

VALVE

MAGAZINE
FALL 2019
VOL. 31, NO. 4



VMA President Bill Sandler Retires

: VALVES
: IN EPCM
: PROJECTS
:

: CYCLE
: ISOLATION
: MONITORING
:

: ORIGINS
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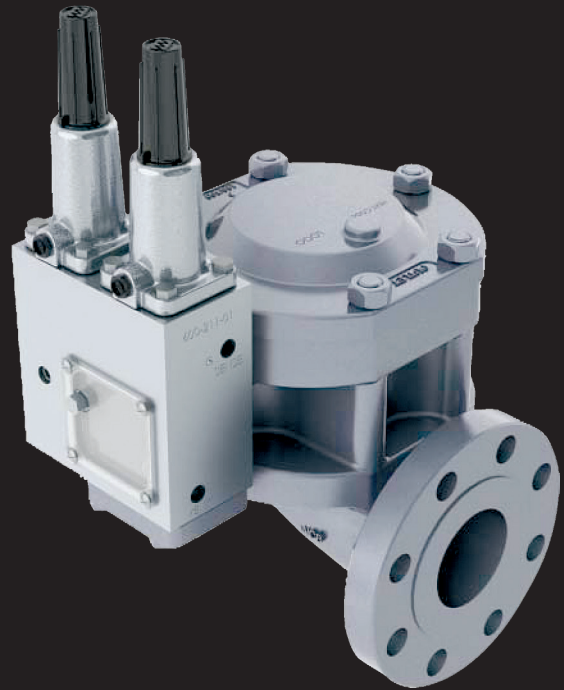
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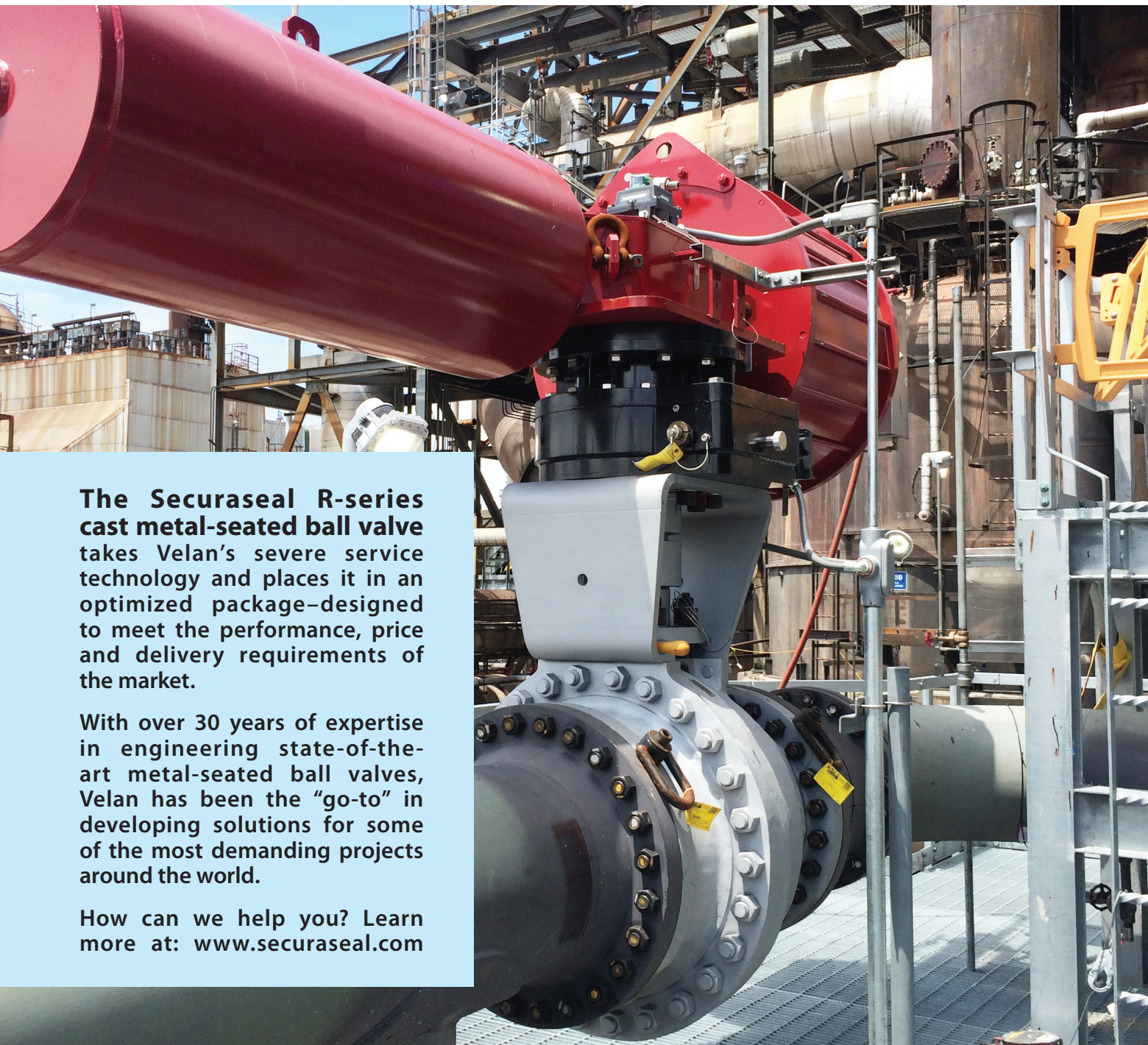
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DOING BUSINESS IN AN UNPREDICTABLE WORLD

BY KATE KUNKEL AND BARBARA DONOHUE

VALVE

MAGAZINE

FALL 2019 | VOL. 31, NO. 4



Economists and industry experts had a difficult time at this year's VMA Market Outlook forecasting what's to come because of new pressures, the ups and downs of the market and much uncertainty.

