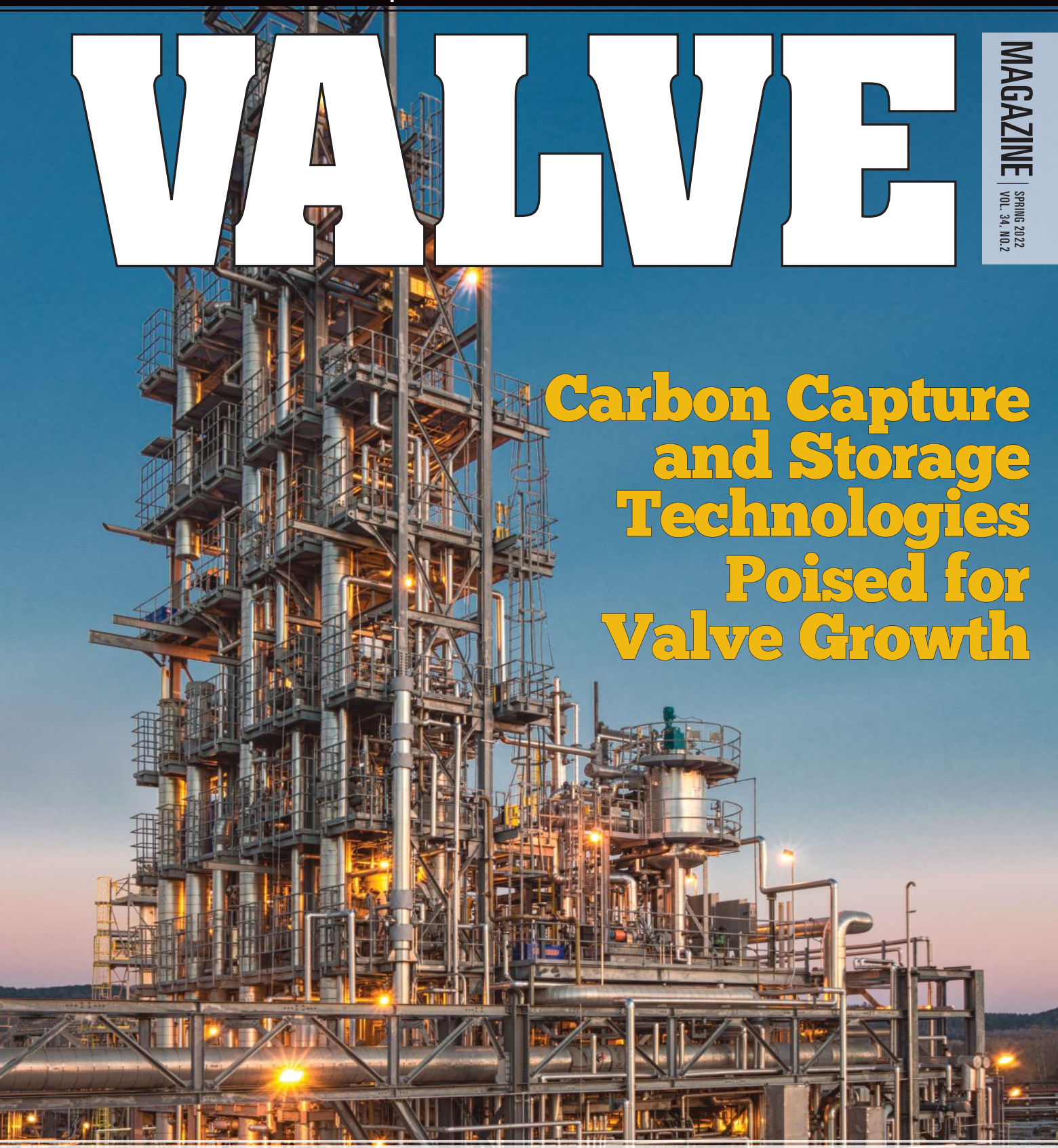
VMA LAUNCHES UPDATED WEBSITE | VALVE BASICS OFFERS VIRTUAL & IN-PERSON EVENT FOR 2022

VALVE

MAGAZINE | SPRING 2022 VOL. 34, NO.2



Carbon Capture and Storage Technologies Poised for Valve Growth

- VALVE BASICS: GATE VALVES
- THE BIGGEST VALVES
- THE HYBRID WORKPLACE
- AXIAL FLOW CHECK VALVES

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For 175 years we've been on a mission. Your mission. When people are counting on you. You can count on us.

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Our repair equipment includes lapping machinery for balls up to 36". The welding department, headed by our in-house welding engineer, can handle casting repair and upgrade on virtually any alloy, especially Cr/Mo materials

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VALVE MAGAZINE
SPRING 2022 | VOL. 34, NO. 2

PHOTO CREDIT: KELLY L ON PEXELS

14

Carbon Capture and Storage as a Harbinger of Valve Industry Growth

In the first installation of this two-part feature, glimpse into the nascent technologies of carbon capture and storage and its encouraging future for the valve industry.

COVER IMAGE CREDIT: U.S. DEPARTMENT OF ENERGY NATIONAL CARBON CAPTURE CENTER

BY MARGO ELLIS AND GREG JOHNSON

PRODUCTS

40 Editor's Picks

> Diaphragm and bonnet assembly
> Emergency shutoff valve module
> Steam-tight control valve
> Single-bolt grip restraint

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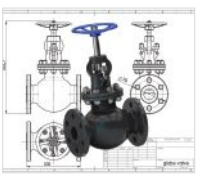
Solenoid Valves: What Are Their Types and How Do They Work?



The Limits of Standard Manual Globe Valves for Throttling

COLUMNS

DEPARTMENTS

VALVE MAGAZINE

www.VALVEmagazine.com

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VMA VALVE MANUFACTURERS ASSOCIATION OF AMERICA

www.vma.org

A Few of the Many Valves that Keep the World Running

With Earth Day in the United States approaching on April 22, the Spring issue of VALVE Magazine introduces the first article in a two-part series on how valves stand to play a critical role in carbon capture and storage (CCS) as a way to combat the world's growing carbon dioxide emissions. And in an ironic twist, the technology can also prove to be beneficial to the thermal power market by extending the lifecycle of the fossil fuel industry. Turn to page **14** to learn about this needed and developing CCS process.

Another feature in this issue is the trend of big and bigger valves. These valves, some of which can be large enough to stand or walk in, are historically used in water and wastewater applications. While clean water and wastewater management may be taken for granted in some parts of the world, they are an integral piece of improving human health and the environment. And none of this is possible without valves!

VALVE continues with its approach to provide nonproprietary, peer-reviewed foundational education on different types of valves, actuators and controls. In this issue, we look at gate valves as part of our regular Valve Basics feature, written by the magazine's most prolific writer over the years, and two-time winner of VMA's "Person of the Year" Award, Greg Johnson.

We also explore control and choke valves and some of their applications. To select the right valve, the importance of understanding all the intricacies of the application where a valve will be used cannot be reiterated enough. The article on page **28** explores some of the issues and considerations for control and choke valves in the offshore oil and gas industry. Regardless of whether your companies operate in this industry, author Adrian Croft sums up a key element to success in valve selection for any application . . . "ultimately, [it] is a case of having a dialogue."

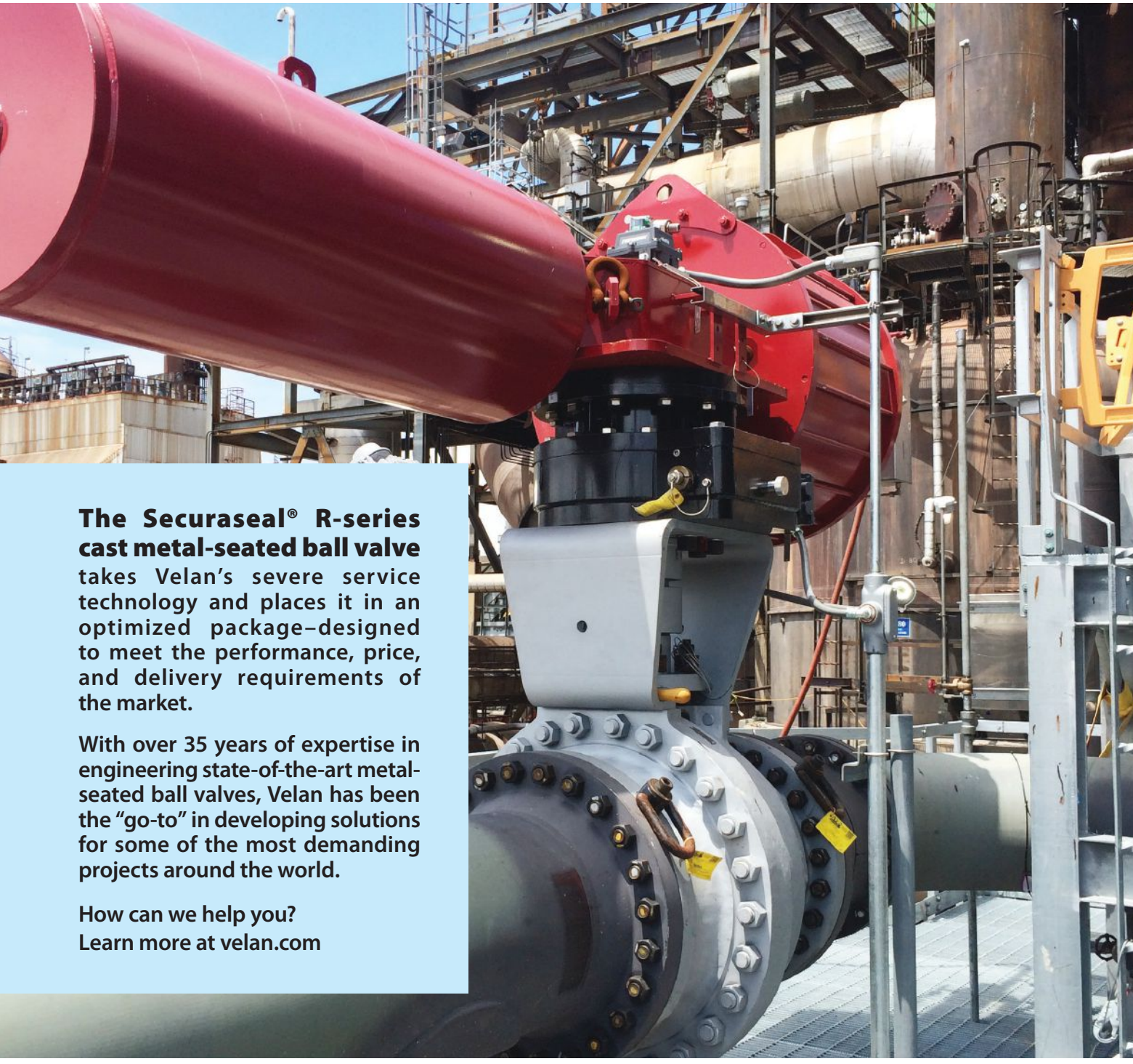
In this vein, I look forward to continuing the dialogue with all the VALVE readers and VMA members — in print and digitally — and most importantly, in person at an upcoming VMA event. If you enjoy the articles on specific types of valves, I encourage you to check out VMA's Valve Basics events, which are in person and virtual. More information on these can be found on page **7**.

See you soon!

Heather

Heather Rhoderick, CAE
President

Severe service performance made simpler



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ACQUISITIONS

United Valve Acquires Global Service and Repair's Assets

United Valve has acquired the assets of Global Service & Repair (GSR) of Sulphur, LA. GSR is a provider of repair and modification services on rising/rotating metallic plug valves and other tapered plug valve designs. The acquisition and installation of GSR's special grinding equipment will allow United Valve to better perform repair and service on all types of metallic plug valve designs. These metallic plug valves are used in many critical fluid control applications such as coker switching, isolation and overhead vapor lines, as well as ethylene cracking units.

FloWorks Acquires SemiTorr Group

FloWorks, a specialty flow control distribution platform backed by Clearlake Capital Group, L.P., has acquired SemiTorr Group, a specialty fluid handling systems and components distributor.

Founded in 1988 and based in Tualatin, OR, SemiTorr offers products and services to the high purity, sanitary and general industrial sectors. The company's products include processing equipment, pumps, tubing, hoses, fittings, valves, filtration and instrumentation, among others.

Trillium Flow Technologies to Acquire Termomeccanica Pompe

Trillium Flow Technologies (Trillium) and Termomeccanica Pompe S.p.A. have signed a joint agreement that will bring the Termomeccanica Pompe, Gabbioneta pumps and Begemann brands together under the Trillium umbrella in Italy. Due to customary regulatory approvals, the transaction is expected to close in two months. Following the transaction, Termomeccanica will concentrate its activities on developing the ecological and gas compression sectors, where its subsidiaries TME and TMIC operate.

Allied Valves Expands its Brands

Allied Valve has expanded its array of brands with the acquisitions of Power Specialties Inc., PROMAC Inc. and JMI Instrument Co. The three companies will be merged to form Allied Instrumentation, which will cover seven states in the Midwest, employ 50 people and generate more than $50 million in revenue. Allied Instrumentation will be led by newly appointed president, Kevin Scheibler.

Quality Valve Acquires Griffco Valve

Griffco Valve, based in Amherst, NY, has been acquired by Quality Valve, a valve and parts distributor in Mobile, AL, specializing in quick shipment MRO service support. Quality Valve is working with Griffco's existing team and building customer and vendor relationships established over the past 30 years. Going forward, Griffco Valve, a Quality Valve company, will continue to operate from its headquarters in Amherst, NY with additional investments planned to increase inventory, add operating capacity and enhance its product offerings.

PROJECTS & COLLABORATIONS

Curtiss-Wright and Teledyne FLIR Defense Sign Agreement

Curtiss-Wright Corporation has entered into an agreement with Teledyne FLIR Defense to supply unmanned systems and integrated solutions to the U.S. nuclear power market and the Department of Energy. Mobile unmanned systems (MUS), including drones, robotics and submersibles, play a critical role in industrial and defense applications by automating operations and eliminating the need for humans to perform tasks in hazardous conditions. Curtiss-Wright's products are installed in every nuclear plant in North America.

PEOPLE IN THE NEWS

Richards Industrials has appointed **Jim Gray** as global vice president of sales. Gray is an industry veteran and brings more than 30 years of sales and business development experience. Previously, Gray served in a variety of sales/sales management positions with Fisher Controls, Dresser, GE Oil and Gas, and FCX Performance.

Jim Gray

Thom Jessup

The Fluid Sealing Association (FSA) has appointed **Thom Jessup** of VMA member EGC Enterprises as the new president and **Amy Hammarstrom** of General Rubber Corp. as the new vice president.

MRC Global Inc.'s chairman of the board, **Rhys J. Best**, will retire upon completion of his term as a director at the annual meeting of the company's stockholders scheduled for May 5, 2022. The board of directors of MRC Global has selected **Robert L. (Bob) Wood** to be its next chairman, effective and contingent upon his re-election as a director at the annual meeting.

