is only used at startup, it is critical to the process and must function on demand. The conditions are harsh containing high pressures that drop to atmospheric pressure at the outlet. Cavitation and vibration are associated with this process and operators should account for them.

Cavitation is a phenomenon that occurs when the pressure of a fluid drops below its vapor pressure and then recovers above the vapor pressure. As a result, bubbles form and then implode causing damage to the closest metal boundary, severely shortening a valve's performance and life expectancy. Similarly, vibration from high pressure drops will also induce mechanical wear and fatigue on parts. A robust valve design must be selected with multistage trim to control the pressure drop in stages, eliminating cavitation.

Raw crude is separated then processed into final products and stored for transport. Source: Baker Hughes



One example is a valve used in high pressure applications that uses multiple stages to eliminate cavitation, taking the pressure drop in stages so the process fluid doesn't drop below the vapor pressure at any point. In some cases, a downstream plate can



A 30-in. aluminum bronze ASME B16.34 Class 150 RF (Raised Face) cooling water valve with 1 stage special trim for noise attenuation. Source: Baker Hughes

be used to provide back pressure and alleviate some of the pressure drop from the valve. Valves can range from AMSE B16.34 pressure class 1500 to API 6A rated pressures 10,000 or 15,000 psi and can be found in a number of materials with multiple trim stages depending on process conditions.

The valve pictured (opposite page, top left) is a good example of a robust design that can be specified up to 15,000 psi. It contains multiple stages to reduce pressure and is trash tolerant due to the axial flow. The trim is designed to never allow the pressure to drop below the vapor pressure, thus preventing cavitation.

### Conclusion

FPSOs continue to be a popular solution for processing and storing crude in remote areas of the ocean. They are advantageous because they do not require any permanent underwater infrastructure, take 50% less time to commission than a traditional offshore platform, combine upstream and midstream processing into one site and can be moved to another location when the oil wells are depleted. Control valves are vital components of the process and are integrated into all units of the FPSO, some more complex than others. Some of the most challenging control valves are antisurge, cooling water and sea lift system valves. They are used in the process to control temperature,

flow and pressure with harsh service conditions and can highly impact production if they are not properly sized and selected. Each control valve should be carefully designed for a given application to overcome flow control challenges while mitigating damage from the environment. Control valves are critical to the offshore vessels, ultimately keeping the process running safely, protecting equipment and maintaining quality product output. ❗

### ABOUT THE AUTHORS

**Rebecca O'Donnell** is a product manager for Masoneilan control valves for Baker Hughes. She has more than 20 years experience in promoting, specifying and educating the market on the value and technical benefits of control valves.

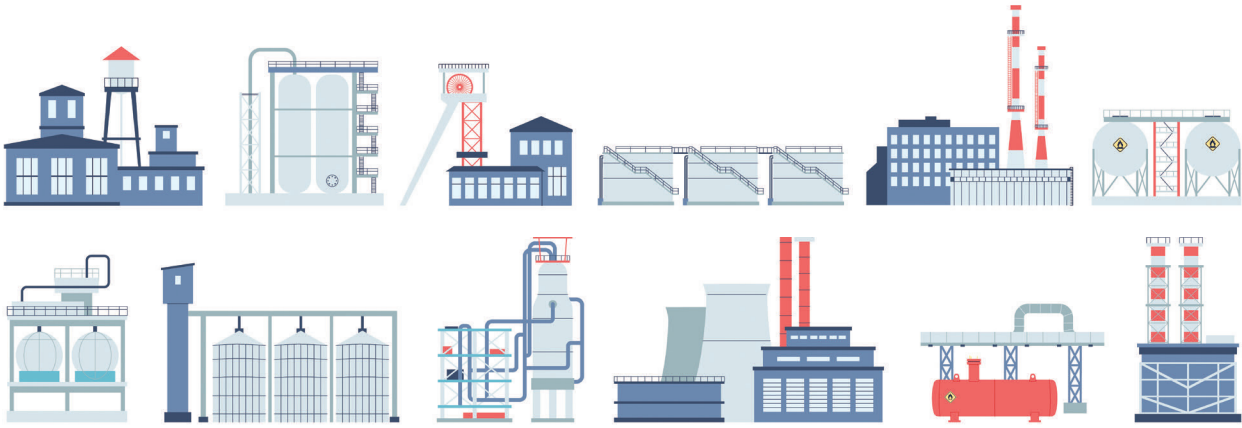


**Teo Arcopinto** is a valve solution engineer with Baker Hughes, working in Casavatore, Italy. He has been in the control valve industry for more than 20 years, focusing on power and oil and gas severe service valves.



## MARKET OUTLOOK

# Infrastructure Project Growth Expected to Continue



Speakers at the recent Market Outlook Workshop conducted by VMA and HI shared mixed predictions across industry sectors.

BY: HEATHER GAYNOR, Editor-in-Chief

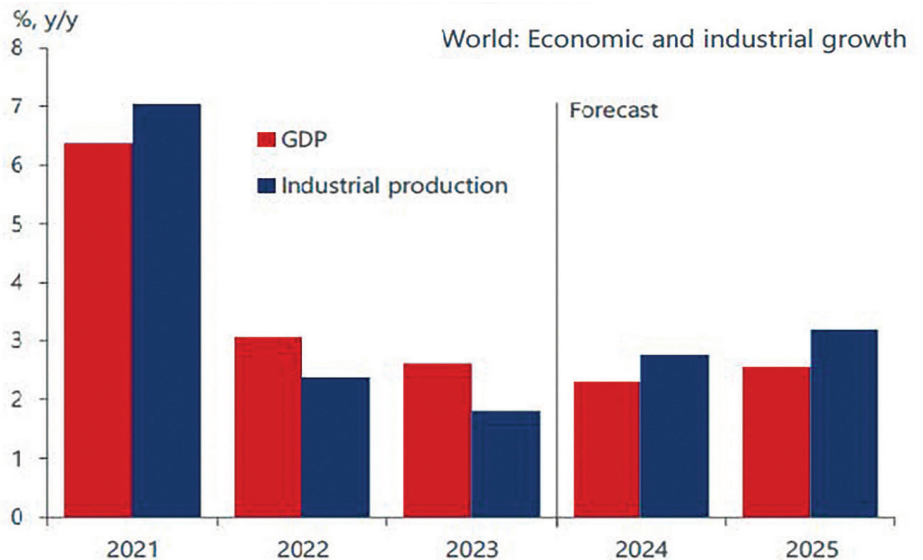
In early August, the Valve Manufacturers Association and the Hydraulic Institute held their annual Market Outlook Workshop in suburban Chicago. Speakers included some return favorites and a few new experts. Among the sectors covered were oil and gas, water and wastewater and construction and HVAC, in addition to presentations that offered insight across multiple industries. The overall sentiment was positive with continued infrastructure investments offering opportunities for valve and pump manufacturers, and with industrial growth outpacing GDP again, but there are a few areas that may lag or even face a downturn, according to the speakers. Read on for highlights from each speaker.