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Because engineering, procurement, construction and management projects must balance cost, quality and time, they carry a specific set of challenges including what to do during various valve lifecycle stages.

BY KARAN SOTOODEH

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- » Bearing Isolators

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Managing Valves in EPCM Projects: More Challenges

Part II of this article explains how valve suppliers and makers are challenged by actuator supplier selection strategies, ordering for specialized valves, the reality that the project team may be located at different sites, third-party involvement, manufacturer capacity, different early- and late-stage situations and political climates.

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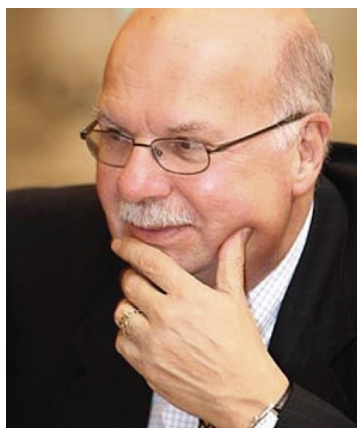
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It's Been a Great Ride



I just returned to the VMA office after spending a week at The Breakers in Palm Beach, FL for our 81st Annual Meeting. For me personally, it was the 43rd such meeting and my last one as president. I could not have foreseen, however, that it would also be four days of endless surprises celebrating my retirement.

On Tuesday evening those who came to Florida threw a “surprise” retirement party attended by many VMA friends—both past and present. My good friend Bob Arnold served as emcee for the evening, introducing many of my VMA colleagues, who got up to say something about me, turning the evening into a roast. In addition to my wife Ellen, who has been with me for many VMA meetings over the years, my daughter Marisa and son Marc surprised me by showing up and going to the podium with a few things to say about their father. I also was presented with a beautiful Lladro giraffe statue to add to my collection of more than 100 giraffes as well as a plaque commemorating my years of service to the association.

At the association business meeting on Thursday morning, VMA Chairman David Hughes presented a beautiful engraved glass clock on behalf of the VMA Board, a timepiece that will have a place of honor in my home.

Then, when I felt like nothing more could possibly be done to celebrate, I received a final surprise: At the VMA Gala Friday night, former Chairman Jim White announced to attendees that the board had approved funding of a scholarship fund in the amount of \$100,000 in my name. To commemorate, they presented me with a plaque to hang at VMA headquarters that reads:

*The William S. Sandler – VMA Scholarship Fund
To carry on Bill's passion for life-long learning and
to support the future for those in the valve industry*

Talk about going out on a high.

I close this final column by reporting that, from beginning to end, this has been one terrific ride. I can't thank VMA members, the board and this readership enough for all the support I've received over the years and most importantly, for the friendships that we've formed.

Bill Sandler

President, Valve Manufacturers Association of America

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NEW CONTRACTS

ValvTechnologies Expands European Reach

ValvTechnologies, Inc. signed a representative agreement with Gestra UK Limited, a provider of flow control valves and systems for heat and process fluid control. The addition strengthens ValvTechnologies' power generation business in the UK, expanding its international reach to England, Wales, Scotland, Northern Ireland, Isle of Man, Jersey and Guernsey.

Flowserve to Support Shell's Floating LNG Facility

Flowserve entered into a five-year contract with Shell Australia to provide general maintenance services for Shell's Prelude Floating Liquefied Natural

Gas (FLNG) facility.

Prelude is an offshore development, producing natural gas from a remote field in Western Australia. The Prelude FLNG facility is scheduled to produce 3.6 million tons per annum (mtpa) of LNG, 1.3 mtpa of condensate and 0.4 mtpa of liquefied petroleum gas.

Curtiss-Wright Gets \$80 Million in Navy Contracts

Curtiss-Wright Corporation was awarded contracts valued at more than \$80 million to provide propulsion valves for the U.S. Navy's Virginia-class nuclear-powered attack and Columbia-class submarine programs. The awards were received from Bechtel Plant Machinery, Inc. for supporting ship construction and spare parts procurement and General Dynamics



□ Curtiss-Wright was awarded \$80 Million in U.S. Navy contracts.

Electric Boat for supporting ship construction for Block V, which includes the new Virginia Payload Module.

Victaulic Chooses BlueScope as Distributor

Victaulic appointed BlueScope Steel as a national distributor of the full line of mechanical joining products for use in mining and commercial building piping systems. Victaulic products

available through BlueScope Steel will include mechanical pipe-joining products for a variety of applications.

BlueScope is a major supplier of steel-related products across a variety of industries throughout Australia and New Zealand.

Metso Expands Valve Distributor Network

During the first half of 2019, Metso signed new distributor agreements for its valve business in eight European countries. The new agreements expand the coverage of Metso's valve offerings in several customer industries including refineries, petrochemical, chemical, fertilizer, steel, bioenergy, food, power, pulp & paper and wastewater. Some of the European distributors also provide service support for Metso valves and valve controls.

Emerson Automates First Caspian Subsea Project

Emerson has completed a \$48-million contract for automation systems and cloud engineering software-as-a-service for the Shah Deniz 2 project in Azerbaijan and is fulfilling an ongoing five-year services contract. The \$28 billion project includes the

MARKET FOCUS: Renewables Strong for Now

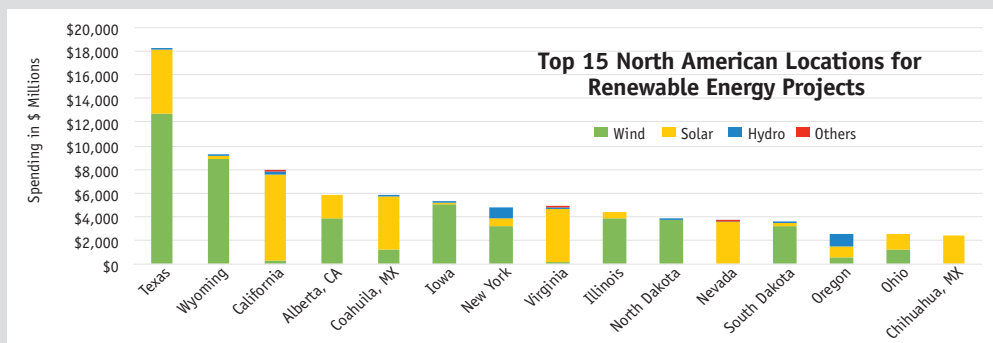
Although North America saw an overall fall-off in power plant construction in 2017 and 2018, renewables remained strong, according to Britt Burt, vice president of global research, power industry, Industrial Info Resources, Inc., one of the speakers at the VMA Market Outlook Workshop Aug. 8-9, San Diego. The general drop was caused by natural gas projects started in 2015 and 2016 that needed to get online before coal-fired plants closed, he said.