Bruce Brabant

DeZURIK is sad to announce that **Bruce Brabant**, 57, Oconto, WI, passed away on Feb. 15, 2022. Bruce spent many years in the valve industry, most recently as technical marketing manager for DeZURIK, Inc. Previously he was North American new business development manager for Wolverine Flow Control and sales manager for DSS Valves, along with 12 years in sales management at Weir Minerals/Delta Industrial Valves.

MRC Global Awarded Equipment Supply Contracts for Sunrise Wind Project

Aker Solutions AS has awarded MRC Global Norway AS contracts to provide the complete scope of valves, instrumentation, piping, tubing and fittings for the Sunrise Wind offshore wind power project located 30 miles east of Long Island's Montauk Point in New York state. The Sunrise Wind project will be the largest offshore wind farm by power generation capacity in the state of New York. The 924 MW project will be sufficient to power nearly 600,000 homes and supply 100% renewable energy to help realize New York's vision of becoming a leader in clean energy.

Emerson Technologies Selected for Geothermal Clean Energy Production

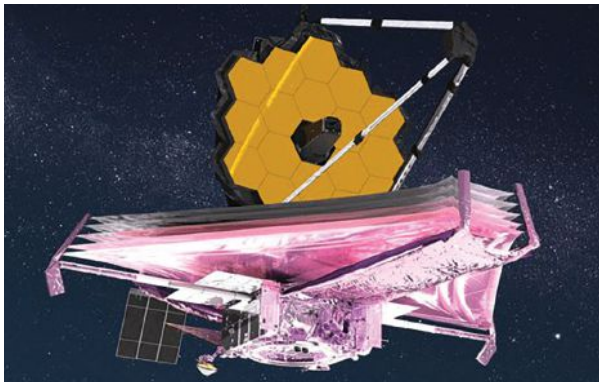
HITA, a deep geothermal energy company in Belgium, has selected global software and technology leader Emerson as a key technology provider in the discovery and development of geothermal energy sources in Northern Belgium. Emerson's geological and reservoir modeling software will help reduce risk in selecting locations for renewable geothermal energy projects, increasing the safety and reliability of construction and operation while enabling long-term sustainable energy production from the earth's heat.

ValvTechnologies Welcomes New Distributor SVI Industrial

SVI Industrial will be representing ValvTechnologies in North Carolina and South Carolina. SVI offers not only new valve solutions but also industrial maintenance to include valve repair and machining services, code welding and fabricating, custom-engineered gas path solutions, industrial noise control design and manufacturing, as well as industrial masonry and corrosion control systems.

James Webb Launch Caps Exciting Year for Equilibar

On Dec. 25, 2021, the long-awaited James Webb Space Telescope successfully launched from French Guiana. The telescope is an international collaboration involving NASA, the European Space Agency and the Canadian Space Agency. It will continue and expand on the ground-breaking discoveries of the Hubble Space Telescope, which launched in 1990. In 2017, David Reed, Equilibar's vice president of operations, designed a pressure control system to deliver nitrogen gas to NASA's acoustic testing chamber at the Goddard Space Center in Maryland.



AWARDS

Equilibar Granted NC Governor's Award of Excellence

Equilibar was recognized for working with the state to increase its international presence. Equilibar's David Reed, Operations vice president, and Julie Detmering, Export and Compliance manager, accepted the Governor's Award of Excellence at the governor's mansion in Raleigh, NC. Each of the manufacturers recognized has worked with the state to increase its international sales. The free services are delivered through the Economic Development Partnership of North Carolina.

Curtiss-Wright Nuclear Division Engineer Recognized

Curtiss-Wright's Nuclear Division announced that a member of its industry-leading engineering staff — J. Fred Hall — is among the group of engineers recently named Curtiss-Wright Technical Fellows in recognition for their commitment to technical excellence. Recipients of the program honors are selected for exhibiting the pinnacle of engineering capability and expertise in their field of study.

Flowserve Wins 2021 Chemours Supplier Award

Flowserve Corp., a leading provider of flow control products and services for the global infrastructure markets, was selected to receive a 2021 Chemours Supplier Award. These awards recognize suppliers that have

2022 YEAR-LONG

VMA Valve Basics 101 and 201
Virtual
www.vma.org/valvebasics

MAY

2-5
OTC (Offshore Technology Conference) 2022
Houston, TX
otcnet.org

JUNE

12-15
ACE Annual Conference & Exposition
San Antonio, TX
awwa.org/ace

AUGUST

3-4
2022 VMA/HI Market Outlook Workshop
Virtual (members only)
www.vma.org/marketoutlook

SEPTEMBER

7-9
2022 VMA Annual Meeting*
(members only)
Santa Barbara, CA
www.vma.org/annualmeeting

OCTOBER

8-12
WEFTEC 2022 Conference & Expo
New Orleans, LA
weftec.org

OTHER VMA EVENTS
Please visit vma.org/calendar for additional programs as they are scheduled.

*Open to VMA/VRC members only. Visit www.VMA.org to learn if your company qualifies for membership.

VALVE MAGAZINE

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ARTICLE SUBMISSIONS
VALVE Magazine welcomes articles, proposals, manuscripts, photographs and ideas from our readers. For a copy of the magazine's Author's Guidelines, contact Margo Ellis, Editor-in-Chief, at mellis@gardnerweb.com

distinguished themselves by driving quality, innovation and sustainability improvements in Chemours' supply chain.

Control Magazine's Readers' Choice Awards Include Several VMA Members

Marking the 30th anniversary of Control magazine's Readers' Choice Awards, several VMA member companies were winners in the category of Final Control Elements. Awards were bestowed to Baker Hughes, Bray International, Emerson, Flowserve and Neles. Emerson took top honors for Control Valves, On/Off Valves and Pneumatic Actuators.

Victaulic Wins Gold in 2021 Product of the Year Contest

Victaulic Tools for AutoCAD (VTFA) won gold in Consulting-Specifying Engineer's 2021 Product of the Year program in the Software: Design, Modeling, Monitoring category. The contest highlights new products in the HVAC, fire safety, electrical and plumbing systems engineering markets. Victaulic Tools for AutoCAD is a free tool that provides AutoCAD users the same classic routing features and drawing productivity gains that were previously only available in the Victaulic Tools for Revit platform. The VTFA add-on provides toolsets engineered for civil, industrial, plant or mechanical projects, and includes features to simplify pipe routing, procurement and exporting bills of materials.

Backed by Ferguson, Newport News Waterworks Receives Sustainable Water Utility Award

Ferguson Waterworks has announced that Newport News Waterworks recently received the Sustainable Water Utility Management Award from the Association of Metropolitan Water Agencies. As part of Ferguson's efforts to partner with utilities that are embracing sustainable efforts, the company worked with Newport News Waterworks to undertake one of the largest smart metering overhauls in the country. Together, Ferguson and the utility are implementing approximately 130,000 smart water meters to help conserve water, provide more accurate billing information, decrease leak response time and reduce the municipality's carbon footprint.

Emerson Awarded Industrial IoT Company of the Year

Global technology and industrial software leader Emerson has been named the "Industrial IoT Company of the Year" by IoT Breakthrough — an honor awarded to the company four of the last five years. IoT Breakthrough, which received nearly 4,000 nominations for the 2022 competition, recognizes Emerson's technology and software innovation that is helping customers in essential industries realize safer, more efficient and sustainable operations.

FACILITIES

Crane ChemPharma and Energy Announces New Saunders Valves Facility

Crane ChemPharma and Energy, a business of Crane Co., has broken ground on its new Saunders factory in Cwmbran, UK. The 100,000-sq-ft facility, planned to open in the fall of 2022, will manufacture Saunders HC4 and Saunders IDV ranges of aseptic and industrial diaphragm valves and related products as well as continue to meet the most stringent quality and product approvals.

Emerson Expands Cylinder Manufacturing Capacity in Canada

Emerson has expanded the manufacturing capacity of its Brantford, Ontario, facility to better serve Canada's immediate-demand automation market. Emerson has added production of its complete range of AVENTICS Series PRA Profile Cylinders, Series TRB Tie Rod Cylinders and Series TaskMaster TM5 NFPA Profile Cylinders.

Baker Hughes Expands Presence in Guyana

Baker Hughes has expanded its presence in Guyana through the opening of a new local supercenter facility for oilfield services and equipment. Baker Hughes has a strong history of localization in Guyana. The company currently provides drilling services, drill bits and drilling and completion fluids to several drilling rigs, with its Completions and Wellbore Intervention product line supporting all upper completions for development wells in Guyana. Baker Hughes' Turbomachinery and Process Solutions and Upstream Chemicals businesses also provide technology and solutions to the second floating production, storage and offloading (FPSO) vessel in Guyana and other projects in the region.

FERGUSON INDUSTRIAL

Wolseley Industrial Group is now

FERGUSON INDUSTRIAL

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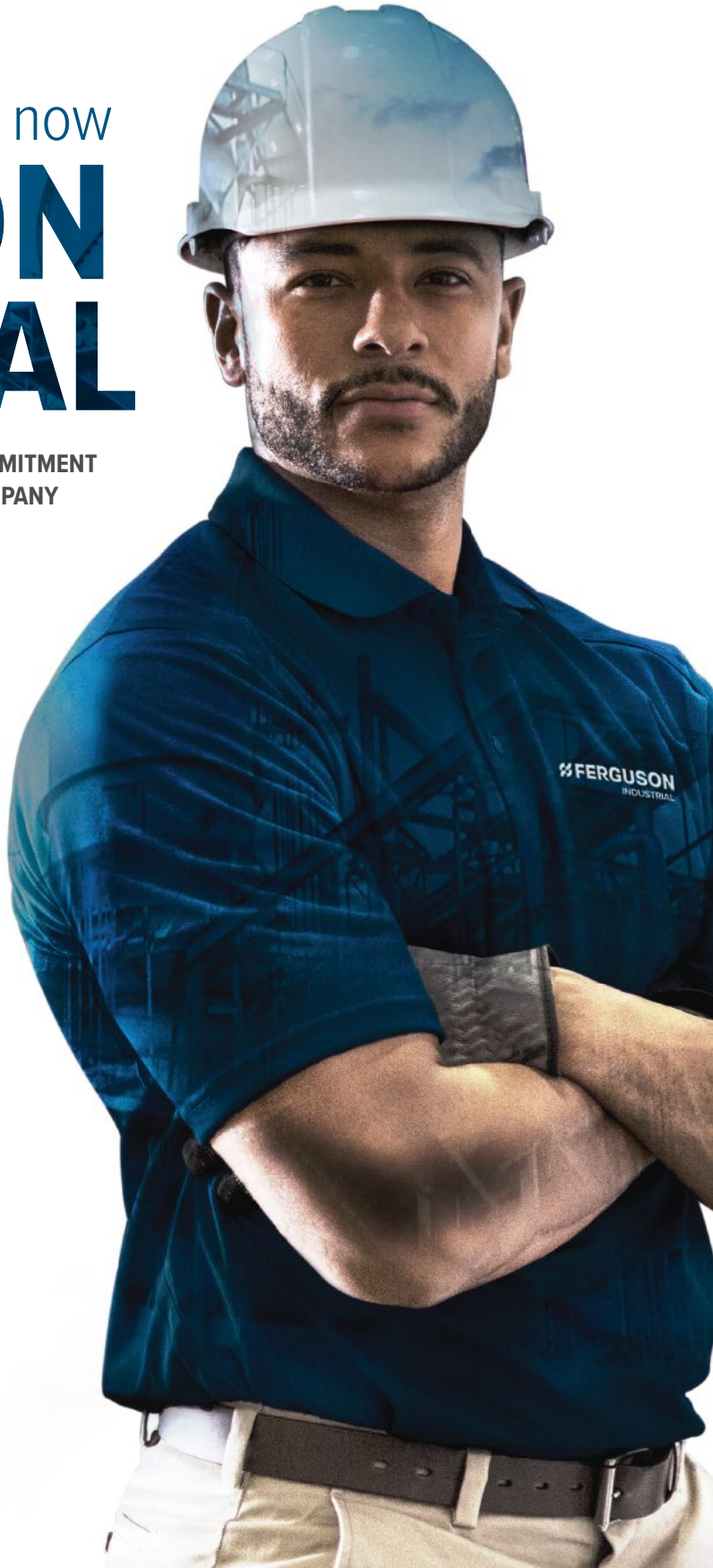
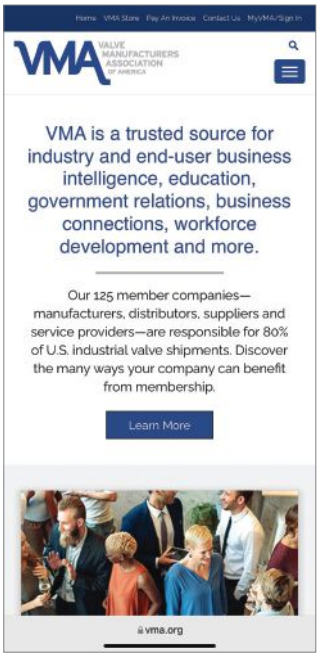


FERGUSONINDUSTRIAL.COM/REBRAND

VMA Programs Foster Member and Industry Networking

Building strong connections has never been as important as it is today. VMA understands this, and we have several opportunities to keep our members — and the entire industrial valve value chain — connected. Whether it's linking you with the information you need via our revamped website, providing a forum in which members of common interests can get together, or connecting our entire industry through events such as the Valve Forum or Valve Basics, the VMA is committed to creating ways for our members to network, share best practices and learn.

A NEW LOOK FOR VMA.ORG



You may have noticed a little something different about VMA.org. That's because it recently received a makeover with an improved look and functionality for the website. With this launch comes an enhanced experience for our members, visitors and advertisers.

The new site provides a more modern design scheme and includes an update to the website's structure and functionality. It also features improved user engagement with more capabilities in terms of search and targeted content. Anyone viewing the site can easily do so from a mobile device, tablet or desktop.

Visit the new VMA.org today!

LEARN THE FUNDAMENTALS OF VALVES AND ACTUATORS WITH VALVE BASICS

Valve Basics is your gateway into the world of valves and actuators. It is open to anyone in the industry and is especially useful to end users, engineering firms and procurement. Valve Basics provides an overview of valves, valve actuators and valve automation, and how they are used in various applications. Unique to VMA's program is that it is presented in a non-proprietary, non-biased way to provide a solid foundation on different types of valves and actuators and their applications. With multiple presenters, attendees receive information from experts on each type of valve.

When you register for the full Valve Basics program — which consists of two sections — you receive 24/7 access to:

- **Valves 101** — covering the major valve types, including linear, check, quarter-turn and pressure-relief, plus actuation basics
- **Valves 201** — offered for those who want to take the next step in learning more about critical flow control products, including actuators, controls, automation and more

In addition to the courses, live virtual "Town Halls" will take place throughout the year, allowing attendees to interact with the Valve Basics instructors. The LIVE Town Halls are taking place on the following dates:

- Thursday, April 28
- Thursday, Aug. 25
- Thursday, Dec. 15

There will also be a Valve Basics in person event Nov. 9-11, 2022, in Houston, TX, with more details to come.