### Chemical industry opportunities abound

Britt Burt, senior VP of research for the power industry at Industrial Info Resources, discussed the

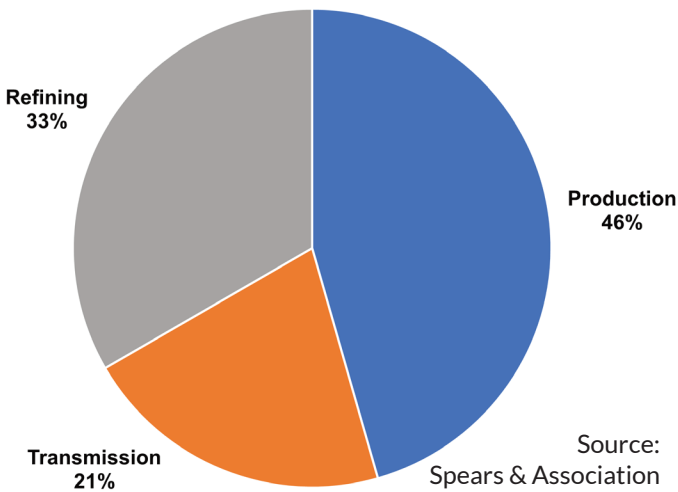
outlook for the chemical and power industries in the U.S. and Canada. Burt shared that momentum for projects continues to grow thanks to government incentives, investor environmental and sustainability goals (ESG) and potential construction for new plants including hydrogen,

FIGURE 1 Industrial Production Growth will Overtake GDP Again



Source: Oxford Economics/Haver Analytics

**FIGURE 2 Energy Valve Shipment by Sector-2024**



will continue as new power plants and grid infrastructure comes online.

**U.S. oil production expected to increase again next year**

In the oil and gas markets, John Spears, president of Spears & Associates, returned to the MOW this year and shared that energy valves represent 34% of the \$5.6 billion U.S. industrial valve market. In Figure 2, energy valve shipments by type show a nice cross-section of valves being ordered for the energy sector. With crude oil production increasing this year and expected to increase next year, petroleum valve shipments may be up as much as 5%, according to Spears, while pipeline construction was up this year but is expected to drop in 2025.

**Shifting trends in new construction types**

Paul Trombitas, partner and building products sector lead at FMI Consulting, presented his company's data and predictions for the coming years in construction and HVAC needs, including a predicted sizable growth in off-site construction of panels and modular systems built and assembled offsite and later installed on-site. Residential, nonresidential and nonbuilding structures are all expected to increase in demand in the U.S. over the next four years, with residential leading the way. However, industry sentiment indices from FMI sources, the National Association of Homebuilders and the American Institute of Architects vary from 42 to 67, indicating varying levels of confidence currently, with the last measure being May 2024.

Trombitas spoke about where construction is occurring and defined what he called new and old economy construction. New economy where growth is occurring includes life sciences, data centers, distributed power, high-tech manufacturing and logistics, while old economy includes lodging, shopping centers and malls, offices and movie theaters.

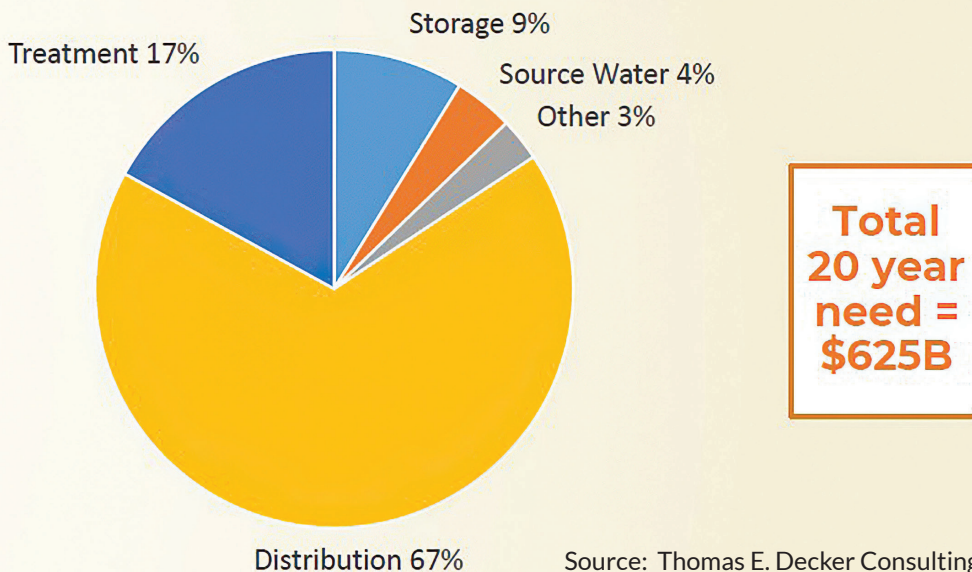
ammonia, ethylene, methanol and plastics recycling planned.

In addition to new construction or additional capacity projects, maintenance spending at plants remains strong with nine ethylene plant turnarounds already scheduled for 2025, offering both manufacturers and maintenance and repair (MRO) companies many opportunities.

Burt said the power industry has more than 6,800 projects planned in the U.S. and Canada totaling \$1.39 trillion USD, and more than \$8.3 trillion planned globally.

The push toward decarbonization through tax subsidies and government mandates remains a key driver for renewable power projects, and the development of small modular reactors and other advanced reactor designs for nuclear plants continues and will support this growth. With rapidly rising electric demands in the U.S., construction of new natural gas-fired power plants is on the rise to meet these needs, and retiring of coal plants is delayed due to lack of capacity replacement power. However, these closings

**FIGURE 3**



Life sciences continue to increase with prescription drug use among adults continuing to rise. Logistics has also grown rapidly, with a huge bump during the height of the pandemic with home deliveries of nearly everything including groceries, food delivery and from online retailers of all kinds. High-tech manufacturing sites continue to be constructed to meet the demands for computer chips and batteries driven by new technology including electric vehicles. Data center growth has increased due to the rapid adoption of remote

working and telecommuting globally, which has remained since the pandemic. And building products have evolved to meet the needs of these data centers.

Buildings are also being retrofitted or improved to become smarter and more efficient in their water, lighting, HVAC and overall energy usage. Owners are looking for ways to reduce the costs of utilities and operating costs at their sites using smart technology and controls to make more data-driven decisions to manage their facilities.

FMI reported a total growth of 32% in HVAC nonresidential spending in the past four years, and predicts another 17% growth between now and 2028, with customers looking for design flexibility and energy efficiency to meet their needs.

### Supply chain dynamics still abnormal post-pandemic

Michael “Pez” Pesendorfer, senior research associate at Baird, provides analysis and coverage of companies in the flow and motion solutions sector including process automation, instrumentation and controls, pumps, valves, motors and aftermarket products and services. Pesendorfer presented on behalf of himself and Michael Halloran, a regular fixture at VMA events who speaks on these markets.

In this sector, Pesendorfer shared that uncertainty persists post-pandemic as demand correlations are still distorted due to supply chain dynamics not yet normalizing and China recovery lagging overall. He said while interest

rates are likely at their peak, many in the market anticipated the Federal Reserve dropping interest rates as many as six times this year, but it’s only happened once since the height of the pandemic, slowing growth. However, as rates are expected to continue decreasing, he expects more capital spending from companies across the flow and motion solutions sectors. Near-term uncertainty persists, but high-level tailwinds have the team at Baird optimistic.