Grassroots and expansion projects for power kicking off between 2019 and 2021 are mostly in renewables—solar and wind with some natural gas. What happens next

depends partly on tax credits and whether Congress takes action to extend them, he said. The production tax credit for wind is coming into its last year so any projects in that area have to be under construction by the end of 2019; solar drops from 30% at the end of 2019 to 10% by 2021.

What that means overall for the power industry is that, unless Congress takes action on renewable tax credits, construction will probably occur on more natural gas-fired facilities, he said.

For a story on all the outlook speakers, turn to 16.



Source: Industrial Info Resources, Inc.



Emerson automates First Caspian Subsea Project.

first subsea development in the Caspian Sea. The BP-operated Shah Deniz 2 is expected to produce 16 billion cubic meters of gas per year incrementally to Shah Deniz 1 production.

NEW FACILITIES

Mueller Building Foundry in Decatur, IL

Mueller Water Products and the Economic Development Corporation of Decatur and Macon County plan to build a new foundry in Decatur, IL. The foundry will be one of the largest state-of-the-art, finished goods brass foundries in the world. It will increase production capacity to meet current and future demands of Mueller customers and the industry. Up to 250 employees will work at the facility.

Emerson Opens New Cybersecurity Lab

Emerson opened its newest cybersecurity lab in Pune, India. The labs help manufacturers adopt digital transformation strategies, while protecting the integrity of plant operations, networks, systems and data. The new facility, part of Emerson's larger global cybersecurity network, reinforces

Emerson's commitment to offer advanced automation solutions to its customers worldwide.

MERGERS & ACQUISITIONS

EnPro Industries Purchases Aseptic Group

EnPro Industries, Inc. has acquired The Aseptic Group, which comprises Aseptic Process Equipment SAS and Aseptic Services SARL. The privately held company distributes, designs and manufactures aseptic fluid transfer products for the pharmaceutical and biopharmaceutical industries. The group will become part of EnPro's Garlock family of companies.

IMI Purchases PBM

IMI plc announced the acquisition of PBM Inc. PBM will become part of IMI's Critical Engineering division. The acquisition is part of IMI's strategy to broaden its critical engineering offering into adjacent markets.

Champion Valves Purchased by US Valve LLC

US Valve LLC, a division of Airtech USA, acquired

Champion Valves Inc. Champion will continue to operate as it has in the past, including doing business under the Champion name and under supervision of Gary and Linda Spangler. Responsibility will eventually transition to Steve Lovell, president of US Valve.

Astor Place Holdings Acquires Richards Industrials

Astor Place Holdings, the private investment arm of Select Equity Group, L.P., bought the assets of Richards Industrials, Inc.

CEO Bruce Broxterman and the management team will remain in their current roles. Astor Place Senior Advisor Jim Graner will assume the role of non-executive chairman of the board.

Victaulic Acquires Globe Fire Sprinkler

Effective July 8, 2019, Victaulic purchased Globe Fire Sprinkler. These two companies combined will have the resources and capabilities to bring new solutions to the fire protection industry around the world.

Emerson Acquires Two Product Lines from Circor

Emerson bought the Spence and Nicholson product lines from Circor International. The acquisition complements Emerson's portfolio of steam system solutions for process industries and commercial buildings.

The Spence and Nicholson line of products include steam regulators, control valves, safety relief valves, temperature regulators, steam traps and other steam accessories and solutions.

NOVEMBER

12-14

Valve Basics Seminar & Exhibits

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www.vma.org/ValveBasics

19-21

Power-Gen International

New Orleans
www.power-gen.com

2020

FEBRUARY

27-28

VMA Leadership Forum

New Orleans
www.vma.org

MAY

4-7

Offshore Technology Conference

Houston
www.otcnet.org

JUNE

3-4

Valve Repair Meeting & Exhibition

Houston
www.vma.org

14-17

ACE20—AWWA Annual Conference & Exposition

Orlando, FL
www.awwa.org

AUGUST

6-7

VMA Market Outlook Workshop*

Boston
www.vma.org

SEPTEMBER

9-11

VMA/VRC Annual Meeting*

Santa Barbara, CA
www.vma.org

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Metso Flow Control Separating, Renamed Neles

Metso and Outotec have agreed to combine Metso Minerals and Outotec to create a new company called Metso Outotec. Metso will continue under the name Neles as a separately listed entity focused on flow control, independent from Metso Outotec. Olli Isotalo, who was recently appointed president of the valves business area of Metso, will be CEO of Neles.

AWARDS & MILESTONES

VMA Members Among Top 100 Houston Companies

BHGE was ranked #10 and DistributionNOW was ranked #13 on a list of the top Houston-based, publicly traded companies. The list, which is compiled by the Houston Chronicle, ranks the companies based on 2018 financial results,

which were collected and analyzed by S&P Global Market Intelligence.

Victaulic Wins Gold Dealer Design Award

Victaulic's QuickVic SD Installation-Ready System was recognized for outstanding product design in the 16th annual Dealer Design Awards, sponsored by the Air Conditioning Heating & Refrigeration news magazine. The contest is judged by a panel of contractors that evaluate products based on qualities that ease installation, maintenance and service in the industry. Victaulic received a Gold Award in the HVAC Commercial Equipment category.