Learn more and register at www.VMA.org/ValveBasics.

MEMBERS ONLY! MARK YOUR CALENDARS: VIRTUAL MARKET OUTLOOK WORKSHOP, AUG. 3-4, 2022

VMA and the Hydraulic Institute (HI) are partnering again this summer for the Market Outlook Workshop, Aug. 3-4. This VMA member-only event brings together global and national economic professionals, as well as the experts who research and follow the economic indicators for end-use markets important to the valve and pump industries.

The Market Outlook Workshop is your opportunity to gain insights from end-user market experts that you can use to plan, prepare and succeed. Learn more about the event and join the interest list at www.VMA.org/MarketOutlook.

VMA AWARDS WILLIAM "BILL" SANDLER SCHOLARSHIP TO THREE STUDENTS

The 2022 William Sandler Scholarship program is currently accepting applications for the 2022-2023 school year. Now entering its third year, the VMA William "Bill" Sandler Scholarship Program was established to provide educational opportunities to the children of VMA and VRC member company employees. Sandler was with the VMA for 42 years, the longest-serving employee in the association's history. He rose to become VMA's president, leading and guiding the association through the ever-changing industry.

Sandler's unwavering commitment to his family, fellow employees and all association members was unparalleled. His knowledge, passion and persistence set the stage for his vision for the VMA to become a reality. VMA endows scholarships in Sandler's name for college and trade school students in the fields of Engineering and Manufacturing.

The program provides financial assistance to help offset the rising cost of postsecondary education — both in technical schools and four-year universities and colleges — and promote career pursuit in areas of importance for the valve manufacturing industry.

Kerri Piper

VMA awarded the 2021 William Sandler Scholarship award to three outstanding recipients: Kerri Piper of Dublin, PA; Lucas Dalla Costa of Munster, IN; and Kasey Piper of Dublin, PA.

Lucas Dalla Costa

Kerri Piper is attending Bucknell University in Lewisburg, PA, where she plans to obtain a bachelor's degree in Electrical Engineering. Kerri's father is employed by Harold Beck & Sons Inc.

Lucas Dalla Costa is a freshman at Purdue University Northwest, located in Hammond, IN, where he is pursuing a B.S. degree in mechanical engineering. His father, Mark Dalla Costa, works at Val-Matic.

Kasey Piper is attending Bucknell University in Lewisburg, PA, where she plans to gain a B.S. degree in Chemical Engineering. Piper's father works at Harold Beck & Sons Inc.

Kasey Piper

For more information on the program and to apply for the 2022 scholarship, visit www.vma.org/sandlerscholar. The deadline to apply is June 30, 2022.

VMA Committees: Moving the Valve Industry Forward

VMA's committees comprise member company individuals who help VMA deliver member benefits and execute the strategic plan. Committee members also receive the benefit of discussing issues with their peers and benchmarking with each other. We'd like to thank the committee chairs and vice-chairs for their continued support and leadership. If you are a VMA member and would like to join a VMA Committee, please visit www.VMA.org/Committees.

EDUCATION & TRAINING

- **Committee Chair:** John Molloy, Training Manager, Products, Applications and Sales, ASCO
- **Committee Vice Chair:** Noah Miller, Sales Manager, Check-All Valves

GOVERNMENT AFFAIRS COMMITTEE

- **Committee Chair:** Brian Wright, President and CEO, A-T Controls

MANUFACTURERS COMMITTEE

- **Committee Chair:** Walter Amaya, Global Supply Chain Manager, Baker Hughes

MARKET OUTLOOK/STATISTICS COMMITTEE

- **Committee Chair:** Steve Szpak, Director, Sales and Marketing, Trillium Flow Technologies

MARKETING & COMMUNICATIONS COMMITTEE

- **Committee Chair:** Kyndle McMurry, Marketing Communications Manager, Richards Industrials

STRATEGIC PLANNING COMMITTEE

- **Committee Chair:** Nathan Brunell, Product Line General Manager, Baker Hughes

TECHNICAL COMMITTEE

- **Committee Chair:** Stephane Meunier, National Sales Director, Emerson
- **Committee Vice Chair:** Nicolas Lourdel, Manager, Product Development Process, Velan Valve Corporation

VALVE MAGAZINE ADVISORY BOARD

- **Committee Chair:** Greg Johnson, President, United Valve

COMMITTEE SPOTLIGHT: MANUFACTURING COMMITTEE

Chair Walter Amaya, Global Supply Chain Manager, Baker Hughes, answers a few questions from the VMA staff about his role with the Manufacturing Committee.

Q: Tell us about VMA's Manufacturing Committee.
This committee is composed of manufacturing and supply chain leaders and members of the VMA. Our objective is to provide support and guidance to the manufacturing community in matters that are relevant and contemporary to the different aspects of the supply chain process.

Q: What do you enjoy about being a part of the Manufacturing Committee?
I very much appreciate the exchange of ideas and manufacturing trends across our industries and product lines. The extensive experience of our members is a great resource to continuously look for ways to improve the way we do things.

Q: How is the Manufacturing Committee helping VMA members? And you, personally and professionally?
During Manufacturing Committee meetings, we discuss relevant issues and technologies that can help our members to become safer and more competitive. We take advantage of our scheduled events and publications to share those topics with our manufacturing community. For me professionally, being part of this committee has allowed me to learn from many experienced leaders in the industry and personally to meet great people with shared interests.

Q: What future changes, innovations, technologies and opportunities are you excited about for the valve industry?
Being on the manufacturing side of the industry, we are used to constant changes and the need to adjust and adapt quickly to meet our customer needs. Nonetheless, these past few years have brought an unprecedented number of challenges ranging from material and labor constraints and expanding logistic times and costs. But this has also brought in opportunities to reexamine and challenge many of our operating practices and become more creative to find solutions that will help us to be successful going forward.

I am convinced that the valve industry will continue to play a critical role in the new energy generation technologies and many other fields that are being developed right now.

Q: How did you get into the valve industry?
I joined the valve industry as a supply chain leader after 25 years of working in the manufacturing of construction and locomotive equipment. So far, this has been a great experience to learn and contribute to a global industry so vital to our daily lives.

Q: What are some hobbies or activities that you enjoy outside of work?
I love to spend most of my free time with my wife and four children. We enjoy traveling and fishing, and I do most of my reading while traveling. On the other hand, I need to get back to a better jogging routine.

Q: If you could write a book, what would it be about?
I am very passionate about history, [so] most likely [the book] will be a historic novel situated in Latin America.

Q: What is your favorite sports team?
I was fortunate to live a few years in Western Pennsylvania and that left me a strong follower of the Pittsburgh Steelers, so I enjoy every season as part of Steeler Nation.

Carbon Capture and Storage as a Harbinger of Valve Industry Growth

In the first installation of this two-part feature, glimpse into the nascent technologies of carbon capture and storage (CCS) and its encouraging future for the valve industry and methods of controlling the world's carbon dioxide emissions. The follow-up summer article will delve deeper into member companies' CCS experimentation and research efforts underway.

BY MARGO ELLIS AND GREG JOHNSON

For many people who work in the valve industry, the goal of clean energy feels like a threat to the profession, especially in the thermal power market. The focus of this article is not about the rationale or need behind our collective shift toward global carbon reduction. For the valve industry in particular, one approach of CO_2 emissions mitigation — carbon capture and storage (CCS) — is not a doom-and-gloom scenario. Instead, it's a new frontier that can extend the lifecycle of fossil fuels and simultaneously provide much new work for those in the industry, as various processes of the technologies are valve-intensive.

There are the other familiar and ubiquitous carbon-cutting mitigation methods such as renewable energy (wind, solar, hydrogen, geothermal) and nuclear power, but without CCS technology and abatement, it will be virtually impossible to remove emissions from the global economy. In a recent report from the International Energy Agency (IEA), to meet the global consensus goal of net-zero CO_2 emissions by 2050, the world will need to deploy more than 150 times as much carbon capture capacity than we currently have.

The enterprise of CCS — a means of capturing CO_2 and storing it to prevent its release into the atmosphere — has its roots in enhanced oil recovery (EOR), tracing back nearly 50 years. CCS has quickly become a growing necessity in talks toward achieving net-zero (and eventually negative) emissions as part of the world's imminent energy transition, especially those countries that produce and consume the largest amounts of fossil fuels. A very viable and least-understood mitigation pathway, CCS involves three main steps:

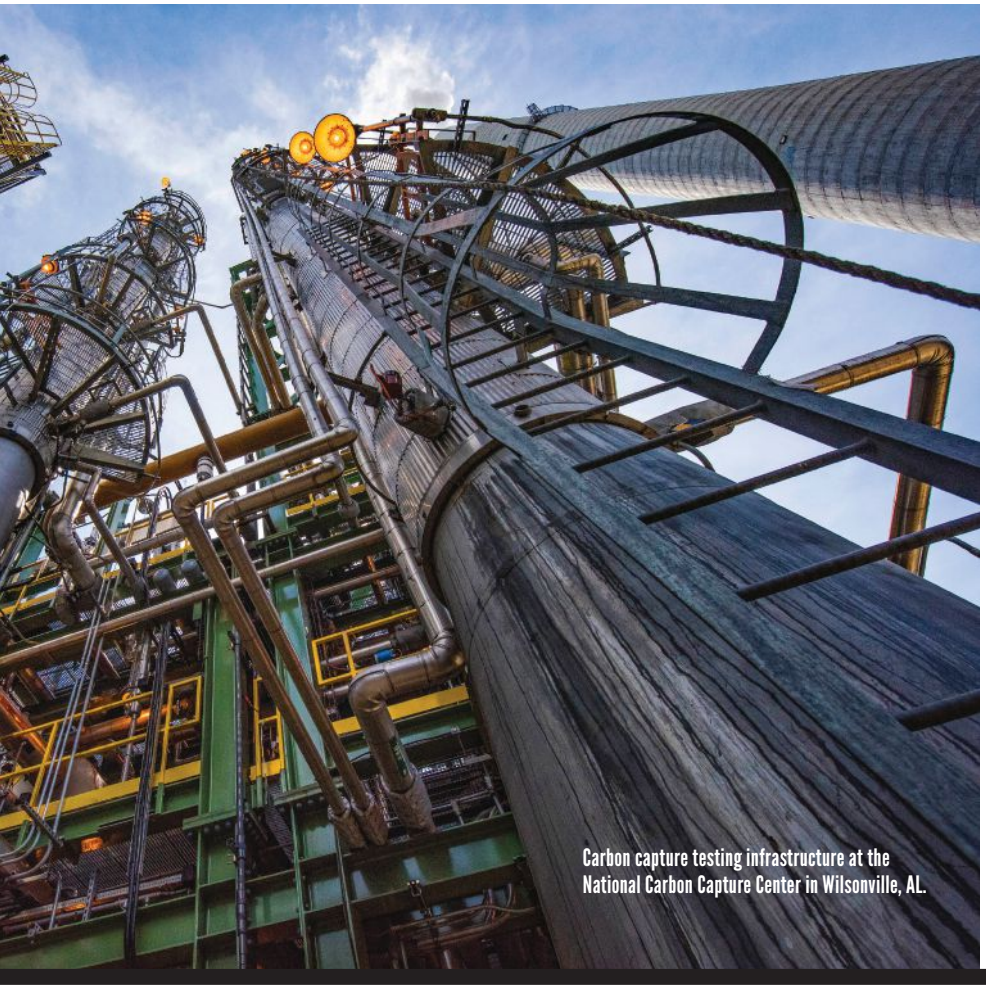
- Capturing CO_2 at the source
- Compressing the CO_2 for transport
- Injecting the CO_2 deep into the ground into a rock formation where it is permanently stored

Industrial large-scale emissions processes — those that come specifically from manufacturing and products such as cement, petrochemicals and steel, for example — are a major contributor to greenhouse gases, supplying 22% of global emissions, according to the Global CCS Institute. The most expedient and direct abatement approach is point source capture technology, where the CO_2 is captured from power plants' smokestacks, which has the greatest potential for reduction of CO_2 emissions compared to other sectors like electricity, agriculture, transportation and commercial/residential buildings.

Steps one and two of CCS (capture and transport) are where the need and use of valves are paramount, especially in power sectors such as coal, natural gas, ammonia, iron and steel, and midstream projects. On the capture side, there are three basic types of technologies that prevent large quantities of CO_2 from being released: pre-combustion, post-combustion and oxyfuel with post-combustion.

CAPTURE OF CO_2

The most popular form of capture for industrial CCS (and directly applicable to this industry) is post-combustion, where CO_2 is separated from combustion exhaust gases — involving pressure, temperature, piping and valves. A majority of CCS methods utilize some combination of temperature and pressure. Fluids in these environments require piping and valves, so the overall outlook for the valve industry to benefit from these endeavors is promising. The amine process (see sidebar of terms and definitions) is a particularly strong user of piping systems, so new amine units, as well as retrofits, will necessitate many valves. The specific requirements of these units also will entail valve and piping materials designed to handle the potential corrosivity of the fluids in these processes. Besides the amine process, there are other post-combustion methods that involve the use of absorption and adsorption to separate the CO_2 from the flue gases.



Carbon capture testing infrastructure at the National Carbon Capture Center in Wilsonville, AL.

Howard Herzog, senior research engineer at the MIT Energy Initiative, and author of the 2018 book *Carbon Capture*, in explaining how the demand will impact this industry, said, "The capture part can be looked at as a type of chemical plant. And the storage part can be seen as similar to oil and gas production (except we are injecting into the ground rather than extracting) and many valves are needed. Finally, there's pipeline transport that's similar to gas pipelines; and once again, valves are essential."

TRANSPORT OF CO_2

Step two of CCS is transport. After the CO_2 is removed from the fossil fuel bloodstream, it needs to be transported for storage, and pipelines are (and will continue to be) the most common mode of transporting large quantities of CO_2. Truck, rail and ship transport are other modes, but they are used primarily for smaller quantities. Currently, most CO_2 pipelines exist to support EOR in western and southern oilfields. In most cases, these pipelines are transporting the CO_2 from naturally occurring CO_2-rich geological formations to areas of active oilfield use.

The current pipeline infrastructure for CO_2 is limited, and significant investment to scale up to levels that can support exponential growth in CCS will be needed. According to the Net-Zero America Project, the United States is currently the worldwide leader in carbon transportation with 85% of CO_2 pipelines globally and will need to spend up to $230 billion on about 68,000 miles of additional CO_2 pipeline by 2050.