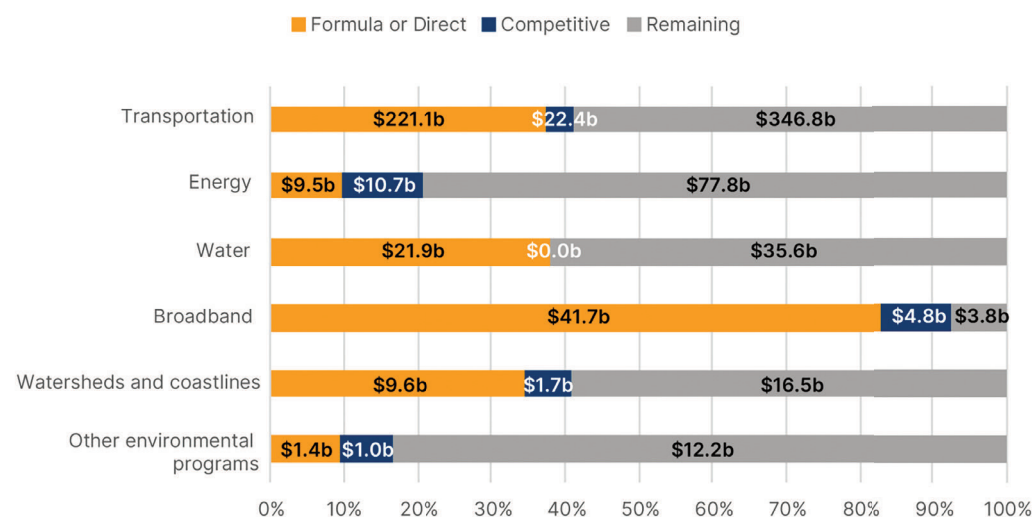
He said that industrial companies tend to fare well with inflation, and balance sheets remain strong. The infrastructure bill and other regulatory drivers have had a positive impact, and more than \$500 billion of the IRA (Inflation Reduction Act) and IJJA (Infrastructure Investment and Jobs Act) funding is still unawarded and unallocated, leaving room for more growth and margin opportunity particularly with AI, 5G, ecommerce fulfillment and logistics, remote connectivity and IIoT.

While there is a lot of growth potential in energy transition to hydrogen, solar and LNG, as well as storage, network support for distributed power offers huge potential. Growth is expected to continue or resume in process markets including oil and gas and chemical processing, defense and aerospace, water and wastewater infrastructure and power. But recovery is still somewhat uncertain in metals and mining, with the exception in rare earth metal opportunities offering big potential.

Pesendorfer said oil and gas midstream and upstream are stronger than they have been in a decade given significant energy market disruption and underinvestment, but factors

including overall global economic recovery, OPEC actions, midstream infrastructure capacity utilization (especially in North America) and terminal and export infrastructure are less sure. And in spite of growth potential in clean or renewable energy, global demands are expected to keep increasing with broader electrification across the world and the continued need for more data centers to power the growth in AI and super-computing needs.

**FIGURE 4** Progress of IJJA-award funding, by infrastructure sector and funding type



**Source:** Progress of IJJA-awarded funding, by infrastructure sector and funding type  
**Note:** Awards data as of November 15, 2023



### Water and wastewater markets thriving

Tom Decker, principal of Thomas E. Decker Consulting, addressed the group to share his predictions for the water and wastewater markets. Decker shared that myriad problems are plaguing the

U.S. water system: more than 250k pipe breaks each year; 6 billion gallons of water lost daily from the U.S. infrastructure; 20% of U.S. pipes working beyond their useful life, and heat and drought issues. According to the EPA, drinking water system needs are most pronounced in the distribution system (see Figure 3), with more than \$625 billion needed over the next 20 years.

Like Pesendorfer, Decker pointed out that there is still a lot of unallocated and unspent money from the IJJA and IRA legislation, even with \$20 billion allocated from the American Rescue Plan Act and more than \$60 billion earmarked for water and wastewater available from the IJJA over the next five years, already used to fund more than 1,400 projects.

One of the biggest threats to water systems today is the pending PFAS legislation and regulations. With PFAS found in 45% of all U.S. tap water (according to Decker), even the billions allocated from the government so far isn't enough to address the problem for municipalities and water utilities. While technology is being developed and tested to eliminate and destroy PFAS compounds in water, utilities may be at risk for liability even if PFAS is removed from their systems but not destroyed. Legislation has been drafted that would shield companies from some liability but has yet to be passed. We will continue to monitor and report on the PFAS issue, including sharing highlights from the VMA/HI PFAS Workshop this November in Alexandria, Virginia, in our next issue.

Long term, the water supply is at risk globally due to drought and other factors. Conservation is having a slight impact, but other solutions need to be explored. Among these are reuse projects and desalination, with projects planned in the U.S. and globally and more coming as new technologies are developed.

The aging workforce and lack of qualified workers in the water and wastewater industries are expected to have a major impact in the next decade. Increased materials cost including concrete, sand and stone, machinery and controls is also impacting project pricing. In spite of the challenges, the need for water and wastewater infrastructure repair, replacement and new construction globally continues to grow and valve and pump manufacturers should benefit from these projects.

### Conclusion

The impact of the 2020 pandemic continues to affect the valve and pump industries, and manufacturing in general. But major legislative packages including the IJJA and IRA, BABA (Build America Buy America) and increasing energy needs have had a positive effect on construction and repair of major infrastructure systems across the U.S. and across all sectors. The experts mentioned above all see many opportunities ahead, but not without challenges. Increased regulations, the aging workforce, lack of qualified workers to fill those roles and others and a shift in the way people want to work (more flexibility and hybrid work is often desired by the younger generations) will continue to present challenges for the foreseeable future. ▶

## Introducing MSS SP-160-2024

MSS SP-160-2024\* – Valves for Hydrogen Fluoride Alkylation Service standardizes HF Alkylation valves across the industry and improves equipment process safety.

SP-160 was developed by a task group with industry expertise to standardize on one industry specification and improve equipment process safety.



[msshq.org/page/ActiveStandards](https://msshq.org/page/ActiveStandards)

Scroll to SP-160 for details.



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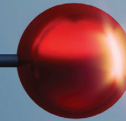
\*This Standard Practice applies to new Gate, Globe, Check, Butterfly and Plug Valves for Hydrogen Fluoride (HF) Alkylation Service.

# TOTAL COST OF OWNERSHIP

## What Does It Really Cost?

Calculating the costs and benefits of low emissions technologies.

BY: ANGELICA PAJKOVIC & BRONSON PATE  
COMPANY: TEADIT



*Editors note: With the influx of new people to the flow control industry amid retirements and consolidation, we are frequently asked for basic information on valves, actuators and controls. Our “Valve Basics” series covers the technical aspects of valves and actuators in each issue. This article reviews a concept anyone in the manufacturing industry for any length of time is likely familiar with, but offers a good overview of greenhouse gas emissions and fugitive emissions calculations, as well as potential solutions. Pending PFAS regulations and controls could impact this, too. Please let us know if you’d like to see more articles like this in the future, and what topics you’d like us to cover.*

**What does it actually cost?** This is the fundamental question at the core of the Total Cost of Ownership (TCO) discussion. Whether it is an individual, an operator, an original equipment manufacturer (OEM), an owner or user or the broader community, the inquiry aims to uncover the complete and actual impact of fugitive emissions on an entity and its surrounding environment.