ValvTechnologies Receives Export Leadership Award

ValvTechnologies, Inc. was recognized by the United States Embassy for leadership in exporting U.S.-made products and services to Chile.

The company was one

of seven that received the award. Recipients are recognized as top U.S. exporters that have played an instrumental role in exporting domestic goods that make significant contributions to the country's economy. Soltex Chile SA, a ValvTechnologies' distributor, accepted the award on behalf of the company.

Highland Foundry Receives OSSE Certification

Highland Foundry Ltd. was granted the Occupational Safety Standards of Excellence (OSSE) certification by the Manufacturing Safety Alliance of British Columbia.

Highland joins an elite group of manufacturers with this OSSE certification. The certificate seal signifies to employees, visitors and business partners alike that the company is committed to the health and safety of its workers and elimination of serious injuries in the manufacturing workplace.

PEOPLE IN THE NEWS

FLOWSERVE... named **Sanjay Chowbey** president, Aftermarket Services & Solutions. He takes on the role previously held by **Kirk Wilson**, the new president of Flowserve's flow control division following the retirement of **John Lenander**.

Chowbey recently served as president of the Subcom business unit at TE Connectivity, a subsea communication infrastructure business. Before that, he served at Dana-her for 11 years in several roles of increasing responsibility.

ADMIRAL VALVE... appointed **Jeff Weingartner** the new director of OEM sales. Weingartner has spent his entire career in the pipe, valve & fitting industry with a focus on the fluid handling market segment. He spent many years with Crane Co. in its ChemPharma & Energy division within the fluid handling business unit. He most recently served as the OEM business development manager for the northeast

region of AW Chesterton Company.

CONVAL... Vice President of Global Marketing and Sales **Michael Hendrick** is retiring effective October 1, 2019. Before joining Conval, Hendrick served in sales management positions at Contromatics, another U.S. manufacturer of high-performance valves.

According to Conval president **Don Curtin**, Hendrick expanded the company's extensive global network of authorized sales and service representatives, managed the inside sales and customer support team, launched several new products, entered new markets, "and cultivated strong long-term relationships with countless end customers through on-site visits, trade shows, seminars and conferences."

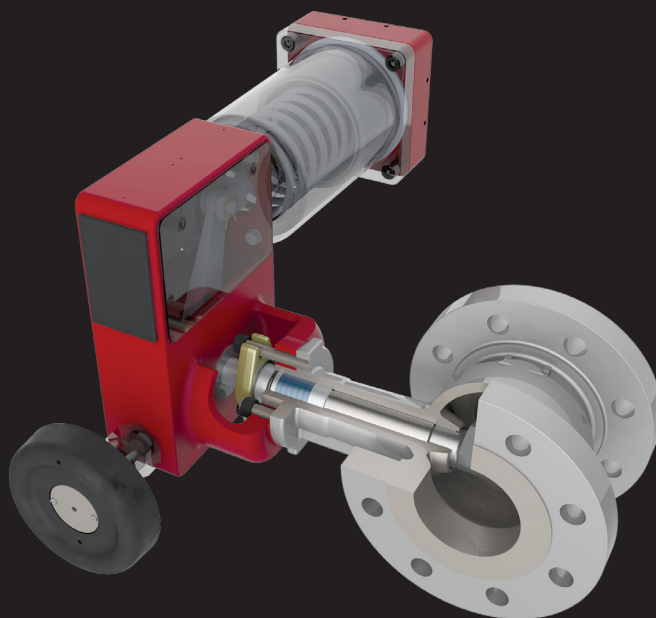


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Annual Meeting Celebrates Sandler, Member Excellence and New Leaders

The VMA/VRC Annual Meeting is usually an upbeat affair as association leaders gather to ring in the new leadership, talk about current issues and note accomplishments of the recent past. The 81st meeting, however, was even more celebratory than normal.

The meeting, held Sept. 25-27 at the Breakers in Palm Beach, FL, was highlighted by several festivities designed to honor VMA President **William Sandler**, who after the longest running presidency and tenure in the association's history (42 years on staff, half of it as president) is stepping down to enjoy a much deserved retirement.

The celebration of Sandler and his career began the night before the meeting started, at a surprise dinner following the Chairman's Reception. Unbeknownst to Sandler, nearly 70 members, longtime friends and family were on hand to roast Sandler and reflect on what he meant to them and to the industry. The evening was hosted by the VMA Board of Directors.

But more surprises awaited the soon-to-retire president, who was further honored at the gala awards dinner that concludes the annual meeting.

"The reason I think of a captain of a ship when I think of Bill is because he has always impressed me with how calm and



PHOTOGRAPHY BY: LILA PHOTO



PHOTOGRAPHY BY: LILA PHOTO



PHOTOGRAPHY BY: LILA PHOTO

TOP: Ellen Sandler, Bill's wife, has been at his side through his long VMA career.
 CENTER: Sandler visits with family and friends at the surprise dinner.
 ABOVE: Sandler's children Marisa and Marc Sandler shared in their father's joy and pride.

steady he has been at the helm," said **David Hughes**, VMA chair (now immediate past chair). "Since I joined the board in 2013, we have at times experienced turbulence, but Bill provided confident and steady leadership throughout. As a result, he is passing onto our new president (see 'VMA Gets a New Captain') a strong and healthy organization."

Finally, as the awards program appeared to come to an end, **Jim White** of Curtiss-Wright, former VMA chair, stepped up to the podium to announce that a scholarship was created by the VMA board as an ongoing way to acknowledge Sandler's contribution to and passion for the valve industry. Thanks to a \$100,000 fund, an annual scholarship will be awarded to a dependent from a VMA member company. Details of the program will be revealed in early 2020.