The valves in these pipelines are mostly midstream that fall under the API 6D "Pipeline Valves" specification, another extremely important segment of the valve industry. In addition to the API 6D valves, there are compressor stations, separation facilities and other piping systems that utilize a variety of valves. All energized interstate pipelines fall under several federal and state rules and regulations. Among those rules is a requirement that emergency shutoff valves be placed throughout the pipeline's length. Today, these lines are

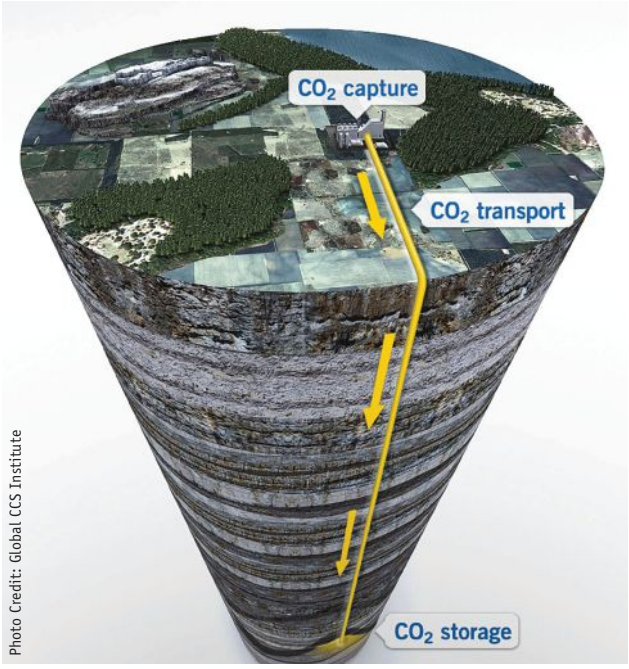


Photo Credit: Global CCS Institute

Figure 1. Illustration of the overall carbon capture and storage process.

predominately in Louisiana, Texas, New Mexico and a few oil-shale-rich western states. By far, the heaviest concentration of CO_2 lines is in Texas.

While CO_2 lines contain no flammable or inflammable substances, there are some safety concerns. First, the pipelines transporting the CO_2 must be pressurized to ensure single-phase (only gas — not liquid and gas) flow in the pipeline. This pressure must be above the critical pressure of CO_2, which is about 1072 psi. This pressure is energy that, if catastrophically released, could cause physical damage.

The greatest concern is the gas displacing breathing air in the event of a massive leak, since CO_2 is heavier than the air we breathe. A large, relatively windless release could settle in low areas such as valleys. This could elevate the CO_2 percentage to harmful or even deadly levels at about 6% and 10% by volume, respectively. The valve-related effect of this potential scenario could be that more emergency shutoff valves would be required in hilly country or other areas where the vapor could settle.

STORAGE OF CO_2

The third and final step of CCS is storage. The most popular and accepted storage method currently is injecting the CO_2 underground in secure geological formations (Fig. 3) like depleted oil and gas reservoirs, unmineable coal seams and saline aquifers. This is commonly done through injection wells, where instead of pumping fluids like oil and gas out of the ground, the compressed CO_2 is pushed down subsurface under high pressure. This is the same process that is used in CO_2 EOR. As one can imagine, the process requires compressors, piping and many valves. In most cases, the injection pressure is usually in the range of 1500 to 2000 psi.

The mechanism used to direct and funnel the CO_2 into the ground is called a Christmas Tree, and a manifold that sits above the ground and has various valves, fittings and gauges on it. The valves used on these trees are referred to as upstream valves and fall under the API 6A, "Specification for Wellhead and Christmas Tree Equipment" specification. The API 6A valve is also a very important part of the U.S. (and worldwide) valve industry.

A brief note about what is referred to as CCUS, which includes the use or utilization as a separate endeavor of the process where the captured carbon is used instead of stored: At this stage of research and development, it's largely prohibitive from an economical and practical standpoint, but this is an area for much innovation, development and growth.

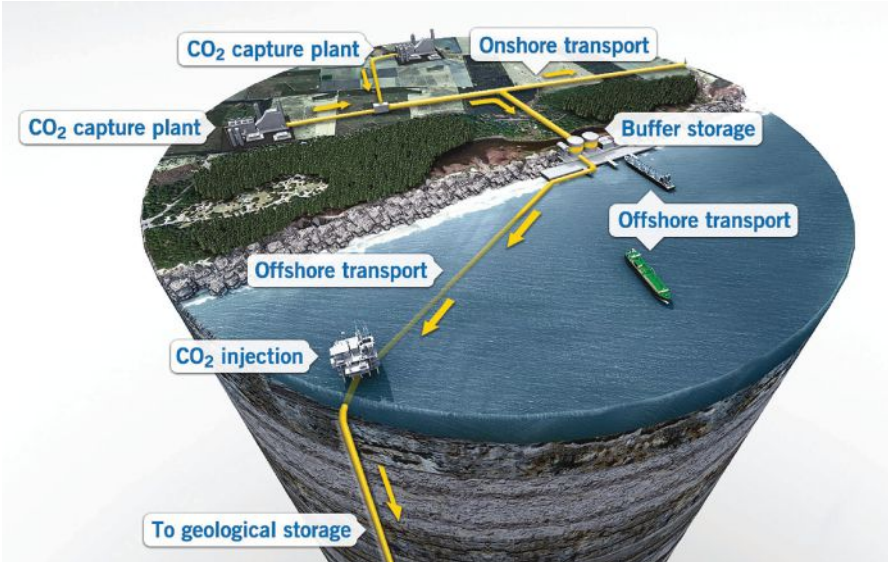


Figure 2. CCS transport overview. Photo credit: Global CCS Institute

FUTURE-LOOKING GROWTH AND POTENTIAL

Looking ahead at how these technologies hold the promise of further development and where the United States stands compared to other countries, Herzog explained, "The United States has traditionally been a leader in CCS technology. Other countries that have strong CCS programs include the United Kingdom, Norway and Japan. The Netherlands and Australia also have strong interest, but their commitment has waxed and waned due to politics. China also has CCS programs."

In considering the urgency issue and how climate change perceptions and politics are inexorably linked to any wide-reaching rollout of CCS initiatives, the outlook is unclear, but change is afoot with new initiatives toward

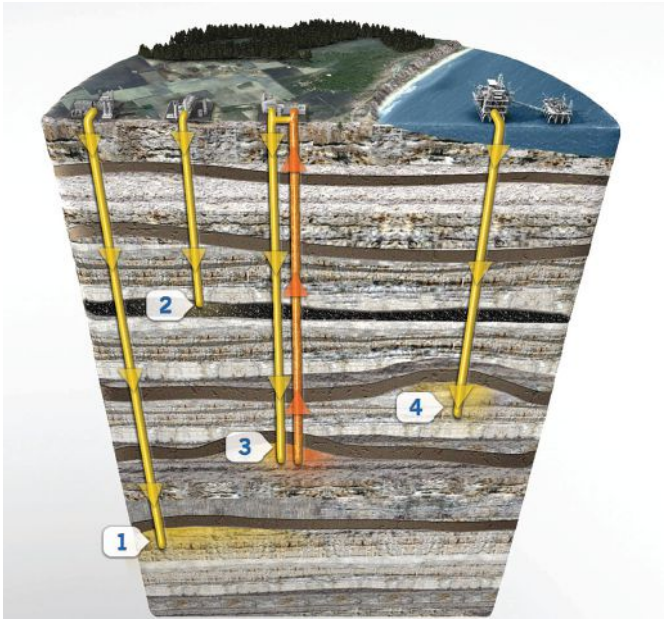


Photo credit: Global CCS Institute

Figure 3. Depiction of carbon capture storage: 1) Saline formations; 2) Injection into deep unmineable coal seams; 3) Use of CO_2 in EOR; 4) Depleted oil and gas reserves.

broader CCS implementation in business and government. On this point, Herzog added, "Eventually costs will come down as with most technologies; however, it will always be cheaper to emit CO_2 into the atmosphere (absent climate policy) than to capture and store the carbon. This is why policy (carbon prices, emissions limits) is required to create markets for CCS—then carbon capture is competing against other mitigation methods as opposed to competing with doing nothing."

From the vantage point of the valve industry, attempts to curb emissions may present a challenge at first glance, but in looking at all the uses for valves in the CCS sphere, growth and demand are practically guaranteed. In this ironic twist, valuable fossil fuel assets would continue to be used while simultaneously holding the promise of CCS and the valve-manufacturing industry by extension. A closing thought from Herzog's book: *"The fossil fuel era will not end because we run out of fossil fuels, but because of restrictions on CO_2 emissions with carbon capture, we can continue to use our fossil fuels. How much fossil fuel we will use depends on how carbon capture technology evolves. And as the story of fossil fuels demonstrates, we should not underestimate the power of technological change."*

Learn more about CCS experimentation and research and development underway at a few of our VMA member companies in part two of this series in the upcoming Summer issue of VALVE Magazine. VM

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Terms and Definitions

Carbon capture and storage: Technology that will allow fossil fuels to continue to be used via traditional processes while emitting little or no net carbon. These traditional processes are the heaviest users of valves and are the backbone of the valve industry.

Pipeline valves: These are valves used in the transmission of fluids such as oil, natural gas, chemicals and CO_2. Most intrastate pipelines are operated at high pressures in order to be effective. These pressures are commonly in the 1200-1500 psi range. Some are higher in the 2000 psi range or greater.

Power plant valves: Power plants use many valves to create energy. Most of the plants create steam that is then used to drive generators. These primary steam valves operate at temperatures above 1000°F and pressures in excess of 2000 psi, with some pressures reaching the 4000 psi range. Powerplant valves, which can be very expensive, are a big segment of the industrial valve market.

Enhanced oil recovery (EOR): A gas such as CO_2 is injected at high pressure deep into an oilfield to help force the oil to the surface.

Pre-combustion carbon capture: A process where the CO_2 is removed from a fuel stream before any combustion takes place. A pre-combustion process called Integrated Coal Gasification Combined Cycle (IGCC) has become synonymous with clean coal technology.

Post-combustion carbon capture: A process where CO_2 is removed from the flue (exhaust) after combustion has taken place. This is the most popular method for industrial carbon capture.

Oxy-combustion carbon capture: A process where pure oxygen is substituted for nitrogen-rich air in the combustion phase. Could be a useful process if technological barriers are breached.

Amines: Amines are chemicals developed to remove acid gases such as CO_2 and hydrogen sulfide in certain industrial processes.

Amine process: The amine process falls under the scope of separation processes known as chemical scrubbing. This process can usually remove at least 90% of the CO_2 in a flue gas stream. The amine process is one of the most popular CO_2 capture processes in use today.

The Fundamentals of Gate Valves

The venerable gate valve remains a primary choice for many service applications.

BY GREG JOHNSON

Gate valves are a product of the industrial revolution. While some valve designs such as the globe and plug valve have been around longer, the gate valve dominated the industry for many decades, only recently ceding substantial market share to ball and butterfly valve designs.

The gate valve differs from ball, plug and butterfly valves in that the closure element, called the disc, gate, or obturator, rises on the base of a stem or spindle out of the waterway and into the valve top, called the bonnet, by means of multiple turns of the spindle or stem. These valves that open with a straight-line motion are also called multi-turn or linear valves and differ from quarter-turn styles, whose stems rotate 90 degrees and generally don't rise.

Gate valves are available in dozens of different materials and several pressure classes. They range in size from fit-in-your-hand NPS ½ inch, through big-as-a-truck NPS 144 inch. Gate valves are constructed of castings, forgings or weld-fabricated assemblies, although casting designs dominate.

One of the most desirable aspects of gate valves is their ability to open fully and leave the flow bore virtually free of encumbrances or friction. An open gate valve offers about the same amount of resistance to flow as a section of pipe of the same port size. As a result, gate valves are still strongly considered for blocking or on/off applications. In some valve nomenclature, a gate valve is called a block valve.

Gate valves are generally bad choices for regulating flow or operating in any orientation other than fully open or fully closed. Using a partially open gate valve for throttling or regulating flow can result in either damage to the disc or body seat rings, due to the seating surfaces banging against one another in the partially open, turbulence-inducing flow environment.

An example of the original wedge-style gate valve designed by James Nasmyth in 1843. This one dates from 1848-1850.

All photos credit: Greg Johnson

GATE VALVE STYLES

From the outside, most gate valves look somewhat similar. However, inside there are a host of different design possibilities. Most gate valves consist of a body and bonnet that contains a closure element, called a disc or a gate. The closure element is attached to a stem that passes through the bonnet of the valve, ultimately interfacing with a handwheel or other actuation device to operate the stem. Pressure around the stem is contained with a packing material that is compressed into a packing area or chamber.

The motion of a gate valve's disc upon the stem dictates whether the stem rises during opening or threads into the disc. This reaction also defines the two major stem/disc styles of the gate valve: the rising stem or the non-rising stem (NRS). The rising stem is the overwhelmingly popular style of stem/disc design for the industrial market, while the non-rising style has merited longtime favor with the waterworks and plumbing industry segments. Some marine applications where gate valves are still used and space is tight, also utilize the NRS style.

The most common stem/bonnet design in use on industrial valves is the outside screw and yoke (OS&Y). The OS&Y design is preferred for corrosive environments because the threads are outside the fluid containment area. It also differs from other designs in that the handwheel is attached to a bushing at the top of the valve yoke, and not

Gate valves generally have a low total cost of ownership. They are relatively easy to manufacture and are easy to repair.

to the stem itself, thus the handwheel does not rise as the valve is opened.

GATE VALVE TRIM

The word "trim" is often overheard when valve professionals are talking about industrial gate valves. Trim has nothing to do with how slim and fit a valve is; rather, it refers to the internal components of a valve that are exposed to great stress or subject to a harsh combination of erosion and corrosion. In a gate valve, the trim components are the stem, disc seating area, body seats and backseat, if applicable. Common utility bronze or brass valves usually have trim parts of the same material as the body and bonnet. Cast and ductile iron valves have either all iron trim components or occasionally bronze trim. The term for an iron valve with bronze trim is "iron body, bronze mounted" (IBBM).

Steel valves can be furnished with a number of different trims. Stellite, Hastelloy, 316ss, 347ss, Monel and Alloy 20 are some of the materials regularly used for gate valve trim.