As reducing fugitive emissions remains a critical priority for industries worldwide, it is essential to develop a deeper understanding of how adopting best practices and advanced technologies can contribute to a more sustainable future. By addressing the TCO and implementing strategic changes, companies can realize significant environmental and financial benefits.

### What are fugitive emissions?

Fugitive emissions refer to the unintended and uncontrolled release of gases, often from industrial equipment

such as valves, pumps and connections. In petroleum refineries, these emissions can include methane, ethane, propane and sometimes more harmful substances like benzene. In chemical plants, these emissions can include 1,3 butadiene, ethylene oxide, ethylene dichloride and vinyl chloride. While these volatile organic compounds (VOCs) have a short atmospheric lifespan, they tend to have lasting adverse effects on the environment.

The loss of product due to these occurrences also negatively impacts production efficiency, as lost product due to leaks represents a significant economic drain. Reducing fugitive emissions is, therefore, often considered not only a regulatory and an environmental necessity but also a financial imperative.

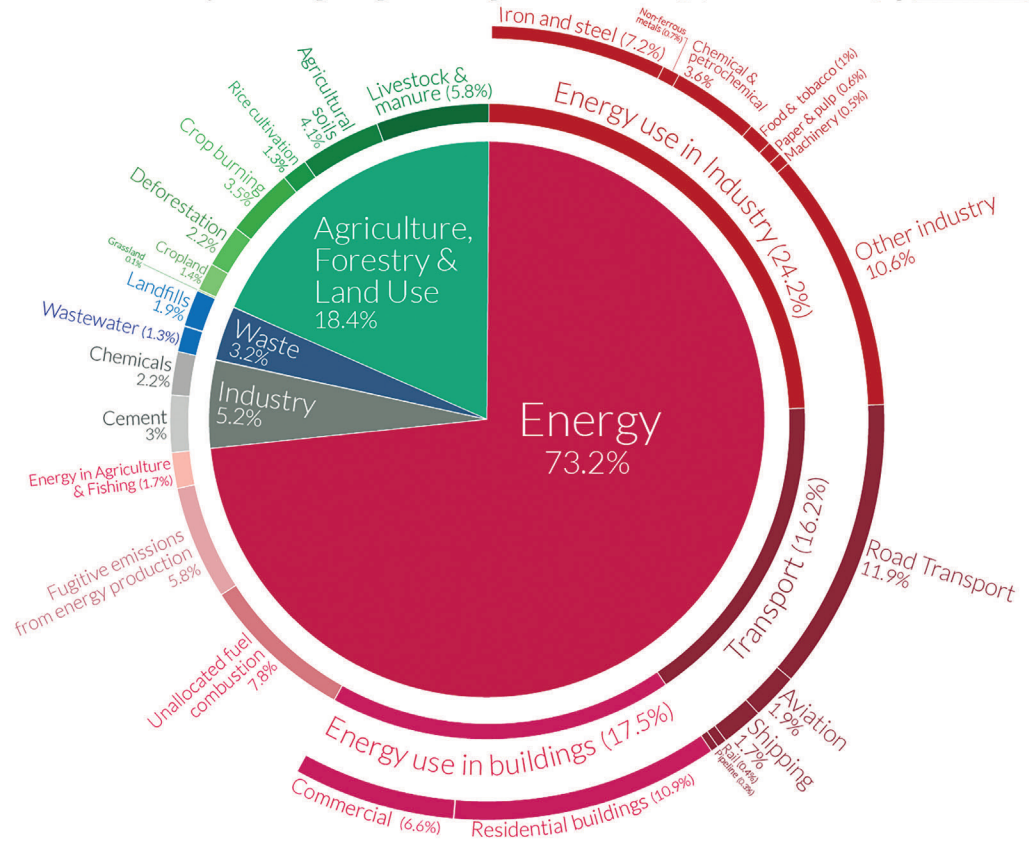
The TCO approach to fugitive emissions looks at the comprehensive cost implications of industrial operations, including environmental and health impacts. Understanding and addressing these emissions through a TCO lens can benefit operators, OEMs and the community substantially.

### Global issue with local mitigation

The recognition of fugitive emissions as a prevalent environmental and societal issue dates back to the 1950s when Dr. Bernie Stargwall investigated pollution in Los Angeles, California. His findings revealed that numerous small leaks in refineries and chemical plants collectively caused significant air pollution. To combat this phenomenon, California implemented strict work practices to mitigate smog and emissions, leading to markedly clearer skies despite population growth.

# Global greenhouse gas emissions by sector

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO<sub>2</sub>eq.



OurWorldinData.org – Research and data to make progress against the world’s largest problems. Source: Climate Watch, the World Resources Institute (2020). Licensed under CC-BY by the author Hannah Ritchie (2020). Source: Climate Watch, the World Resources Institute

Historically, different regions have adopted varied approaches to tackle fugitive emissions. With no globally standardized ‘rules’ or ‘requirements,’ the European Union focused on engineering solutions, while the United States emphasized regulatory measures. Although many credit Europe with leading the push for reduced emissions, California’s success serves as a prime example of the long-term benefits of stringent emission control measures.

China’s recent decision to adopt a dual-strategy approach, in which they focus on engineered solutions and regulatory measures, is, therefore, unsurprising; its implementation has resulted in a more rapid reduction of emissions. This comprehensive approach serves as a model for other nations, demonstrating the effectiveness of combining design enhancements with rigorous operational practices.

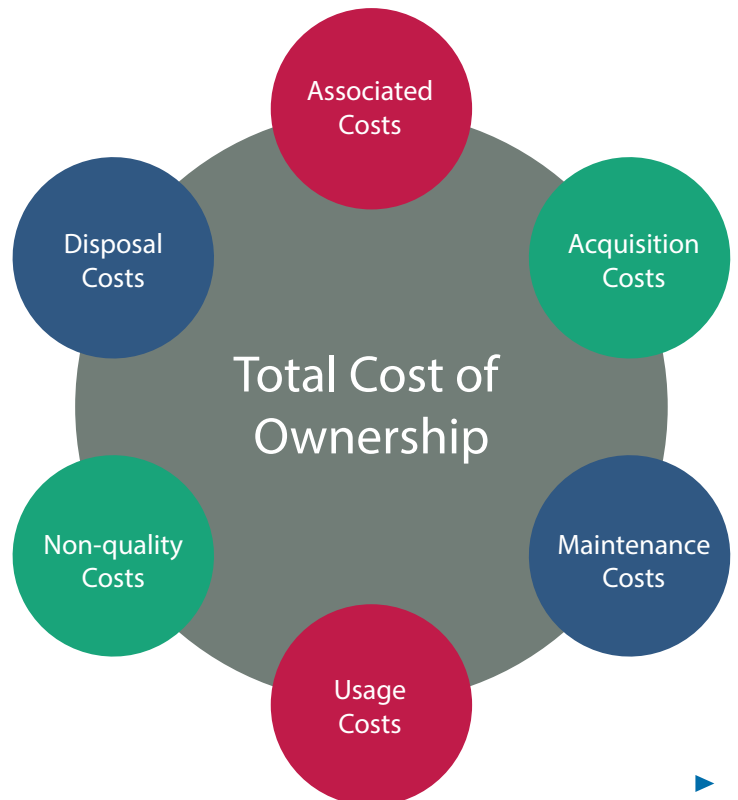
Increasing the implementation of advanced low emission technologies is, arguably, the next step in the push toward environmental sustainability.