PHOTOGRAPHY BY: LILA PHOTO



PHOTOGRAPHY BY: LILA PHOTO



TOP LEFT: MC for the Sandler roast was his long-time friend Bob Arnold.

TOP RIGHT: Rob Bartlett, director and CEO of the British Valve and Actuator Association, traveled from the UK to share this special evening with Sandler and friends.

RIGHT Sandler was surprised by a beautiful pair of Lladro giraffes.

BELOW: Jim White, who headed up the scholarship efforts, presented Sandler with a plaque that will display the winners each year.



PHOTOGRAPHY BY: LILA PHOTO



VMA Gets a New “Captain”

Another aspect of the 81st annual meeting that brought excitement to the floor was when VMA’s new leader **Heather Rhoderick, CAE, CMP**, was announced. Rhoderick takes over from William Sandler as the new VMA president effective Nov. 6. She comes to VMA after 11 years with the American Composites Manufacturing Asso-

“I AM HONORED TO JOIN THE VMA TEAM AND BUILD ON THE STRONG FOUNDATION OF SUCCESS.”

— HEATHER RHODERICK, CAE, CMP

ciation (ACMA), a 475-member trade group based in the Washington, DC-area. At ACMA, she became the senior vice president of events and information, which gave her an extensive background in association revenue generation, member education, and communication and association operations. During her career, she has accumulated more than 20 years working for manufacturing trade associations.

Rhoderick was selected after an extensive search by the Executive Search Committee, led by incoming chairman Bryan Burns. “I am honored to join the VMA team and build on the strong foundation of success already in place,” Rhoderick said. “I believe that VMA is well positioned for growth, and am excited to help lead the organization so that it continues to bring value-added programs to its members and the industry.”

PHOTOGRAPHY BY: LILA PHOTO



PERSON OF THE YEAR

Sandler was not the only person surprised by recognition during the meeting. The highest award given by VMA, "Person of the Year," went to **Jim Walther**, KITZ Corporation. Walther has also been in the industry many years and has been active almost since he joined the industry. He has been an integral part of the annual meeting planning committee for most of that time including this year as special activities were organized. Among his other long-time accomplishments on behalf of the association is to serve as part of the association's nominating committee.

Walther received the honor in the 46th year of the award's existence. It is presented to an individual who has devoted an extra measure of time and talent to supporting VMA or VRC programs.

Before presenting the award to this year's winner, **David Hughes** brought on stage eight other men who have received the award and attended this year including: 2003 recipient **David Moser**, 2004 recipient **Chris Warnett**, 2010 recipient **Greg Johnson**, 2011 recipient **Arie Bregman**, 2015 recipient **Jim White**, 2016 recipient **Kim Beise**, 2017 recipient **Tony Pecora**, and 2018 recipient **Stephane Meunier**.

NEW LEADERS

Part of each annual meeting is for the membership to approve a new slate of leaders as recommended by the VMA Nominating Committee. Taking over from David Hughes as chairman this year is **Bryan Burns**,



Person of the Year Jim Walther (left) is presented his award by David Hughes, immediate past chairman.

PHOTOGRAPH BY: LILA PHONO



The new chair of VMA for the next term is Bryan Burns.

PHOTOGRAPH BY: LILA PHONO

president and CEO of DeZURIK. Other elected officers approved at the meeting include:

- **Vice Chair: Brad Ellis**, senior vice president of Crane Co.
- **Program Chairman: Arie Bregman**, vice president and general manager of DFT, Inc.
- **David Hughes**, director of Global Accounts-Final Control (a business unit within Emerson Automation Solutions), will serve as immediate past chairman of the board.

Approved as new board members this year (for three-year terms) are:

- **Andy Duffy**, vice president of sales, Emerson Fluid and Motion Control (ASCO)
- **David Loula**, director of global products and markets, ITT Engineered Valves.

- Serving for an additional one-year term is **Patrick Dunn**, vice president of sales and service for Metso North America.

Continuing their terms on the board are **John Ballun** (Val-Matic), **Nathan Brunell** (BHGE), **Seth Guterman** (American Valve), **Yves Leduc** (Velan), **Matt Thiel** (AUMA), **Jim Walther** (KITZ), **Ron Warren** (Bray) and **Brian Wright** (A-T Controls).

CURRENT ISSUES

Also an integral part of the annual meeting are speakers invited to give their thoughts on current trends and issues in the industry. This year, attendees heard about the U.S. economic outlook as well as an economic view of the industry from Wall Street; the latest on tariffs and the USMCA (U.S.-Mexico-Canada Agreement); how to work with distributors as channel partners; and cybersecurity issues from the member perspective. **VM**

To read about what these presenters had to say, visit www.valvemagazine.com for additional annual meeting coverage.

WELCOME NEW MEMBERS

Joining VMA as a full member is: **Trimteck, LLC** (trimteck.com). This is the ninth new company to join the association in 2019. Based in Coral Springs, FL, Trimteck provides customers around the world with flow, temperature and pressure control solutions for critical industrial processes.

Joining the Valve Repair Council is: **John H. Carter Company** (johnhcarter.com). This is the second new VRC member in 2019. John H. Carter is a manufacturer's representative and distributor of industrial equipment in the Gulf Coast states of Louisiana, Arkansas, Mississippi, Alabama and the Florida Panhandle. The business is the largest operation of its kind on the Central Gulf Coast.

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Power Professionals Gather in New Orleans this November

PowerGen International Exhibition and Summit brings together the companies that generate electricity, utilities and solution providers for all types of power generation. This year's event is Nov. 19-21 at the Ernest N. Morial Convention Center, New Orleans.

The program portion of the event, which is now called a summit, offers expertise from more than 200 industry presenters during 65 sessions. To reflect the changing industry, summit tracks are broken down into seven areas: Digital transformation of power plants, energy storage breakthroughs, gas-fired turbines and plants, microgrids, onsite power, optimizing plant performance and coal-fired generation.