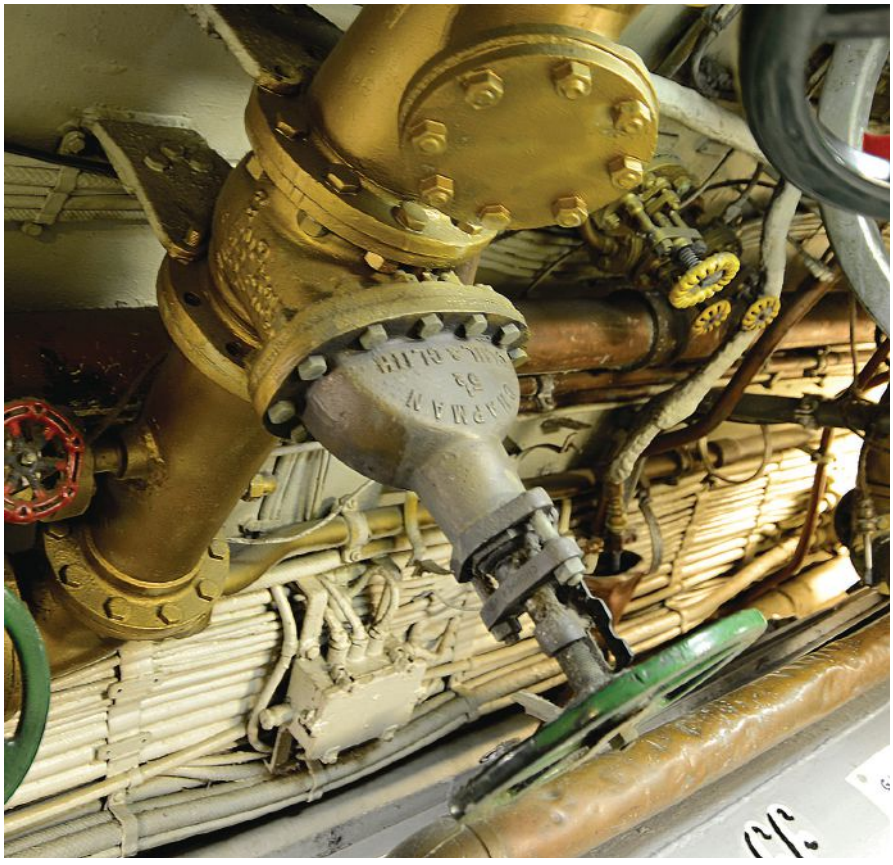
DISC DESIGN

The heart of the gate valve is the closure element, which can be of two designs, either the wedge or the parallel seat. The wedge design is the most popular and has been around since invented by famous British engineer James Nasmyth in 1843. The wedge style utilizes the slightly angled disc mating with the same angled valve body seats to affect a tight closure. These valves are seated by applying torque to push the disc firmly into the seats. Three types of wedge disc are available:

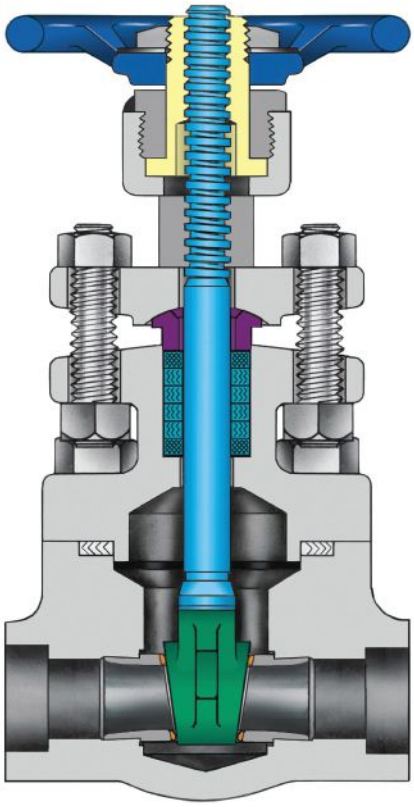
- The **solid wedge** has been around the longest and at one time virtually all wedge gates were the solid type. The drawback to a solid design is that it does not have any flexibility and if there is any valve body/seat distortion due to extreme temperature fluctuations or pipe stresses, the solid disc can become jammed in the seats. The solid disc is still standard on bronze, cast iron, water service and compact carbon steel valves (API 602 type).
- The **flexible wedge** type is just that: flexible. By the addition of a groove or slot around its periphery, the flexible disc can adapt to temperature changes and adverse piping stresses without binding. The flexible design also is a little easier to manufacture in that minor imperfections in the seating surface angles can be compensated for by the disc's flexibility. The flex-wedge design is by far the most common type seen on commodity gate valves used in industrial applications.
- The **split wedge** type consists of a two-piece design with mating surfaces on the back side of each disc half. These mating surfaces allow the downward stem thrust to be uniformly transferred to the disc faces and onto the seats. This flexible design also provides protection against jamming due to thermal expansion. A disadvantage to the split design is that in dirty services, residue or debris can cake in between the disc halves, causing the valve to improperly seat or even jam. Split wedge designs are commonly found on stainless steel and high alloy valves, as well as many small bronze valves.

Wedge gates are guided by grooves or ribs cast or welded into the body of

This is one of the eight 90-inch gate valves located in the bowels of Hoover Dam.



Space is at a premium on ships and NRS gate valves have been used in these applications for decades because they require less room than OS&Y gate valve designs.



This small gate valve is a common design in sizes NPS 1/2 – 2 inches. The tapered disc is clearly visible.

the valve. These wedge guides keep the disc in alignment as it opens or closes and also keeps the disc from sliding against the downstream seat during opening and closing.

The other gate valve disc style is the parallel seat design. Parallel seats may be spring loaded to provide for a tighter seal or create positive sealing in the upstream direction. Parallel seated valves are position seated, in that the position of the disc dictates the sealing efficacy, and not the amount of force (torque) applied to the disc by the stem.

BODY/BONNET DESIGN

Gate valves generally are made of two principal parts: the body and the bonnet. These comprise the pressure-containing envelope of the gate valve. There are a variety of designs for the interface of these two components.

- The **screwed** joint is the simplest design. However, it is only used for inexpensive, low-pressure bronze valves.
- The **union** joint is also primarily used on bronze valves, but the union design allows for easier disassembly for repair and maintenance.
- The **bolted-bonnet** joint is the most popular joint and is used on the vast majority of gate valves in industrial use today. Unlike threaded and union bonnet valves, the bolted-bonnet connection requires a gasket to seal the joint between the body and bonnet.
- The **pressure-seal** joint is energized by the fluid pressure in the valve body acting upon a wedge shaped, soft iron or graphite gasket wedged between the body and bonnet. On a pressure-seal valve, the higher the body cavity pressure, the greater the force on the gasket. Pressure-seal bonnets are used extensively for high-pressure high-temperature applications, such as the power industry.
- **Welded** bonnets are a very popular body-bonnet joint for compact steel valves in sizes ½ inch through 2 inches and pressure classes 800 through 2500, where disassembly is not required.

OTHER GATE VALVE DESIGNS

Also in the gate valve family are knife and sluice gates. The bonnetless knife gate is especially suited for use in slurries such as in pulp and paper mills.

Knife gates are very thin, only

An NPS 36 pipeline-style parallel seat gate valve is unloaded at one of the U.S. Strategic Petroleum Reserve locations.

A trio of NPS 36, NRS gate valves are seen in manifolds at a water treatment facility.

slightly wider than their closure element (disc). Because of their unique geometry and thin cross-section, knife gates are limited to low pressure applications.

In appearance, the sluice gate doesn't look like it even belongs in the gate valve family; however, based upon its sliding disc design, it is characterized as a gate valve. Sluice gates are limited to very low pressures — in most cases, simple head pressure. They are used primarily in wastewater and irrigation systems.

GATE VALVE MARKET SEGMENTS

While the quarter-turn valve has achieved a large chunk of the gate valve market share over the past 50 years, there are still industries that rely heavily on them, including the oil and gas industry. Crude or liquid pipelines are still the home to parallel seat gate valves, despite the inroads that ball valves have made on the gas pipeline side.

In the larger sizes, the gate valves are still the primary choice for the refining industry for most applications. The robustness of design and total cost of ownership (which includes the economics of repair) are points that make this legacy design desirable.

Application-wise, many refinery processes utilize temperatures above the safe operating temperature of Teflon, which is the primary seating material in floating ball valves. The high-performance butterfly valve and metal-seated ball valve are beginning to see more use in refinery applications, although their total cost of ownership is often higher than that of the gate valve.

The waterworks industry segment is still dominated by iron gate valves. They are reasonably inexpensive and long-lasting, even in buried applications.

The power industry utilizes alloy gate valves for applications involving very high pressure and very high temperature. Although some newer Y-pattern globe valves, and metal-seated ball valves designed for blocking service are found in power plants, gate valves still find favor for plant designers and operators.

MATERIALS OF CONSTRUCTION

Steel and iron are the most popular materials for gate valve construction, with steel being the choice for most industrial applications and iron for water, wastewater and heating, ventilation and air-conditioning (HVAC). Other materials popular for gate valve construction include stainless steel, bronze and high alloys such as Hastelloy and Inconel.

Standards for the design and construction of gate valves are published by the American Petroleum Institute (API), Manufacturers Standardization Society (MSS), American Waterworks Association (AWWA) and American Society of Mechanical Engineers (ASME).

STILL POPULAR

Gate valves are still the primary choice for many service applications. Their cost of manufacture to value ratio is still very high. On typical petrochemical and refining projects today, the percentage of gate valves on the requisition is about 60%.

Mark Twain once said, "The rumors of my death have been greatly exaggerated." Although the ball, plug and butterfly valve segments have been gaining market share for decades, the venerable gate valve can respond the same way — the rumors of its demise have been exaggerated. VM

Greg Johnson is president of United Valve. He is a contributing editor to VALVE Magazine and a current Valve Repair Council board member. He also serves as chairman of the VALVE Magazine Advisory Board, is a founding member of the VMA Education and Training Committee and is past president of the Manufacturers Standardization Society. Reach him at greg1950@unitedvalve.com.

The Biggest Valves: Sizes Growing in Step with Greater Demand

Valve manufacturers that have the expertise, equipment and facilities to produce large valves are rare.

In a time of ever-increasing demand for industrial growth and end products, sectors such as refining, water and wastewater, hydropower, chemical, and mining are seeing a move toward bigger valves. But with greater size, many factors and design considerations come into play, as it's not a simple proposition of enlarging the valve components. Very few companies in the world are capable of manufacturing such large valves. Below are three VMA member companies — DeZURIK, ITT Engineered Valves and Mueller Water Products — that fielded questions about this change and the complex engineering, unique challenges and great lengths to which they've gone to meet design, manufacturing and logistical needs all along the way. Also included are the three manufacturers' case studies citing specifics of their work. More examples, case studies and photos are available on the VALVE website in the expanded online version of this article.

DEZURIK

BY DON BARTELL AND GEORGE STEVENSON

For DeZURIK, a large valve is considered 42 inches and greater. The company manufactures cast eccentric plug valves to 72 inches, resilient seated butterfly valves to 168 inches and knife gate valves to 48 inches. At the manufacturing plant in Redmond, WA, DeZURIK specializes in engineering and fabricating large diameter and custom valves up to 144 inches. Fabricated construction allows the use of high alloys for wetted parts and less costly materials for exterior construction. For the hydro market, DeZURIK has supplied custom fabricated fixed cone and jet flow gate valves in sizes up to 78 inches and throttling knife gate valves up to 96 inches for releasing water from the low-level outlets of reservoirs.

WHY IS THERE A TREND TOWARD PRODUCING BIGGER VALVES?

- Population shifts to more arid climates require water to be transported from the source through larger and longer pipelines than ever before.
- Limitations on groundwater pumping enacted to maintain healthy aquifers and prevent seawater encroachment necessitate transporting water from surface water sources through large pipelines over long distances.
- Aging infrastructure and increasing urbanization where larger water treatment and wastewater/sewage treatment facilities are being specified, which requires larger valves.
- Climate change and increased extreme weather events, such as hurricanes, flooding and levee breaches that require larger storm water-handling valves. The hydro sector, for example, is impacted by climate change and more frequent large rainfall events. Dam owners are under pressure by regulators to increase the ability to release water faster to avoid flooding or overtopping, which often translates to a need for larger valves. A lesser factor is the regulatory requirement to release more flow from low-level outlets to improve downstream conditions for fish and recreation. Many existing low-level outlet valves are incapable of releasing greater mandated flows. Also, drought conditions are increasing the need for longer pipelines and more storage.
- Accessibility is a growing challenge. On one of our projects, the tortuous route for the pipeline was determined by the public not wanting a pipeline under its homes, so it was run under roadways instead. A bigger pipeline under the roadway of this heavily populated area was more acceptable to the public.
- Increases in power consumption require valves for hydropower facilities and oil and natural gas pipelines.

WHAT ARE THE MOST SIGNIFICANT CHALLENGES IN DEALING WITH EXCEPTIONALLY LARGE VALVES?

There are simply fewer companies that have the design expertise and manufacturing capability available to handle big valves. There are also fewer

Figure 1. 168-inch AWWA butterfly valve.

foundries that can pour the large castings. Engineering capability and complex tooling may need to be created. Valve manufacturers that have the expertise, equipment and facilities to produce large valves are rare. The manufacturing process may be less vertically integrated — handling, testing and transporting larger valves is more challenging.

OTHER NOTEWORTHY LARGE-VALVE CHALLENGES INCLUDE:

- Material handling for fabrication and testing (factory crane capacity and lift height limitations) is a challenge. Another issue is machine tool limitations (the mill and lathe size required).
- Compliance with industry standards that apply to smaller valves can often be cost-prohibitive to meet on a larger valve.
- Stroke speed (speed that the gate or flow element moves) for large electrically actuated valves may need to be faster than that for a smaller valve so as not to exceed standard 15- or 30-minute electric actuator motor run times.
- Standard semi-trailer over-road maximum capacity is 80,000 pounds. At the site, the contractor may also have handling limitations or the access to the installed location may be restricted, requiring the valve be shipped in pieces and assembled onsite.

ARE YOUR LARGEST VALVES ALL "ONE OFF" OR CUSTOM-MADE?

The first time a large valve is built, it is a custom build, but as requirements for larger valves increase, so does the likelihood that the valve build will be repeated until it is no longer a special. All large Hilton valves are custom fabricated or "one off." The advantage of this is that the valve can be designed to meet specific pressure regimes. Most cast valves have a minimum pressure rating of 150 psi; if only 50 psi is required, a 50 psi fabricated valve can be supplied. This greatly reduces the weight and cost of the valve.

DEZURIK CASE STUDY: A BUTTERFLY VALVE FOR WASTEWATER TREATMENT

This 168-inch (14-foot internal diameter) AWWA butterfly valve (Figure 1), manufactured by DeZURIK in 2021, will be installed as part of a wastewater treatment plant in one of the Los Angeles County Sanitation Districts. The valve will control the flow of treated water from the plant through a seven-mile-long, 18-foot-diameter tunnel to the outfall. This project, approved in 2012 after a multiple-year evaluation, is a preemptive solution to an aging sewer infrastructure and a growing population. The existing two tunnels were built in 1937 and 1958 and a failure in either tunnel or overflow conditions would require drastic measures to ensure continued water treatment service and prevent flooding to the area. The most concerning was the possibility of accidentally dumping untreated sewage and contaminating local waterways that lead to the harbor and surrounding beaches.

This 168-inch outfall valve is the largest ever built in the United States. It weighs about 70 tons and is roughly 21 feet wide (including the actuator) and 17 feet tall. The body is 43 inches from flange to flange and has integrally cast lifting lugs and support bases. Engineers also designed a new flange bolt pattern since there is no AWWA specification for valves this size. Extensive valve testing and validation were requirements for this project. Pressure rating and testing is 50 psi. The valve is tested to meet requirements of the AWWA 516-21 standard. Stress calculations were performed on all torque-bearing components validating design prior to building. A requirement for ultrasonic testing of castings was also completed.