## Low emissions (low E) technologies

Investing in technologies to reduce fugitive emissions offers dual benefits. Financially, it minimizes product loss and reduces maintenance and operating costs. From a community perspective, it enhances the quality of life by reducing harmful exposures, particularly in vulnerable entities such as schools near industrial sites.

More specifically, emission reduction technologies aid with:

- Community and environmental stewardship:** Reducing emissions improves air quality, protects community health and enhances the company’s reputation as a responsible entity. This is particularly important when industrial sites are near residential areas, schools or other sensitive environments.
- Maintenance and operational efficiency:** Poor quality leak detection and repair programs lead to higher maintenance and operating costs. Advanced sealing technologies and rigorous monitoring can mitigate these costs and ensure smoother operations.



- **Cost savings:** Lost product due to leaks represents a direct financial cost. By minimizing these leaks, companies can recover product value along with the costs associated with processing and handling the material.

Addressing fugitive emissions, therefore, requires a strategic approach. Companies must assess which components will likely leak and prioritize replacement or repair.

### Emissions ID and reduction technologies

Technologies like infrared (IR) and optical gas imaging (OGI) cameras and other leak detection tools can identify emissions that might go unnoticed between regular maintenance cycles with conventional leak monitoring tools. This enables a quicker repair to a leaking component, reduces product loss and emissions to the environment.

Technology such as certified low-leak packing used in valves can significantly reduce fugitive emissions to near zero. This not only reduces environmental impact but also retains product and lowers operating costs over time.

Other practical applications for reducing emissions include:

- **PTFE packing innovations:** Over the past decade, advancements in graphite and graphite/PTFE packing have led to substantial reductions in emissions. API 622 standards have driven these improvements, ensuring that modern packing materials can achieve near-zero emissions. Companies should request detailed testing data from sealing manufacturers to ensure they select the best products.
- **Repacking old valves:** Instead of replacing entire valve systems, repacking valves with low-emission materials can yield impressive results. Testing under API 624 has shown that repacking can reduce emissions to as low as six parts per million (PPM), significantly lowering the environmental impact and product loss.

It is important to note that not all low-emission technologies provide the same level of reduction. Some products may leak more than others, even if they meet the minimum set by the API standards.

### The potential impact of API standards

API standards, 622 for packing and 641 for quarter-turn valves are crucial for setting low-emission packing and valve benchmarks. Companies typically use these standards to develop advanced packing solutions providing near-zero emissions. While not all facilities are required to use valves that meet these standards, proactively doing so can offer substantial benefits. The cost difference between low-emission and standard technology components is often negligible, but the potential savings in reduced emissions, reduced product loss and compliance with environmental regulations are significant.

Companies can reduce their environmental footprint while achieving cost savings by selecting components that have passed the rigorous API standards tests and by updating/including only components that meet these stringent standards in their approved manufacturer lists (AMLs).

It is best to view these changes not as regulatory burdens but

as strategic investments that can provide a positive return. By doing so, businesses can enhance their reputation, meet stakeholder expectations and contribute to a sustainable future.

### Case study

Consider a hypothetical facility with 30,000 valves and 105,000 connectors. By replacing 90,000 flange connections (connectors) with ASME 16.20 low-emission spiral wound gaskets and repacking 5,000 valves with API 622 compliant packing, the facility can drastically reduce emissions. Utilizing EPA emission calculations, this change can lower fugitive emissions from 639 tons to just 1 ton per year, with an annual savings of \$900,000. This example highlights the immense potential for cost savings and environmental benefits through strategic upgrades and maintenance.

### Understanding the latent benefits

Addressing fugitive emissions through the lens of TCO involves evaluating the costs and benefits of various technologies and practices. By leveraging the best available control technologies and adhering to stringent standards, companies can make data-driven decisions to achieve substantial reductions in emissions while enhancing their financial performance. As the global push for sustainability intensifies, the adoption of these practices will not only meet regulatory requirements but also position companies as leaders in environmental stewardship.

The focus on TCO to reduce fugitive emissions underscores the importance of a holistic approach that considers both financial and environmental impacts. Investing in advanced technologies and adhering to best practices significantly reduces fugitive emissions, generates a financial return and positions companies for the future while complying with current regulations. 📈

### ABOUT THE AUTHORS

**Bronson Pate** is currently the Environmental Consulting Manager for Teadit North America. With more than 15 years of experience dealing with regulatory and technical issues in leak detection and repair (LDAR) for numerous industries, he has participated in or led 375 audits at multiple facilities on U.S. EPA LDAR Consent Decree (CD) requirements.



**Angelica Pajkovic** is a Client Specialist at Teadit, with a particular focus on technical content development. Hailing from Toronto, Canada, she has over six years of experience in the industrial industry. In her previous role as Editor-in-Chief at an industrial B2B publishing company, she gained a rounded understanding of the challenges, interests and business relationships in the industrial sector. For more information, contact Angelica at: [angelicap@teadit.com](mailto:angelicap@teadit.com).



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## CASE STUDY

# Additive Manufacturing of Pressure Equipment

How manufacturers can design and produce PED-compliant equipment using additive manufacturing.

BY: Holger Eckholz & Domagoj Vnucec,  
SAMSON AG; Jörg Keller & Martin Boche, TÜV  
SÜD INDUSTRIE SERVICE GMBH

Process automation products are regularly re-engineered and redeveloped as digitalization, flow simulation, design and control engineering are constantly studied and improved. Technological innovations, such as those now available with additive manufacturing, open many new opportunities beyond traditional subtractive manufacturing methods. In this case study, SAMSON will help shine a light on the challenges that companies face when developing pressure equipment product lines manufactured with additive technology.

### European Pressure Equipment Directive

Similar to vessels, piping or unfired pressure vessels, valves and final control elements are classified as “pressure equipment” if they are subject to a maximum allowable pressure greater than 7.25 psi (0.5 bar). Pressure equipment manufacturers must ensure the safety of their products, while also guaranteeing fair competition on the European Union market.<sup>[i]</sup>

Like the ASME Boiler and Pressure Vessel Code (BPVC) in the U.S., European pressure vessel manufacturers must adhere to European Pressure Equipment Directive 2014/68/EU (PED), which stipulates the relevant manufacturing requirements for EU manufacturers. Specific product requirements are found in Harmonized Product Standards, such as EN 16668 for industrial valves, EN 13480 for metallic industrial piping or EN 13445 for unfired pressure vessels. These standards often reference other supporting



Top: Three-layer print of medium-sized plug heads (150 pieces).

Bottom: High-load valve trim parts, such as flow dividers. Source: SAMSON

harmonized standards when applicable. The standard requirements apply to both the material properties and the manufacturing procedures. Regular reviews and audits are prescribed for these manufacturing procedures. Products of certain hazard classifications (PED categories I to IV) must additionally be certified by the applicable additional organizations, called Notified Body organizations, and bear a CE marking to be placed on the EU market (similar to a UL certification in the U.S.).