On the floor, more than 900 exhibiting companies display a wide variety of products and services of interest to the power generation industry including VMA members and other valve companies, pump manufacturers and other equipment companies, as well as engineering firms, consultants and power generation specialists.

This year's keynote speakers include famed football star Archie Manning as well as Paul D. Hinnenkamp, chief operating officer of Entergy, and Chris Moser, executive vice president of Operations for NRG Energy, Inc.

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2020 Market Outlook: Doing Business in an Unpredictable World

BY KATE KUNKEL AND
BARBARA DONOHUE





SWINGING MARKET CONDITIONS, POLITICAL TENSIONS AND TRADE BATTLES were top-of-mind for the economists and industry experts speaking at this year's VMA Market Outlook Workshop, Aug. 8-9, 2019 in San Diego.

While presenters talked about some of the same pressures they have for years such as the lack of skilled labor, the need for infrastructure improvements in the U.S., the effects of new technologies and what's happening with oil and gas prices, forecasting was more difficult this year because of uncertainty over basically everything right now.

One speaker referred to what's happening as "chaos."

The global and U.S. economies are both going through one of the longest, slowest recoveries in history, which has created a few opportunities but also contributed to the uncertainty.

Yet there was good news: Several speakers said they see no recession in the immediate future—the indicators used to measure a downturn aren't present or are behaving in unusual ways.

In a few U.S. markets that are valve end users, the outlook was mostly positive. Water/wastewater will see "explosive growth," according to one speaker, and construction, mid-stream/downstream oil and gas, petrochemicals and mining are expected to see continued growth over the next two years.

But for much of the world and this nation, the situation is unsettled.

"The top three concerns for the economy right now are uncertainty, uncertainty and uncertainty," which "was raised to a record high in 2019," said David Teolis, assistant director, International Economics, General Motors Company.

ISSUES AT THE FOREFRONT:

- While China has always been a topic of discussion during Market Outlook workshops, the focus this year switched from China as a competitor to China in light of the ongoing battle over trade embargoes and tariffs and how this situation will affect the world.
- This recovery is not like any others in history not just because of its length, but because so many of the indicators are out of whack with previous financial periods.
- A recession was not imminent as of this year's Outlook, most speakers said. However, recovery will slow down further in the next couple of years and then economies may take a hit.

HIGHER LOWS AND LOWER HIGHS

The world's economies are currently in the longest expansion in modern times, according to Michael Halloran, senior research analyst at Baird. However, the growth occurring has been very slow.

The current period "has been a limited growth cycle in large part due to modern monetary policy. There are higher lows and lower highs," he said. "The feds of the world are manipulating growth through interest rates, bond purchases and more, which is softening the downside, but also constraining growth on the upside," he added. Given those conditions, "it's not surprising that the low growth cycle has been so long."

At the same time, Halloran also noted that: "This is the most chaos I've seen without a recession."

PERFORMANCE DRIVERS

In the past, knowing the fundamentals of markets and their trajectory guided Halloran in making intelligent projections on where stocks were going.

The situation is different right now, however. "Macro politics, macro-economics, and trade and monetary policy are driving stock performance more than they ever had," he said. In the past, such factors aligned with the fundamentals, but "that is not happening at this point in time," he said.

Halloran said global government stimulus activity, falling regulatory burdens and faster approvals are current tailwinds for economic growth. Worldwide, central bank policies continue to drive markets, and in the U.S.

recent rate cuts have been made by the U.S. Federal Reserve.

However, not much room exists in the current picture to allow for inflation and greater profits because of commodity declines. "It's easier for industrial companies to pass on price increases when commodities are rising—not so much when they are down year over year," he said.

Conditions that bear watching include trade tensions with China, the strength of the U.S. dollar and slowing global growth, especially among emerging markets that are dependent on commodities sales to developed markets. Halloran believes that these factors, along with historically high government and consumer debt, will contribute to the risk of a recession in the next 24 months or so.

Meanwhile, trade and tariff disruptions remain front and center, and macroeconomic risks are causing indecision and delays into 2020, he said.

Halloran stressed that the Purchasing Managers Index, which he said is a good indicator of demand, "is still relatively optimistic, although it is contracting a bit."

On the other hand, the yield curve for lending is currently inverted, which can be an indication of an upcoming recession. "It could be a false indicator based on geopolitical sentiment, but historically, if a yield curve is inverted, a recession could occur within about two years," he said.

WHAT TO DO

To stay ahead of competitors, Halloran urged process control companies to focus on building revenues in recurring business, aftermarkets, services and software revenue streams. "As the

low-growth world drags on, emphasis on higher-margin recurring aftermarket revenues is critical for growth and margin expansion," he said.

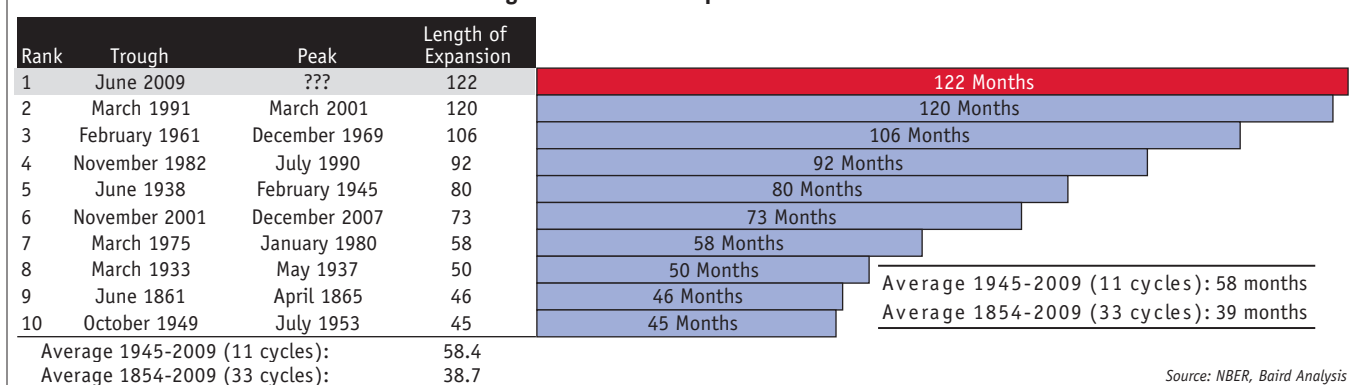
Regarding the internet of things, although products and capabilities are increasingly common, the surrounding opportunities (e.g., integration, monitoring, software) remains a contested battleground. Halloran suggested that opportunities exist in layering on the connectivity. "Take that product and expertise and translate it to the next level of growth," he said.