DEZURIK CASE STUDY: A KNIFE GATE VALVE FOR NASA

A 66-inch Hilton bonneted knife gate valve (Figure 2) is installed at the John C. Stennis Space Center NASA rocket test facility in Mississippi that oversees the safe operation of rocket engine propulsion test programs. During testing of rocket engines, temperatures on the test stand are high enough to melt the steel and destroy the concrete structure of the stand. Therefore, during testing, the test stand is flooded with water to lower the temperature on the stand. A 66-inch pipeline feeds water to the A-1 test stand that is capable of static firing a test article up to 33 feet in diameter. The A-1 test stand was used most recently to test the Space Launch System RS-25 rocket engine.

The cooling water isolation valve is only required to open at 25 psi maximum pressure differential and there is normally no pressure for the valve to open or close against. The pipeline is designed to handle a pressure of 275 psi, therefore the valve body is designed for the full pressure rating of 275 psi with a test pressure of 413 psi.

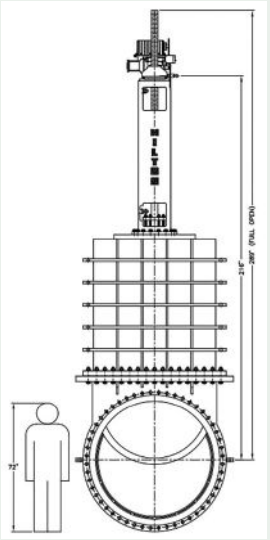


Figure 2. Sketch of the 66-inch Hilton bonneted knife gate valve at the NASA John C. Stennis Space Center rocket test facility.
Photo credit: DeZURIK

Figure 3. 132-inch fish diversion valve.
Photo credit: ITT Engineered Valves

ITT ENGINEERED VALVES

BY JEREMY CARROLL

ITT Engineered Valves has 70 years of experience creating large custom valves for a variety of applications to ensure all of these considerations are made prior to manufacturing.

WHY IS THERE A TREND TOWARD PRODUCING BIGGER VALVES?

ITT has certainly seen an increase in both the creation of, and demand for, larger diameter valves. This trend is driven in large part by three unique factors.

First, the capabilities of ITT's customers are growing, especially regarding their pumping operations. As pumps grow, they're able to push much more material through a valve, requiring a larger diameter. For example, while two 30-inch valves seem to equal the same capacity as one 60-inch valve, a larger diameter valve can fit much more material. It would likely take two 48-inch valves to equal the same capacity as one 60-inch valve, which is a much more efficient way to work.

Second, many municipalities are investing in large valves for processing water/wastewater to keep up with growing populations. For instance, while the population of a city like Boston continues to grow, the actual physical size of the city stays the same. Instead of growing horizontally, municipalities are investing in equipment that can process sewage much faster to keep up with demand.

Finally, events like the recent flood in Houston have forced many municipalities to rethink their maximum capacity. Water/wastewater systems must be designed to handle maximum capacity, which is often in the early evening when commuters arrive home from work. Some municipalities are beginning to dig deep tunnels to act as reservoirs for wastewater — during peak time, water is diverted to that tunnel through large-diameter valves and is later returned back to the processing plant during the middle of the night.

WHAT ARE THE MOST SIGNIFICANT CHALLENGES IN DEALING WITH EXCEPTIONALLY LARGE VALVES?

As the size of the valve increases, handling the valve becomes more difficult. This includes longer testing times, ability to maneuver and the cost of shipping. For the customer, installation becomes more difficult as the valve becomes harder to move and rigging must be more precise.

A major consideration for large valve manufacturers is the maximum psi the valve can handle. For example, users of 2- to 24-inch sizes often send roughly 60-90 psi through their valves, which are usually designed to handle up to 150 psi. No problem there. But when looking at a 72-inch valve, which is designed to handle around 25 psi, it's much easier for the actual psi to rise above that threshold. When psi rises

above the amount a valve has been designed to handle, a series of issues can occur, including the inability to open and close the valve, damage to internal components and more.

ARE YOUR LARGEST VALVES ALL "ONE OFF" OR CUSTOM-MADE?

In ITT's experience, roughly 90% of all large valves — which are defined as anything over 42 inches — are custom-made. When designing something so large, each attribute of the valve costs more and every application requires unique characteristics. For these reasons, designing large valves to sit in inventory would be impractical.

ITT CASE STUDY: FISH DIVERSION VALVE FOR HYDRO-ELECTRIC DAM

F134, 132 inches, 50 psi, 104,825 pounds, 42 feet tall (including actuator) 16 feet wide and 6 feet deep, installed in 2016 — this fish diversion valve is for a hydro-electric dam in Asia (Figure 3). The local population's primary industry was fish, and the dam created concerns related to the welfare of the fish midway through the project. ITT had to work quickly with the engineering firm to develop a fish bypass around the dam turbines, which decreased damage to the river's fish population, allowing the project to move forward without further delay.

Unlike other valve designs, the knife gate design allowed for unrestricted flow through the bypass system. However, with no standards for knife gate valves of this size and with high-pressure requirements, ITT engineers had to rely on years of experience and finite element analysis to create a product that would not affect the safety and livelihood of the surrounding communities.

One interesting challenge in this project is that the 132-inch valve was too large to ship as a unit, so it had to be designed as an erector set and shipped in pieces to be assembled in the field (with limited valve knowledge onsite). To overcome this challenge, ITT designed the product so it would assemble and seal in the field without the need for extensive know-how.

ITT CASE STUDY: KNIFE GATE VALVE FOR VICTAULIC COUPLINGS

F134, 84 inches, 50 psi, 24,000 pounds, 26 feet tall (including actuator) 8.5 feet wide and 5 feet from flange to flange, installed the first in 2004 and another in 2020 — this large knife gate valve is in Michigan where the customer needed a Victaulic pipe connection (Figure 4). Victaulic couplings are typically reserved for small-diameter valves and are not very common with knife gate valves, especially in this diameter. ITT was able to accommodate the customer's needs, meeting the required face-to-face dimensions and reducing the amount of time needed to tighten the flange bolts.

In addition to the odd connecting flanges, the valves needed to fit into an existing vault with height restrictions. To do so, ITT partnered with a hydraulic operator company to supply a self-contained hydraulic power unit that could be integrated into the hydraulic cylinder. The operator-to-valve connection featured a close coupled design that eliminated the need for a yoke, allowing for a height reduction of over six feet. This design required precision machining of the valve bonnet in order to guarantee smooth assembly and actuation. In addition to the two installed Victaulic valves, three additional valves are planned for the future.

Figure 4. 84-inch knife gate valve.

Photo credit: ITT Engineered Valves

MUELLER WATER PRODUCTS

BY TIMOTHY FALLON AND JULIAN RAMIREZ

Mueller Water Products is a manufacturer and marketer of products and services used in the transmission, distribution and measurement of water. For more than 160 years, Mueller has manufactured a variety of valves, including large custom-engineered valves. The company's broad product and service portfolio also includes fire hydrants, pipe connection and repair products, metering products, leak detection, pipe condition assessment and pressure management products.

WHY IS THERE A TREND TOWARD PRODUCING BIGGER VALVES?

The frequency and severity of drought in the West and severe weather events, like slow-moving hurricanes in the gulf and on the East Coast, have motivated municipalities to creatively figure out how to collect, protect and conserve available raw and semi-finished freshwater resources. The large population migration to non-drought areas and the numerous water conservation projects in drought-ridden regions are fueling some very large projects, such as protectively "banking" water that has already been treated in new facilities. There are also big projects underway to prevent raw water reservoirs from overflowing to the south. To do this, new or larger pumping stations are being built to pump (transfer) water over to neighboring northern reservoirs to minimize losing what has already been naturally collected. Moving larger amounts of water requires bigger valves.

WHAT ARE THE MOST SIGNIFICANT CHALLENGES IN DEALING WITH EXCEPTIONALLY LARGE VALVES?

One of the biggest challenges is costing and pricing. Due to the seldom-sourced large-diameter product, the ability to accurately estimate the cost to produce these sizes is a big risk for manufacturers — the work is often too large to machine in-house, so the outsourced production becomes an unknown cost variable, which is a gray area in getting a fixed or capped cost. The same goes for the raw materials. These projects are sometimes years out, so the cost per pound of carbon steel and stainless alloys can swing in the wrong direction over the course of the project. Also, any ancillary (one-time) equipment costs need to be taken into consideration, such as testing equipment (test heads with bolts and nuts). The costs are high and the lead time alone to obtain a pair of large-diameter test heads can be up to 18 months. Another challenge is that when you are dealing with large castings you have more room for casting issues, like porosity. Also handling and testing becomes more complicated as valves get larger.

Figure 5. R. Scott Scheffler of MOOG Flo-Tork with new 102-inch butterfly valve.
Photo credit: Mueller Water Products

ARE YOUR LARGEST VALVES ALL "ONE OFF" OR CUSTOM-MADE?

Yes. Anything that is not covered by a nationally recognized standard (or designed to the intent of a standard) is considered a custom product. For both butterfly and plug valves, we have large standard castings, but we have also fabricated large butterfly valves.

MUELLER CASE STUDY: VALVE AND ACTUATOR UPDATES FOR AGING RECLAMATION PLANT

The Hyperion Water Reclamation Plant is the largest sewage treatment facility in the Los Angeles metropolitan area, treating 450 million gallons per day. During a comprehensive inspection, Hyperion officials discovered deterioration of its primary outfall pipeline, which wasn't unusual given that the pipeline and pump header were over 60 years old. The inspection also revealed that 10 old isolation butterfly valves on the suction and discharge sides of the vertical turbine effluent pumps needed to be refurbished or replaced due to corrosion of the valve body and disc. When tide and plant hydraulic conditions allow, plant effluent flows with the help of gravity through a 120-inch diameter butterfly valve (Figure 5) to the plant's five-mile outfall pipeline without the use of pumps. Failure of any of these valves could create a backflow event, which would flood the plant.

To repair the pipeline, maintenance and construction crews needed to divert the treated wastewater to an emergency one-mile outfall pipeline. The city's environmental engineering division determined that Hyperion crews and suppliers would need to work around the clock for six weeks to minimize impact on plant operations and the environment.

While refurbishing valves can save money, it can often take longer than installing new products. Existing valves must be inspected to determine if refurbishment is a viable option, and given the location, these valves could not be extracted until the project had begun. This would delay the project's timeline, as parts would need to be located and ordered when work should already be underway. The Los Angeles Department of Public Works had documented that the five existing 60-inch butterfly valves and the five 78-inch valves were Pratt valves installed in the early 1970s. Knowing this information meant original project files, parts and replacement valves could be on hand before starting the work.

However, there was one exception: the 120-in. gravity-fed butterfly valve was critical to public safety and plant operations. If this valve were to fail in the open position at high tide, ocean water from the bay and effluent would back up the pipe and potentially flood the facility. There was no secondary valve, but rather a redundant cylinder for closing and opening the valve. This butterfly valve was custom-made with no original manufacturer marking to be found. Given the time constraints, replacing it with a new butterfly valve was the only viable option. This also meant that a new actuation system would be required.

Moog Flo-Tork designed an actuator that required 3,200 cubic inches (13.9 gallons) of hydraulic oil per stroke with a rated working oil pressure of 3,000 psi. This system would produce up to three million inch pounds of torque from either one of the two rack-and-pinion actuators, which accommodated the need for redundancy. Even though the two actuators are mechanically sandwiched together, they act as independent primary and emergency backup actuation systems. VM

Don Bartell is currently vice president of Municipal Sales for DeZURIK. Don has over 30 years of experience in municipal valve applications and sales management. He received a bachelor of science degree in Engineering from Penn State in State College, PA.

George Stevenson officially retired from his position as chief engineer for DeZURIK's Hilton Valve product line in 2019 after 44 years of service but is still involved in a few special projects. George graduated with a bachelor of science in Mechanical Engineering from California State Polytechnic University in Pomona, CA.

Jeremy Carroll has worked in the material and fluid handling industry for more than 15 years. He has had roles in engineering design, applications engineering, production management and new product development. Jeremy's current role of knife gate valve product manager for ITT Engineered Valves has a wide-ranging scope and often leads to frontline involvement in industries including water/wastewater, pulp and paper, power, mining and petrochemicals.

Timothy Fallon is senior product manager at Mueller Water Products. He has been in the valve industry for more than 20 years and has a strong technical understanding of valve engineering to ensure customers have the optimal flow control solution. Email him at tfallon@muellerwp.com.

Julian Ramirez is product manager at Mueller Water Products, overseeing the development of air valves, industrial butterfly valves and knife gate products. Email him at jramirez@muellerwp.com.

General Considerations for Control and Choke Valves Used in Offshore Oil and Gas Production

The application of control and choke valves used in offshore oil and gas production is a very broad field and in this article, some of the main considerations for valve selection are addressed.

BY ADRIAN CROFT

When selecting a valve, the first consideration is: *Which standards should be applied?* These standards range from international and country standards, engineer-procure-construct (EPC) organization's standards and client specifications. Often, standards will conflict in some details, so determining the priority or discussing priorities with the user is important at the onset of the project. For example, most EPCs have established their own painting and coating systems. In some cases, an EPC will state that a paint system must be applied to all external components, even if they are manufactured from corrosion-resistant alloys. Others simply specify that exposed components (such as nuts and bolts) should be 316 stainless steels. Selecting valves in the offshore industry, therefore, relies on the experience of the manufacturer's sales engineer to both size the valve according to the specifications, as well as select the valve and correctly interpret the requirements of the specification.

The major systems fall into the following categories; however, it should be noted that some processing might be done onshore, well chemistry might dictate that some of these systems are not required. Equally, additional systems might be required for additional processing. Each system, depending on the oil and gas pressure, fluid type, etc. will dictate the valve requirements. Systems can be broadly categorized as follows:

- Well systems
  - Production choke
  - Gas lift chokes
  - Water injection chokes

Photo credit: Trillium Flow Technologies

Typical valve installed offshore.

- Gas systems
  - Flare system
  - Gas injection and cleaning
  - Compression and anti-surge
- Separation
- Water systems
- Chemical injection

Additional systems, not directly part of the production process are:

- Instrument air system
- Hydraulic control system

- Fire detections system
- Potable water system
- Power system

The one big consideration for offshore is to determine if the fluid contains sand. If there is sand in the process fluid, then trim and body protection need to be carefully considered. In clean applications, trim selection is largely a function of pressure drop, noise and velocity; however, when sand is present, this poses an additional challenge in selecting a trim to reduce the rate of erosion, while not blocking up with sand. Much of the selection comes from experience and knowing the application and process and being able to address the issues during the specification of the valve.