## Materials challenges

Designers and manufacturers will normally select the material for a certain part based on standards requirements. This assures that the selected material complies with the applicable safety requirements and technical properties stipulated in the relevant standard, such as ensuring pressure equipment sizing that meets the fundamental safety requirements required by PED or ASME BPVC. However, the harmonized material standards do not address manufacturing procedures that may affect the material properties (such as welding, forming), nor do they cover whether a material is suitable for a certain device or end-use application. These issues must be evaluated separately by the manufacturer and the customer based on their needs. Using harmonized materials has enormous benefits when exporting products, ensuring code compliance across jurisdictions. However, one of the major challenges when using additive manufacturing methods is that there are currently no harmonized standards for additively manufactured materials.

A material's chemical composition is defined by the feedstock (metal powder) used. The metal's molecular structure and mechanical properties, however, depend on the additive manufacturing procedure applied to make a blank (semi-finished product). As a result, everybody who makes additively manufactured blanks is considered a material manufacturer according to the language of the PED. And those who further process an additively manufactured blank into a finished part or ready-to-be-sold final product are considered equipment manufacturers and distributors of additively manufactured pressure equipment. This is comparable to the process chain involved in manufacturing cast parts. Therefore, other PED-compliant solutions must be applied to harmonized materials and finished products within the meaning of the PED.

## Overall process requirements

One approach to the lack of standards is to implement the alternative solution stipulated in the PED for materials that are not referenced in harmonized material standards. With this approach, materials are qualified based on a Particular Material Appraisal (PMA). Additional support is provided by prEN 13445-14 (a draft of a standard), DIN TS 17026 (DIN is the German Institute for Standards) and the EN 764-4 and EN 764-5 horizontal standards. SAMSON has opted to take this approach, as described below.

The PMA is issued by SAMSON in its role as an equipment manufacturer for every additively manufactured material it uses. In addition to the requirements placed on the essential material coefficients, the PMA contains further data relating to the material, material manufacturer, product type, shape and specific testing and sampling.

To harmonize an additively manufactured material using a standardized PMA, the material specifications of the material manufacturer who made the additively manufactured blank are referenced and the manufacturer must confirm and document compliance with the material spec-



Additively manufactured pilot lot of DN 50 PN 40 valve, body and bonnet. Source: SAMSON

ifications by issuing a certificate of specific product testing (3.1 inspection certificate according to DIN EN 10204, or in collaboration with a notified body: 3.2 inspection certificate according to DIN EN 10204).

Additive material manufacturers that want to implement this procedure should be ISO 9001 certified and have a certified quality management system, which has undergone a specific assessment for materials[ii], for example, compliance to Annex I (4.3) of the PED. In addition, the underlying material specifications, and the manufacturing procedure, must be covered by the scope of the material manufacturer's certification. The material specification could then be viewed or used in the



Examples of the additively manufactured samples. Source: SAMSON

same way that a harmonized material standard could be used, which for this example does not yet exist.

Throughout the entire manufacturing process, material manufacturers must ensure the traceability of the finished products — down to the feedstock batch used. From the beginning of the qualification and certification process, in this example, SAMSON established a clear separation between the maker of the blank (material manufacturer) and the maker of the pressure equipment (manufacturer and distributor of the equipment).

This enables SAMSON to procure the additively manufactured blank from a PED-certified material manufacturer, and further process this blank and market it as a PED-certified equipment manufacturer.

Because SAMSON is also a certified additive material manufacturer, the company can manage the entire process in-house — from procuring the metal feedstock to delivering a finished valve.

According to Article 4 (3) of the PED, manufacturers may only market pressure equipment operated at a very small gauge pressure or having very low pressure and volume, provided the equipment was designed and manufactured in accordance with sound engineering practices.

In most valve applications, the pressure equipment exceeds this hazard classification, which means that equipment manufacturers must ensure that the equipment has been designed and manufactured in accordance with the essential safety requirements set out in Annex I of the PED.

To achieve compliance, equipment manufacturers must provide all technical documentation referred to in Annex III and carry out all relevant conformity assessment procedures referred to in Article 14 of the PED.

After successfully completing these procedures, manufacturers must draft an EU declaration of conformity and affix the CE marking to the equipment, indicating it has been certified by a relevant Notified Body.

The specific conformity assessment procedure to be applied to the pressure equipment depends on its hazard level classification (Category I to IV in ascending level of hazard).

## Implementation

For series manufacturers, it makes little sense to assess conformity based on single unit verifications (Module G) with a Notified Body due to the amount of work and money to be invested. Even small production series are economically viable if the additively manufactured version is designed for the same category as the traditionally manufactured version.

For initial certification, SAMSON decided to qualify its Type 3251 high-pressure valve, which is well established on the market, in an additively manufactured Type 3251-AM version.

The standard version of the Type 3251 valve is available in DIN and ANSI sizes from DN 15 to 500/NPS ½ to 20 and in pressure ratings from PN 16 to 400/CL 150 to 2500. The Module H conformity assessment procedure was applied to the Type 3251, which covers pressure equipment up to hazard classification in Category III.

Consequently, the same Module H conformity assessment procedure was performed for the new Type 3251-AM, which is available in valve sizes up to DN 100/NPS 4 and pressure ratings up to PN 400/CL 2500; the equipment was certified by TÜV-SÜD Industrie Service GmbH (Notified Body no. 0036).

Conformity assessment covers design, manufacturing and testing. In addition to the risk and hazard assessment performed for this valve type and the associated strength calculations with higher safety factors, SAMSON drew up comprehensive inspection and test plans for initial sample and pilot lot qualification. These ITPs served as guidelines for inspection of the blanks, finished parts and the completed valve assembly.

In addition to strength calculations, the following was comprised:

- FEM and CFD simulations
- Destructive testing of side samples and initial samples
- Nondestructive testing of initial samples and pilot-lot specimens
- Dimensional inspections of blanks and finished parts as well as ready-assembled valves
- Function tests, leak tests, seat leakage tests and hydrostatic strength tests
- Flow rate and sound pressure level measurements at higher pressure drops
- Inspection of manufacturing requirements and markings
- Inspection of test documentation

In addition to nondestructive testing, special attention was paid to the destructive testing of specimens taken from the initial samples at different positions. Samples were taken at areas that are critical in additive manufacturing (such as critical overhangs) and at different manufacturing heights.

The initial sample test results were compared to the side samples on the printing plate and the material specifications for the printed material; assessments were performed accordingly.

At the same time, guidelines, documented procedures, work and testing instructions as well as protocols had to be defined and implemented for the equipment made from ▶

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additively manufactured materials. Interface documents were drawn up, detailing the requirements to be fulfilled by material (blank) manufacturers.

SAMSON's focus was on quality assurance measures covering the design, manufacturing, final acceptance and inspection of pressure equipment because the assessment and certification — and ultimately the approval — of the quality assurance system by the notified body was essential to the implementation of Module H.

The complete technical R&D documentation had to be created, modified and linked for the new additive materials; this included material specifications, material data sheets, pressure-temperature tables, mounting and testing instructions as well as marking guidelines for equipment nameplates.

Interface documents applying to R&D, sales and customers (such as data sheets, mounting and operating instructions) and SAMSON's in-house sales order handling procedures had to be adapted.