Other opportunities in this low-growth cycle include environmental, social and governance criteria and in energy efficiency. "Customers hesitant to make large investments in new processes generally are still willing to spend on the higher-certainty, albeit lower-return profiles associated with investments into energy efficiency projects and upgrades," Halloran said.

OUTLOOK

- *Municipal water/wastewater, U.S. residential/commercial construction, midstream/downstream oil & gas, chemical and mining industries will see continued growth in 2019 and 2020.*
- *Aerospace/defense and general industrial will remain the same as 2018, while auto and agriculture will go down, mostly because of trade issues. Power generation will continue a downward trajectory.*
- *Companies will not make as much money next year as they thought, and while some growth is expected, downward pressure from geopolitical factors will moderate that growth through 2019.*

Longest U.S. Economic Expansions on Record



Source: NBER, Baird Analysis

THE ONLY CERTAINTY IS UNCERTAINTY

David Teolis, assistant director, International Economics for General Motors Company, pulled no punches when he described the current economic situation. Globally, uncertainty is at a record high, he said.

The world is wondering how long the trade war will persist and if it will extend beyond China, he said. Also, global manufacturing activity is contracting and global central banks are moving into a monetary easing cycle. This is happening at the same time the pace of economic growth is expected to slow even more than the sub-3% Gross Domestic Product (GDP) growth the world has experienced for the last five years. The U.S. and Chinese economies, which together contribute roughly 40% of the global economy, are among those destined for less growth, according to Teolis.

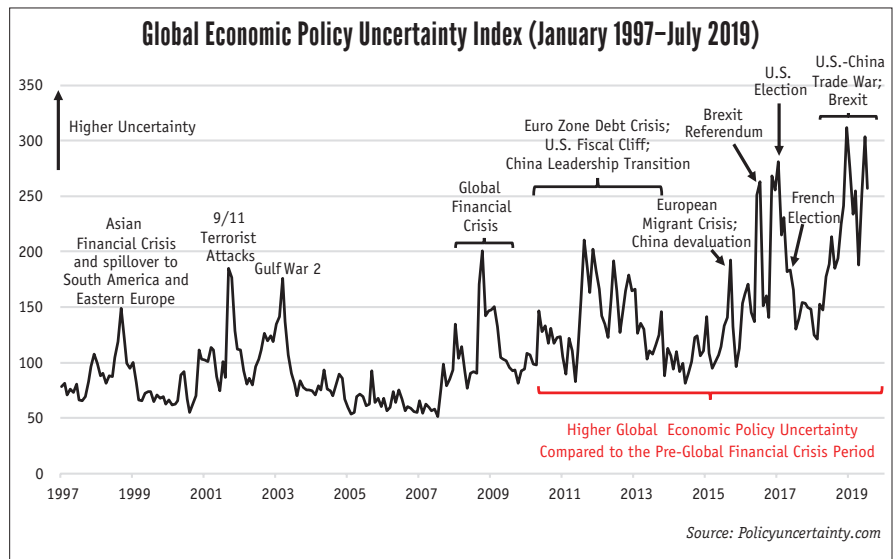
THE PRESSURES

Elections in Canada, the U.S. and Argentina, geopolitical events and technological changes have added to economic anxiety, Teolis said. These lead to delays in decision-making for companies and for consumers, which further limits the pace of economic growth.

He pointed out that inflation, or rather the lack of inflation, is a significant concern globally right now—the U.S. Federal Reserve, European Central Bank and Bank of Japan failed to bring inflation rates to their 2% targets. “Why is this important?” Teolis asked. Because “Targeted inflation is important to stabilize prices to help facilitate the allocation of resources.”

In historic business cycles, recovery is stimulated by pent-up demand after a recession has occurred, he explained. When people finally get a job, they want to spend. In the current situation, pent-up demand has been exhausted by the long period of slow growth, so cutting the Fed rate is not going to help spur spending and raise prices, he said.

Additionally, globalization has created increased competition, which



puts downward pressure on prices, and many aging baby boomers worldwide are not buying as many consumer goods as in the past. Another factor is a phenomenon some are calling the “Amazon effect”—consumers and companies can go online to compare and buy at the lowest prices, which affects competition everywhere.

Teolis said that if price pressures remain low, central banks may need to get involved—if the pressures are only temporary, those banks shouldn’t get involved because adding stimulus now can overshoot goals for the future.

Today, monetary leaders are facing the question of whether exogenous sources of uncertainty such as the trade wars can be effectively addressed by easing monetary policy. If that’s not the case, such policy will be ineffective until the root causes of uncertainty are addressed, he said.

THE TRADE WAR

According to Teolis, President Trump looks at the trade imbalance as a battle China is losing. However, China’s influence in the global economy has been increasing since it joined the World Trade Organization in 2001, he said. One key forecasting institute predicts that China will surpass the U.S. by 2030 or sooner if the U.S. sinks into a recession.

Teolis noted that, since the trade war began, there has been a net reduction in the U.S. trade deficit with China of only \$2.5 billion. “Has it been worth all the chaos and uncertainty?”

he asked.