In the majority of processing systems downstream of the separators, the gas will be clean. Historically, much of the gas produced was a by-product of the oil and much more was flared off than today. These days, both due to environmental concerns and due to the value of gas, gas that is not re-injected is mostly shipped to market. There are many techniques for exporting the gas that largely depend on the location of the rig or vessel, but invariably, compressor and anti-surge systems will be required to pressurize the gas. In valve terms, clean gas is not an erosion concern. There are, however, issues with noise, velocity and vibration around these valves and the system. It is important that the valve supplier is advised of the correct process conditions, and if associated with the compressor, be made aware of the selection rules. For example, compressor suppliers often have a requirement that the valves should be 50% open at the normal flow condition.

Space is limited due to the physical constraints of the rig or vessel. Ultimately, the space limitations mean that the valves are often located close to 90-degree bends, which, in turn, can generate fluid stability issues and ultimately pipework vibration. Control and choke valves are best located in straight pipe runs with a minimum of five straight pipe diameters upstream and downstream (longer runs in some applications). In the majority of cases, the valve supplier will not be made aware of the pipework restrictions and the locations of bends. However, if there is thought to be an issue, then the valve supplier can often increase the number of pressure reduction stages in the valve to help to stabilize the flow. Overall, it is easier to make enhancements to the valve at the onset of the project rather than being forced into pipework modifications during commissioning.

Although valves are only one component in a piping system, the weight of the equipment to be installed offshore is a major consideration as the support structure or vessel must be designed to hold the weight of the processing systems. On larger, high-pressure valves, significant weight savings can be made by considering the valve specification and design. For example, if we consider a 12-in. flanged Class 2500 rated valve, the flange weight might be approaching one ton. Switching from an ASME flange to either a "compact flange" or hub connection could offer both a weight and cost saving, especially where more expensive materials, such as duplex, are used.

Valve materials should be carefully considered. In the majority of applications, cast valves can be used. However, utilizing forgings should be considered where material integrity, such as on the choke valve, is important. Around the well head, valves are mostly designed to API standards, then downstream systems such as separation are designed to ASME. It is possible to use both cast and forged materials according to the API standard, but the standard dic-

Typical valve offshore situated close to bends.

Photo credit:
Trillium Flow Technologies

Photo credit: Trillium Flow Technologies

Stainless steel instruments installed offshore.

tates the minimum material strength. According to the product specification level (PSL), forged valves can either be fabricated by welding or, on higher specifications, welding is completely excluded. On higher specifications, welding is completely excluded. On larger valves, where stamped forgings are not available, then alternative body manufacturing techniques can be considered. For example, hot isostatic pressing large bodies in exotic materials can offer a cost-effective solution for the manufacturer.

In NACE applications where high-value corrosion-resistant alloys (CRA) are required, an alternative could be to use a carbon steel valve with an Inconel internal overlay applied to the wetted surfaces.

When applying ASME materials according to ASME B16.34 design standards, the customer mostly specifies the pipe materials and therefore the applicable valve material. However, again, careful material selection can sometimes result in cost savings; for example, instead of selecting a WCB valve body, a WCC body offers a higher strength material at the same cost and therefore in some cases the valve pressure rating can sometimes be reduced.

When considering the actuator, most actuators are specified as pneumatic diaphragm or pneumatic piston. These actuators, being air operated, are relatively safe in a hazardous environment. The actuators are mostly manufactured from carbon steel that is coated with a suitable paint for an offshore environment. Historically, most of the actuator yokes would be manufactured from cast iron, but a number of specifications now call for carbon steel yokes. On their standard actuators, many suppliers would use 304 stainless steel on exposed components such as bolting, stem coupling and stem. This is not suitable for an offshore environment, as it still corrodes. As a minimum, all exposed actuator components should be manufactured from 316 stainless steel.

Other actuator designs such as manual, electric or electro-hydraulic can also be used offshore. The selection of these methods of actuation is mostly application specific and will be determined in the customer specification. Manual actuators are mostly specified on valves that will be operated infrequently, for example, around the flare system when manual intervention is required. The use of electric actuators is not common offshore, but when selected on specific projects they offer good control and are "stiff," meaning that once in position, process instabilities will not affect the actuator position. Normally offshore there will be a hydraulic ring main that will provide full hydraulic power to electro-hydraulic actuators. When compared to other industries, valves with electro-hydraulic actuators are relatively simple. Electro-hydraulic actuators are often specified in applications where high thrusts and stable control are required. They are also often used on unmanned platforms.

Instruments used in an offshore environment have evolved to address

specific issues encountered offshore. Although the selection of instruments is a wide-ranging topic, most instruments such as airsets and solenoids were available in 316 stainless steel. It is only in the past 20 to 30 years that valve positioners have been available in 316 stainless steel. Prior to that, positioners were generally supplied in a painted aluminum. It was mostly found that painting failed due to chipping of the paint which led to corrosion of the aluminum. In the majority of cases due to these inherent issues, valve instruments are now virtually all specified in 316 stainless steel.

There is no doubt that the oil and gas industry has been at the forefront of the development of painting and coating techniques for salt-laden environments; however, no matter how good the painting and coating system is as the valve leaves the factory, it is only as good as the people who install and maintain the valve during operation. Often during installation or maintenance, paint becomes chipped, which in turn means that the atmospheric barrier is broken, which can lead to failure of the valve or actuator.

Each valve supplied will automatically have a hydro and seat leakage test performed on the control or choke valve. However, these days legislation, standards, company specifications mean that additional testing is typically required on the valves. This can range from material testing or product qualification test/specification such as safety integrity level (SIL), through to specific production tests, such as gas testing, fire testing and fugitive emission testing. As user specifications are often derived from standards, we find that the standards have been incorrectly applied or misinterpreted, especially through EPCs, so that ultimately customers are asking us to test valves when it is not required. A common example (especially in the Middle East) is that fire testing is often specified on control and choke valves. When it is explained to the EPC that the standard only generally applies to isolation valves (such as ball or gate valves), then the requirement is often waived.

Valves in the oil and gas market will always be required to push the boundaries of what is possible. As water depths become deeper, the fluid pressure is increasing and, in control and choke valve terms, becoming more severe. If we consider choke valves, 10 or 20 years ago, 10k choke valves were considered high-pressure valves, but these days they are now mostly standard and valves of 15k and higher are often used in new installations. Ultimately, it is a case of having a dialogue with the customer to both understand the process and produce the best valve solution for the application. VM

Adrian Croft has worked in the control valve industry for more than 44 years. He has had roles in control valve engineering design, parametric design programming, applications engineering and smart instrumentation technology. Adrian's current role of control valve product manager for Trillium Flow Technologies has a wide-ranging scope and often leads to front line involvement in process industries, including power, oil and gas, LNG and petrochemicals.

Thirty-nine Years of Experience Offer Key Takeaways for New Industry Professionals

BY MARGO ELLIS

In an effort to benefit industry newcomers, VALVE Magazine and the VMA want to capture and share the knowledge and experience of those who are transitioning out of the industry. Steve McJones spent his career in the oil and gas industry and shares his insights with the editorial team. He was chairman of the American Petroleum Institute (API) Piping and Valve subcommittee from 2014-2016 and 2018-2019 and otherwise active as a member of this API subcommittee from 2007-2020, when he retired from BP.

Steve McJones

All photos: Steve McJones

VALVE Magazine: What led you to a valve-oriented career? What is your educational background? Tell us about some of the positions you've held over the years.

Steve McJones: My father was an engineer, and he often brought his work home — tinkering with devices and making modifications to equipment in our garage. The garage shop was fitted with a metal lathe, milling machine and welding equipment. I studied Mechanical Engineering at California Polytechnic. The curriculum was very hands-on and prepared me for my chosen career. I started out my career in the Project Engineering department of the ARCO Refinery located in the Los Angeles area.

I later transferred to the Anaheim Technical Center where I was a mechanical specialist focusing on static equipment. Following the BP acquisition of ARCO in 2000, I took a short-term assignment at the Amoco Heritage Yorktown Refinery. The location offered access to many historical locations and interesting sightseeing.

Later, when I returned to the West Coast, I joined the Central Engineering team with BP and my area of responsibility included Static Pressure Equipment and Piping and Valves for the entire refinery network.

McJones at a refinery maintenance shutdown/turnaround in the pipe rack of a process unit.

VM: How has the industry fared in the last 20 or so years? What challenges have professionals in the industry faced most recently?

SM: Overall, the industry has grown and adapted to the challenges imposed on it. Environmental regulations, specifically fugitive emissions performance, has played a big role in shaping the changes to the valve industry in the last 20 years. I am interested to see further progress to reduce fugitive emissions from valves and other types of process industry equipment. The publication of API standards that outline testing and certification of low emission valves performance are examples of progress made in this area. Further reductions in fugitive emissions will improve the public's opinion of the process industry as it continues to provide energy during the long transition to low-carbon forms of energy.

Professionals in the industry have been pressed to make the entire supply chain more efficient while still improving reliability and safety.

VM: How have valves, controls and related products evolved since you first entered the industry?

SM: Most control valves were air-actuated when I started to work in the early 1980s. Instrument air was a vital utility in the refinery or chemical plant. It was difficult to judge the condition of valve trim without valve removal and disassembly. End users are interested to see online valve condition monitoring developed and implemented for critical valve services.

VM: How would you describe the relationships between valve manufacturers, distributors and end users? Has it gotten better or worse?

SM: The manufacturing of valves illustrates the globalization of supply chains. Many commonly known valve brands have moved portions of their manufacturing processes to other regions of the world. These changes have resulted in end customers maintaining a closer relationship with the suppliers to understand these periodic changes in the supply chain.

McJones at a vendor's exchanger shop.

VM: What trends have you observed in terms of customer needs?
SM: The pandemic and its impact on the delivery of global trade reminds us of the downside of global manufacturing where process industry equipment is supplied from distant locations around the world. We may see an increase in domestic valve manufacturing. Casting processes will need to be automated and limit their air emissions if they are to be a sustainable part of the U.S. economy.

VM: Most valve makers and valve users have instituted ESG (environmental, social and governance) policies, which include the push toward decarbonization and a future that focuses on zero emissions. How is this movement affecting the industry?
SM: Increased focus on fugitive emissions performance of the finished product. Manufacturers should be reviewing the entire carbon footprint of their manufacturing supply chain as well. Improving efficiency of casting and forging operations will save money and reduce carbon emissions.

VM: What do you see as today's "hot button" issues?
SM: I see improvements in safety, reliability and performance as the prominent issues. In the area of reliability, casting quality is a frequently discussed topic. With the changes in supply chains, decreases in casting quality over the past 20 years have caused end users to step up the supplier qualification procedures.

VM: Could you comment on the future of the valve industry as a whole?
SM: There will always be a need for valves in our world, whether in some new type of low-carbon energy industry or in the current process industry. Jobs in design and manufacturing will continue to challenge engineers going forward.

VM: Over the course of your career, what is the most challenging situation you have faced? What would you consider to be one of the highlights of your career?
SM: Although not a technical challenge, company personnel reorganizations created some of the most challenging situations that I worked through in my career. These reorganizations impacted the morale of the workforce and led to the resignation of productive and valuable coworkers that chose to leave the company during times of uncertainty.

My career was filled with satisfying projects while working with interesting people. Completing a long and tiring FCC turnaround was always a highlight of my career. I was responsible for following the service and repair of the "big valves" at one such FCC turnaround. Finally, seeing the large slide valves and butterfly valves reinstalled in the process unit with refractory in place and all the details completed was a very satisfying completion.

VM: What advice would you give to industry newcomers to help guide them on their career path?
SM: I encourage younger engineers starting their careers to have patience and curiosity. Curiosity drives a person to research what they don't already know or understand, and with patience, they can stay with an assignment long enough to gain an understanding of the details of the equipment and processes that they are working with.

VM: Anything personal you'd like to share about retirement activities (consulting jobs, more time golfing or other recreational interests, time with family, etc.)?
SM: I retired from BP in the fall of 2020. In my retirement, I have been consulting with Becht in the area of static equipment. I enjoy the variety of projects that come my way, and it is satisfying to stay connected to the industry. My wife and I are longtime sailors. Throughout our relationship, we have always had a sailboat. We have owned our current sailboat, a 35-footer, since 2002. Early in 2021, we embarked on a restoration project of our boat. I completed much of the preparation work and then turned the job over to professionals to complete various fiberglass repairs and paint the boat. The amount of work done compares to a "frame-off" restoration of a vintage automobile. The project was completed in the spring of 2021, and we have been enjoying the finished roduct ever since. VM

During a 2014 valve manufacturer evaluation trip, McJones enjoyed sightseeing and taking in the South Korean local scene and culinary delights.

An Introduction to Axial Flow Check Valves

BY IAN NOBLE & JOHN MCILROY

The primary purpose of check valves is to permit flow in one direction while prohibiting or stopping the flow in the opposite direction. The key point is that the normal resting state of a check valve is the closed position.

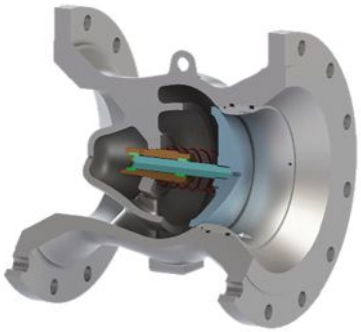
WHY IS A NON-SLAM CHECK VALVE USED?

When flow is reversed in a pipe, this can cause hydraulic shock waves to pass through (also known as water hammer). This can cause severe damage to equipment in the pipeline if measurements are not taken to prevent this. The introduction of the correct check valve, in a fully closed position during reverse flow, can prevent this from occurring and causing severe issues at the site.

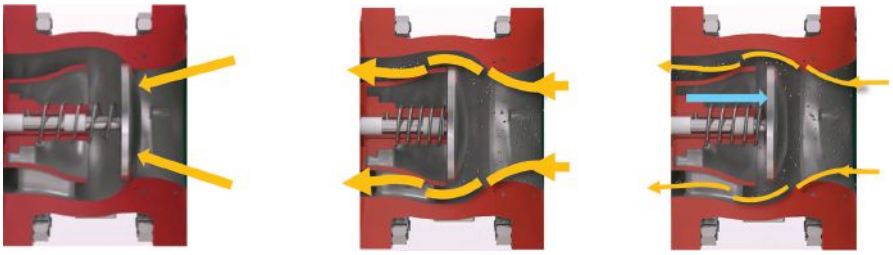
Valves that prevent water hammer and close rapidly without slamming are called non-slam check valves.

HOW ARE AXIAL FLOW CHECK VALVES USED?

Axial check valves are specifically designed for fast-reversing systems where backflow is a constant concern. It is categorized as a non-slam check valve as the valve closes without



slamming meaning no excess pressure spikes are created. Most axial flow check valves are spring-loaded, with a single low-mass disc, which facilitates a fast, dynamic response to reduction in flow. Due to having a single disc and spring when the disc is opening, the force is balanced resulting in an even flow.



When a noticeable reduction in flow occurs, the spring reacts early against the force of the reducing flow.