### Conclusion

This testimonial underlines that there is a controlled, viable path to the additive manufacturing of blanks and semifinished products and the marketability of components for pressure equipment with the support of an experienced Notified Body, in this case TÜV SÜD Industrie Service GmbH. Still, a lot of time and money needs to be invested in obtaining certification as a material manufacturer for

a specific additively manufactured material, in addition to being certified as a manufacturer and distributor of pressure equipment. SAMSON successfully completed these certification procedures at the end of last year: the company is a certified material manufacturer for additively manufactured blanks and it has obtained certification to manufacture, sell and market additively manufactured pressure equipment in compliance with Module H, Annex III of the Pressure Equipment Directive 2014/68/EU. The basis used for the conformity assessment procedure is specified in the declaration of conformity.

The approach described above taken by SAMSON may be viewed as a stop-gap until additive manufacturing standards are available, however all companies must also ensure that their procedures meet all regulatory, statutory, application and other requirements for all products they are manufacturing. ❗

[i] Directive 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonization of the laws of the Member States relating to the making available on the market of pressure equipment, Article 17

[ii] Directive 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonization of the laws of the Member States relating to the making available on the market of pressure equipment, Annex I, Article 4.3



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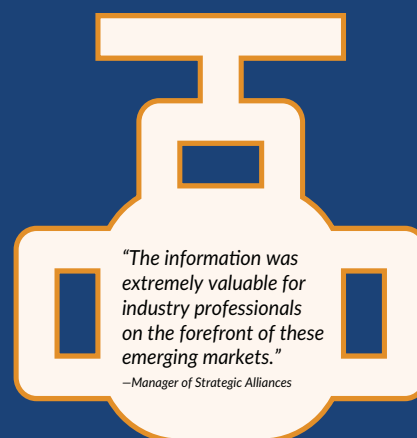


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# Solenoid Valves: Direct-Acting Versus Pilot-Operated

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BY: JOHN MOLLOY, *Training Manager*  
COMPANY: EMERSON

I work with solenoids so much that one VMA member at a recent conference joked that I needed to be wearing an “I Heart Solenoids” t-shirt. During a recent training session with VMA members, one of the most frequently asked questions I get from people came up: What’s the difference between direct-acting and pilot-operated solenoid valves (SOV), and how do we choose between them?

First, remember when discussing SOVs, the solenoid coil is the electrical apparatus of the valve. Think of it as the actuator with the balance of the valve being mechanical. With that in mind, a prescribed voltage would be required to energize the SOV to make it fully functional.

Direct-acting solenoids have the least amount of moving mechanical parts. Typically, a movable core (or plunger), spring or fulcrum lever are found inside the valve body. Once the SOV is energized, the magnetic field created in the solenoid coil attracts the movable core toward the coil’s center.

The movable core, which was sealing an orifice, now allows for media (air, inert gas, water or oil) to flow through the SOV from inlet to outlet (downstream). Note that this “work” is a result of the fact the mechanical parts responding to the flux of the magnetic force are on or off.

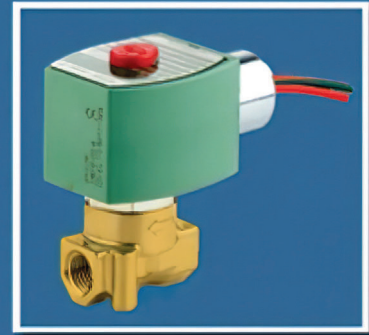
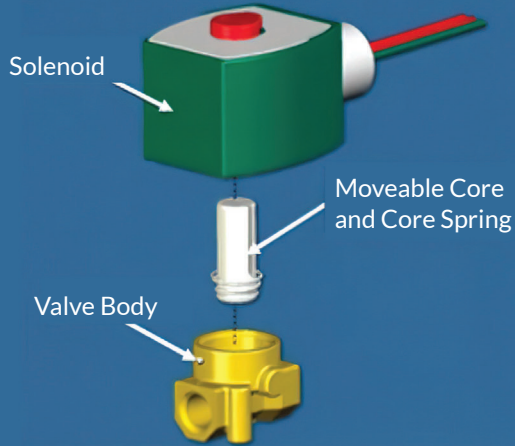
A pilot-operated SOV also uses its coil to lift a movable core, but these valves have a pilot and bleed orifice that enables them to use a fraction of the line pressure from the media source to assist in the lift of either a diaphragm or piston, features that are not included in a direct-acting SOV.

But why are there differences? Direct-acting SOVs, by design, are a zero minimum pounds per square inch gauge (psig); in fact, most can handle a vacuum pressure of -14.7 psig or much higher pressure ranges. There are several tradeoffs associated with this. The main orifice size must remain smaller because if a larger pipe size is allowed, the coil would need to be larger to create more power to pull the moving plunger through the greater volume of media in the pipe.

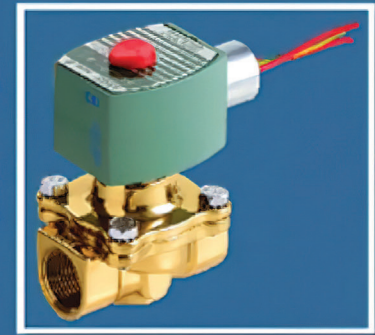
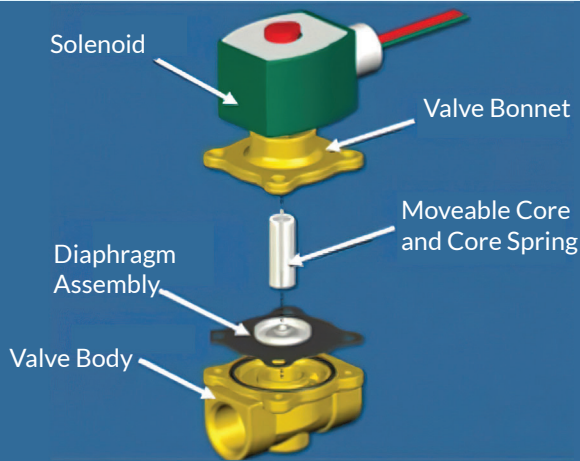
Conversely, an internal pilot-operated SOV, which is “borrowing” from the media at the inlet, will also lift a diaphragm or move the piston enough to allow media to flow through a larger orifice, thus allowing pipe sizes to be greater than the direct-acting SOVs. Additionally, the coil is doing less work and using less power draw or wattage (in most cases). These SOVs with larger pipe sizes can achieve higher Cv (Kv), therefore, greater standard cubic feet per minute or gallons per minute — generally more flow where necessary.

So again, what are the tradeoffs here? Pilot operated can also be zero minimum pilot pressure while maintaining the larger Cv. Flow ratings, added springs and other mechanical attributes of the diaphragms or pistons will mean more movable parts, reducing maximum pressure rating, greater wattage usage from the coil and usually more cost per unit.

There are circumstances where the choice between direct acting or pilot operated will overlap on pipe sizes. Using most of the information above, the end user must decide the best flow factor Cv (Kv), minimum pressure in the



Schematic of the inside of a direct-acting SOV.



Schematic of the inside of a pilot-operated SOV.

line, maximum pressure in the line, wattage consumption and cost of ownership (preventive maintenance, repair or replacement).

The topic of direct acting versus pilot operated will be suitable across nearly all SOV types and configurations. For users, this may require 2-way, 3-way, or 4 way, direct-acting or pilot-operated SOVs. As with most equipment, the application will work best with the right educated choice. ❗

*For Valve Basics, we often revisit previously published articles like this one from John Molloy. We are currently seeking articles for other basics topics. If you have an article you'd like us to consider that would be fitting of this column, please email it to our editor, Heather Gaynor, at [hgaynor@gardnerweb.com](mailto:hgaynor@gardnerweb.com). Please include the article topic, and why you think it would be valuable to our readers.*

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**John Molloy** is ASCO Training Manager for Emerson. Look for him at the next industry event, where he'll probably be wearing an "I heart Solenoids" t-shirt. Reach him at [John.Molloy@emerson.com](mailto:John.Molloy@emerson.com).





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# LATEST LAUNCHES



Source: Curtiss-Wright Farris Engineering

## Curtiss-Wright's Farris Engineering Offers Real-Time Monitoring

Farris Engineering, part of Curtiss-Wright Valves Division now offers the inSure Pressure Relief Valve Monitoring Device.

Monitoring valve performance is needed for EPA Clean Air Act requirements. Devices in many organic hazardous air pollutant (HAP) applications must be equipped with a monitoring device to identify release and record time and duration of release, and must immediately notify operators of a release. Process owners can use this information to improve operational efficiency and reduce downtime.

The device obtains real-time monitoring of pressure relief events by detecting valve stem movement and provides immediate feedback through CW inSure online app or Distributed Control System (DCS). The device can accurately measure pressure relief events and detect unstable flow in challenging applications to save costs and reduce maintenance.

The monitor is factory installed and calibrated, or as a retrofit kit can be installed by a factory-trained technician on most Farris 2600 series spring-loaded pressure relief valves. The device utilizes Bluetooth connectivity to provide live valve status of pressure events, percent open, time stamp, temperature and battery voltage. If connected to a DCS, the company offers three communication protocols to connect to the device: a wired 4-20mA connection, wirelessHART and wireless ISA100 options provide flexibility to the process owner.

Since this is an electronic device used in hazardous locations, the company obtained certification and approvals through CSA Group. The unit is powered by a long-lasting battery that is certified by CSA for hazardous location service.

[cw-valvegroup.com](http://cw-valvegroup.com)

## Gilmore's High-Pressure Check Valve Performs Under Stress

With the movement to higher pressures and temperatures, Gilmore, a Control Devices company, engineered a PR2 Check Valve with maximum allowable working pressure of 20k and temperature range from 0°F to 250°F. The valve was designed to withstand extreme high and low pressures while preventing backflow.

The poppet design was tested according to API Standard 6A, PR2 Design Validation Test, specifically designed for components commissioned in remote and hostile environments. Updates to the new valve design include: improved antirotation pin design to replace weldment for improved serviceability; an Elgiloy spring for robust and precise reliability; Stellite poppet and Inconel seal ring to form a precise metal-to-metal seal; and a compact envelope design for installation where space is at a minimum.

[gilmore.com](http://gilmore.com)



Source: Gilmore



safety standards: ATEX Zone 2 Intrinsically Safe, USA Division 2 Non-Incendive and Zone 2 Intrinsically Safe, Canada Division 2 Non-Incendive and Zone 2 Intrinsically Safe, and IECEx Zone 2 Intrinsically Safe. The device enclosure is rated according to NEMA 4X and IP66.  
[emerson.com](http://emerson.com)

▶ To submit press releases for Valve Magazine, please send emails to [press@vma.org](mailto:press@vma.org).

Source: Emerson

## Emerson's Transmitter Connects Field Assets

Emerson released the Rosemount 802 wireless multi-discrete input or output transmitter, which has eight discrete input/output (I/O) channels, each configurable as an input or an output. WirelessHART capability allows the transmitter to connect to a wireless gateway, which can link to a host – such as a control system or asset management system – via a wired connection. This allows the host to monitor and control assets remotely over a WirelessHART network.

The new transmitter and its predecessor, the Rosemount 702 wireless discrete dual input or output transmitter, are the only WirelessHART-enabled remote I/O transmitters available today. The transmitter functions similarly to previous models, but with eight I/O channels instead of two, each configurable as a discrete input or output. For installations with multiple assets in one area that each must be monitored or controlled, the 802 transmitter is a more cost-effective solution than the Rosemount 702.

Power options include 10-30 volt direct current external line power or an Emerson SmartPower module. The latter option requires no wiring, provides up to 8 years of maintenance-free operation and can be replaced in the field. The transmitter is certified according to the following

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*Heather Rhoderick*

## INDUSTRY

# PROFILE

## Phil Mahoney

*Phil Mahoney is a director of engineering services, Stationary Equipment Group for the A.W. Chesterton Company. His primary focus is on stationary equipment sealing new products and technology. With over 30 years of experience in the sealing industry, Phil has been involved in low-emissions valve sealing much of his career and has been awarded several patents.*



Phil in Moab, Utah, in the Fisher Canyons area during a camping trip. Source: Phil Mahoney

### What inspired you to pursue a career in the world of valves and actuators?

I started my career as a marine engineer on various ships, so I had quite a bit of hands-on experience with valves and actuators. After that, I worked in a shipyard doing repair work, and a lot of that was specific to valves. From there I started working for A.W. Chesterton, a manufacturer of all types of sealing devices including various compression packings for valves. More than 30 years later, I'm still involved in this industry segment and learn something new every day.

### Why did you decide to get involved with VMA?

I've been active with the Fluid Sealing Association for about 20 years; that was my introduction to the benefits of participating in a trade association — working collectively on challenges to our industry, creating educational content on sealing devices and learning from my colleagues from other companies. Chesterton is in the supplier category, and many VMA members are our customers so it was a no-brainer to join the association. The VMA's membership is a great source of knowledge and ideas, and VMA's focus on addressing industry challenges through its government affairs work and creating and delivering educational content for new engineers entering the industry to seasoned end-users is a huge value from my perspective.

### Are there any exciting projects or initiatives you are working on that you'd like to highlight to our readers?

The issue of PFAS as it relates to the sealing industry has been a focus of mine for several years. The VMA has been involved in this area, providing feedback and information to legislators and regulators on the importance and safety of fluoropolymers and fluoroelastomers in industrial applications. The breadth of knowledge and active participation from VMA members in this initiative is impressive.

### How do you stay abreast of changes in the valve and actuator industry?

Besides participating in various industry standards associations like the American Petroleum Institute and the Manufacturers Standardization Society, *Valve* is a great source of information on the industry. A number of my colleagues regularly share articles from the magazine on topics of interest to our internal engineers and our sales specialists that are focused on valve and flange sealing. (Editor's note: We did not prompt Phil to say this, but appreciate the feedback!)

### Are there any emerging trends or technologies that you are particularly excited about?

The IoT technologies available today offer myriad options that can be incorporated into sealing technology applications. The data that we can gather with these systems will help us diagnose performance issues on all kinds of equipment, and we can use that data to help our end users increase the reliability and performance of their systems.

### Is there a piece of advice you were given that has stuck with you?

Don't be afraid to ask a lot of questions and don't be afraid to fail. In our line of work, much of what we know about processes, equipment design and operational experience does not come from classes, it comes from experience. 📌

Read the full interview: [VALVE-MEDIA.com/articles/industry-profile-Phil-Mahoney](https://valve-media.com/articles/industry-profile-Phil-Mahoney)

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