METHOD OF OPERATION

When pressure differential between the upstream and downstream side of the valve exceeds cracking pressure of the spring, the obturator will move and allow flow. The flow area of the valve decreases steadily down to the seat diameter; this is the venturi design.

As a result of the venturi design, the reduced flow area increases the kinetic pressure and reduces the static pressure allowing the valve to fully open quickly. The spring is selected so that the disc is fully opened and stable against its backstop under normal flow conditions.

When a noticeable reduction in flow occurs, the spring reacts early against the force of the reducing flow.

PRODUCT DYNAMIC PERFORMANCE COMPARISON

Simple conventional swing check valves tend to have a very poor response. Under dynamic conditions, relatively long response times are experienced. This yields high reverse velocities resulting in slam and unwanted pressure surges.

Dual plate spring-assisted valves versus conventional swing checks are designed with small plates, which have less inertia than a single thicker disc. Pre-loading with a spring provides a closing force at all angles, thus helping to reduce response time.

As mentioned, axial flow check valves have an excellent response and are recommended where a high-level performance is essential. As flow decelerates in the pipeline, the forces acting on the disc are reduced, and the spring is able to overcome these smaller forces causing the valve to close. Short displacement of the disc combined with axial spring assistance greatly reduces the response time giving a fast slam-free response with minimal reverse.

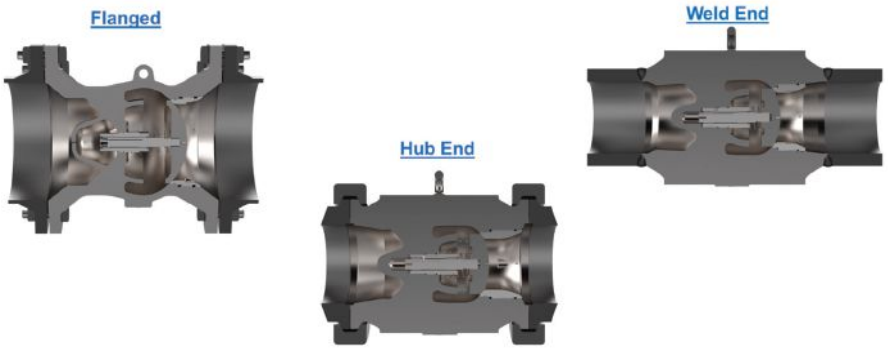
AXIAL FLOW VALVES:

- Cover any service conditions (lowest to highest deceleration systems)
- Have the fastest response time and are non-slam and mitigate against pressure surge or the impact of water hammer

Fluid Column Deceleration (m/s²)			
0 – 3 m/s²	4-7m/s²	8-11m/s²	12 - 16m/s²
• Low risk systems • Low static head single pump • Rising or falling mains without air vessels	• Low-medium risk systems • Multi-pump systems • Single pump systems with air vessels for surge protection	• Medium-high risk systems • Medium to high static head with high downstream energy levels, e.g. due to air vessel surge protection	• Very high risk systems • Very high head multi-pump systems • High back-pressure low inertia pumps • Mine drainage • Boiler feedwater systems • Dense phase gases

STANDARD FEATURES

The base valve design is available in various body configurations to suit the customers' needs for industry standards, specification, weight and connection requirements. The majority of axial flow check valves will be sold as flanged.



STANDARDS

The list below summarizes the most important standards for axial flow check valves:

STANDARD	DESCRIPTION	PUBLISHER SUPPLIER OF CERTIFICATE
ASME B16.34	Applies to new construction and covers pressure — temperature ratings, dimensions, tolerances, materials, nondestructive examination requirements, testing and marking for cast, forged and fabricated flanged, threaded and welding end and wafer or flangeless valves of steel, nickel-base alloys and other alloys.	American Society of Mechanical Engineers (ASME)
ASME B16.10	Covers face-to-face and end-to-end dimensions of straightway valves and center-to-face and center-to-end dimensions of angle valves.	ASME
API 598 EN 12266-1, 2	Defines inspection, examination, supplementary examinations, and pressure test requirements for resilient-seated, nonmetallic-seated (e.g., ceramic), and metal-to-metal-seated valves of the gate, globe, plug, ball, check and butterfly types.	American Petroleum Institute (API)
ISO 5208	Defines examinations and tests that a valve manufacturer needs to act upon in order to establish the integrity of the pressure boundary of an industrial metallic valve and to verify the degree of valve closure tightness and the structural adequacy of its closure mechanism.	International Organization for Standardization
API 6D	API Specification 6D for Pipeline Valves is an adoption of ISO 14313: 1999, Petroleum and Natural Gas Industries-Pipeline Transportation Systems-Pipeline Valves. This international standard specifies requirements and gives recommendations for the design, manufacturing, testing and documentation of ball, check, gate and plug valves for application in pipeline systems.	API

TYPICAL APPLICATIONS

Although axial flow check valves can be utilized in a multitude of applications, a growing number of niche sectors where the valves have primarily been utilized includes the following:

Oil and gas production, including midstream:

- Regasification
- Liquefaction
- Centrifugal compressor discharge
- Fire water lines
- Oil/steam separation
- Steam and CO_2 injection
- Oil and gas gathering systems

Chemical and pharma:

- Chlorine
- Phosgene
- Aromatics
- Polymers
- Acids
- Air separation
- Caustics

Petroleum refining and petrochemicals:

- Hydrogen
- Cracking
- Steam
- Crude oil
- Ethylene
- Propylene
- Steam

Power:

- Steam
- Condensate
- Boiler feed pumps
- Cooling towers
- Service water recirculators
- River water intake
- Renewables

The most important thing to remember is that axial flow check valves are specifically designed for fast-reversing systems where backflow is a constant concern. VM

Ian Noble is the Global Business Line manager for the Crane range of Engineered Check valves, working within the Crane Process Flow Technologies (CPFT) business segment.

John McIlroy has 15 years in the valve industry. His role of application specialist for Crane Engineered Check Valves includes direct customer support, resolving system issues and technical presentations regarding oil and gas, petrochemical, hydrogen production, LNG and renewable energy sectors.

Hybrid Work is Here to Stay: Expert Advice and Industry Input

BY ALANAH MITCHELL

Even before the pandemic, the U.S. workforce increasingly relied on remote collaboration technologies like videoconferencing and Slack. The global crisis accelerated the adoption of these work tools and practices in an unprecedented way. By April 2020, about half of companies reported that more than 80% of their employees worked from home because of COVID-19.

That shift was made possible by decades of research into, and then development of, technologies that support remote work, but not everyone uses these technologies with the same ease. As early as 1987, groundbreaking research identified some of the challenges facing women working from home using technology. That included the difficulties of child care, work-home separation and employee growth opportunities.

Since that time, we have learned much more about virtual collaboration. As an associate professor of information systems, I'm interested in what we can expect as we eagerly anticipate a post-pandemic future. One thing stands out: Hybrid work arrangements — that is, employees who do some tasks in the office and others virtually — is clearly going to be a big part of the picture.

One survey from April 2021 shows 99% of human resources leaders expect employees to work in some kind of hybrid arrangement moving forward. Many have already begun. As just one example, Dropbox, the file hosting service, made a permanent shift during the pandemic, allowing employees to work from home and hold team meetings in the office.

The definition of "hybrid" varies in other organizations. Some workers might be in the office a couple of days a week or every other day. Other businesses may require only occasional face-to-face time, perhaps meeting in a centralized location once each quarter. Either way, research does show many companies fail in their implementation of a virtual workforce.

REMOTE WORK VERSUS IN THE OFFICE

In-office work promotes structure and transparency, which may increase trust between management and workers. Developing an organizational culture happens naturally. Casual office conversations — a worker walking down the hall for a quick and unscheduled chat with a colleague, for instance — can lead to knowledge-sharing and collaborative problem-solving. That's difficult to replicate in a virtual environment, which often relies on advance scheduling for online meetings — although that's still feasible with enough planning and communication.

But if you look at different metrics, in-office work loses out to working from home. My recent research discovered remote workers report more productivity and enjoy working from home because of the flexibility, the ability to wear casual clothes, and the shortened or nonexistent commute time. Remote work also saves money. There is a significant cost savings for office space, one of the largest budget line items for organizations.

Hybrid arrangements attempt to combine the best of both worlds.

IT'S NOT PERFECT

It's true that hybrid work faces many of the same obstacles of face-to-face work. Poor planning and communication, ineffective or unnecessary meetings and confusion about task responsibilities happen remotely as well as in-person.

Perhaps the largest issue when working at home: technology and security concerns. Home networks, an easier target for cyberthreats, are typically more vulnerable than office networks. Remote workers are also more likely to share computers with someone else outside of their organization. Hybrid

organizations must invest upfront to work through these complicated and often expensive issues.

With hybrid work, managers cannot see the work taking place. That means they must measure employee performance based on outcomes with clear performance metrics rather than the traditional focus on employee behavior.

Another potential pitfall: Fault lines can develop within hybrid teams — that is, misunderstandings or miscommunication between those in the office and those at home. These two groups may start to divide, potentially leading to tension and conflicts between them — an us-versus-them scenario.

ESTABLISHING A HYBRID ENVIRONMENT

Numerous recommendations exist on the best way to develop a hybrid model. Here are a few of the best ideas.

Meeting too often or with little purpose — that is, meeting for the sake of meeting — leads to fatigue and burnout. Not everyone needs to be at every meeting, yet finesse from management is required to make sure no one feels left out. And meeting-free days can help with productivity and allow employees a block of uninterrupted time to focus on complex projects.

Listening to employees is critical to making sure the hybrid environment is working. Continually seeking feedback, through one-on-one conversations, focus groups or human resources surveys, is important too. So is recognizing and rewarding employees with in-person or virtual kudos for their achievements. Performance incentives, such as financial rewards or tokens of appreciation including food delivery, help develop a supportive culture that increases employee commitment.

Finally: Both managers and employees must be transparent in their communication and understanding of hybrid plans. Policies must be in place to define what tasks happen in the office and remotely. Access to reliable communications is essential, particularly for remote work. All employees must receive the same information at the same time, and in a timely manner. After all, whether in the office or online, workers don't want to feel they're the last to know. VM

Alanah Mitchell, associate professor and chair of Information Management and Business Analytics, Drake University.

INDUSTRY WEIGH-IN

Juliana Herman, global marketing director, ValvTechnologies:
Figuring out how hybrid work will continue to be implemented is certainly challenging but not impossible. It brings up issues of trust of employees that they are equally productive at home, and although we know that collaboration is easier in the office, companies will continue exploring ways to bridge that gap. It's still important to have the space for people to get together, something that I missed in 2020 and 2021.

Another challenge is how different hybrid work is in certain industries. People in sales, for instance, can easily work remotely, but of course, there's no virtual substitute for a plant or factory floor.

Hybrid work takes another level of leadership or management to sort out policies that require nuanced approaches in how people work, when they work best and the topic of fairness among employees. Implementing across-the-board policies is tricky for everyone involved, particularly in a time of so much change and adaptation.

It's still easy to miss social cues on webcam calls and it's harder to interject comments versus in-person meetings. But I'm confident we will get to a point where people will increasingly adapt and lose biases about remote work being somehow less productive. We all did it quite successfully for the past two years, so it's reasonable to think companies can continue providing the conveniences of working from home while forging a new path on how we balance it all and keep our industry strong.

Toni Zhang, senior engineering manager, Emerson:
Emerson implemented a hybrid workplace policy that allows office employees to work remotely three days per week. There are always challenges when working with engineering professionals remotely; I would say it's 10-20% less efficient compared to working in the same space.

Personally, I prefer to go out to meet and talk to people rather than sitting in front of a screen and camera. One thing I often find is that it might take 30 minutes to research something on Google, but in just 30 seconds the question can be answered by talking to a colleague in person.

Our IT tools like Webex and Teams have been used more frequently, and we have people who have joined Emerson remotely who are new to the process/products, and this has brought challenges to the team even with the IT tools and face-to-face training provided. It feels like efficiency increases if those positions are filled with local candidates.

In the facility where I'm sitting, about 80% of employees opted for hybrid, but I now see more and more people back at the office.

I really appreciate that Emerson offered a hybrid policy that saves me and my family two hours of commute time compared to when I go into the office. I'm still working from home two days per week.

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ITT's PfuZion bonnet assembly is a performance, reliability and maintainability upgrade for the ITT Pure-Flo Bio-Tek range of fractional diaphragm valves.

A new PfuZion diaphragm and bonnet assembly based on EnviZion valve technology is mated to the existing in-service Bio-Tek valve body with a simple, stud-based conversion system. The one-time conversion upgrades the valve to a quick connect system that assures error-proof diaphragm installation and reduces diaphragm replacement maintenance time from 20-30 minutes to well under three minutes. Fastener re-torque after thermal cycling is a thing of the past as the integral thermal compensation system constantly adjusts to assure superior seal integrity.

Cowan Dynamics' new ZE-ESD Module provides midstream pipeline distribution networks with a zero-emission emergency shutoff valve (ESD) actuator system. ESDs are specifically designed to shut off the process within the pipeline in the case of an undesirable event. The ZE-ESD easily works as a drop-in replacement for ESD valves without taking the valve out of operation.

This system is suitable for valves in remote locations that require a self-powered automatic failure position. In the event of an emergency, triggered by an ESD signal, the system will use stored hydraulic pressure to move the valve actuator to the desired fail-safe position (open or close), ensuring an automatic fail-safe system without the need for external power.

Spirax Sarco's expanded product line includes the new Spira-trol steam-tight control valve, which helps customers maximize output, minimize downtime and improve product quality. This product

release has a full peak class VI shutoff double life seat, increasing the life span of the steam plant, simplifying plant maintenance throughout the life cycle of operation and driving down the total cost of ownership for customers in the food, beverage, oil, gas, chemical and healthcare industries.

The control valve has a low impact on maintenance because the valve is not required to be removed from the line and requires no special tools. This new product solution is available in sizes 1/2 – 4" and comes in SG iron, carbon steel and stainless steel. It's suitable for steam pressures to 275 psig, steam temperatures to 428°F and comes with a three-year warranty.

Mueller's new HYMAX grip restraint is available on the 4- to 12-" A-2361 Resilient Wedge Gate valves (RWGV) and Super Centurion 250 fire hydrants.

The grip restraint is a versatile, single-bolt restraint capable of joining a wide selection of pipe types and diameters, resulting in easier, more flexible installations. It significantly reduces installation time and effort and — coupled with the A-2361 RWGV and Super Centurion 250 fire hydrant — helps drive improvements in planning, efficiency and cost savings within the water network.

Emerson now offers the easy-e trim cartridge, a complete trim repair solution for Fisher easy-e globe valves. This factory-assembled repair cartridge combines all valve replacement parts, plus the bonnet, into a simple and ready-to-install repair solution, streamlining the repair experience while creating time and money savings throughout the maintenance process.

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Questions about VMA? Contact VMA President Heather Rhoderick (hrhoderick@vma.org).
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