Because China imports fewer goods, that country has to fight back in a tariff war with other weapons such as ceasing to buy specific goods (e.g., Boeing planes and soybeans). It also can sell U.S. treasury holdings—China holds more than \$1 trillion of U.S. bonds as part of its currency reserves. Liquidating them would push up U.S. Treasury bond yields. China also could allow its currency to weaken, offsetting, at least partially, the impact of higher U.S. tariffs.

“There has been a significant downgrade [in the outlook for the world economy] since January; forecasters have become more pessimistic,” he warned. “They are saying we’re heading back down below 3% [GDP globally]. Populism and protectionism persist in that kind of climate, and they constitute major risks to the global economy.”

FORECAST

- Risks exist for geopolitical (e.g., Iran and North Korea tensions) and geo-economic (e.g., Brexit, oil or other commodity price shocks, financial instability, currency war) events that could halt global growth.
- Financial market instability is threatened by the U.S. Federal Reserve and other major central banks shifting towards a dovish policy bias.
- The next year will see global growth slowdown.

ANATOMY OF A RECOVERY

At the time of the VMA Market Outlook Workshop, the economic recovery in this country had just broken the record for the longest expansion since World War II. Giacomo Rondina, associate professor of Economics for the University of California San Diego outlined for attendees the specifics of what's happened and explained why this recovery has been different than some others.

GDP growth has been good, Rondina said, "but is just now catching up with the potential GDP." The very lengthy expansion period has actually seen less overall growth than normally seen in a recovery. Rondina pointed out that the current expansion shows lower growth overall (20%) than the two other long expansions, Kennedy-Johnson (30%) and Bush-Clinton (35%).

Also, the usual drivers of expansions—residential investment and consumption of durable goods—have not been as important in this expansion as in previous ones, Rondina said. This time around, investment in intellectual property products such as software turned out to be a driver in growing the GDP.

Some other specifics include:

The Labor Market

Labor force participation has almost completely recovered to its pre-recession level. Unemployment is very low and the labor market is solid, but some features are troubling. For example, if more job vacancies exist than unemployed people, that is an

indication of a mismatch of skills, Rondina said. Companies are looking for skill sets they can't find. He also said that productivity is not growing during this recovery as much as it did in previous recoveries.

Financing

Interest rates continue to stay low, and Rondina didn't expect any inflationary pressures. A concern he had is that very low interest rates going into any downturn might prevent the use of these rates to stimulate the economy if that stimulation is needed.

Household debt is falling, and government debt is rising, Rondina said. During the last recession, household debt as a percentage of GDP lingered around 100%, while government debt went from about 63% to 80%. During the current recovery, household debt has gone down steadily, while government debt has risen fast and now is more than 100% of GDP. Rondina said this migration of debt exposure from private to public is one of the unusual features of the current economy.

Imbalances

The current market has created some imbalances. For example, the stock market has been up, but stock prices are not justified by earnings, Rondina said. Real estate, however, is in line with its fundamentals.

Also, low overall inflation masks major changes in the relative prices of some necessary items. To illustrate this, Rondina looked back at a selection of U.S. consumer goods and services from the time frame 1998 to 2019. While the overall inflation rate during that period was 57.6%, some items, such as televisions, computer

software and cell phone services, fell in price. However, other items, mainly services, rose far higher than general prices. For example, hospital services topped out at over 200% more expensive from beginning to end; college tuition was not far behind; and child-care rose over 100%. The implications of this may be felt in the workforce, Rondina pointed out. For example, if childcare takes too big a bite out of income, parents may not re-enter the workforce as quickly. If college is too expensive, students may not continue their studies to get degrees, with the result that they won't acquire the skills needed for good jobs.

In addition, the higher costs of medical insurance and increased wages discourage companies from hiring.

Income inequality is another troubling imbalance that is not improving. People on the lower end of the income range experience not only lower income, but lower income growth than those with higher incomes, Rondina pointed out.

SHOULD WE EXPECT A RECESSION?

As with other speakers at this outlook, Rondina said economic indicators and conditions are out of alignment in some cases. "Some factors are normal; some are not," he said.

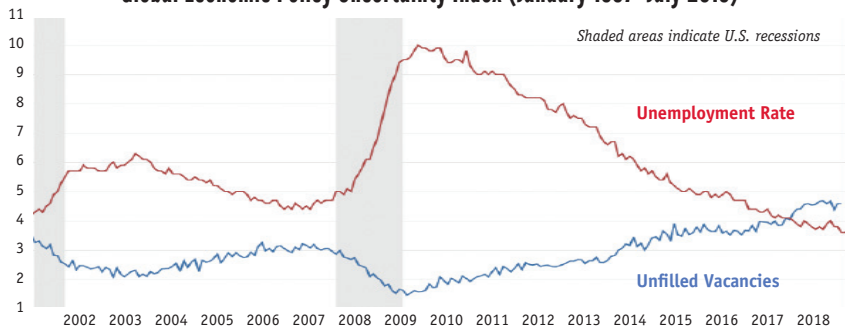
Recessions are painful; they mean lost jobs and lower income, Rondina said. However, they historically have been temporary, whereas some of the imbalances and concerns presently facing the nation are likely to persist beyond the next recession.

For example, government debt is projected to continue increasing, which is less of a burden when the economy is growing and interest rates are low. During the next downturn and/or inflationary cycle, that debt could bring trouble, he said.

FORECAST

- A slowdown may start in 12 to 24 months.
- After it does, the economy is likely to make a downturn.
- Monetary and fiscal policy might not have room to maneuver when a recession hits.

Global Economic Policy Uncertainty Index (January 1997–July 2019)



Source: Bureau of Labor Statistics

PRODUCTION AND EXPORTS UP

John Spears, president of Spears and Associates, said the outlook for 2020 for oil and gas is fairly steady. Production will likely be up for the year but the slowing in the economy may lead to reduced investment and drilling, he said.

OIL DEMAND AND PRODUCTION

The forecast for demand worldwide for next year has been reduced from previous expectations because of the slower economic growth outlook.

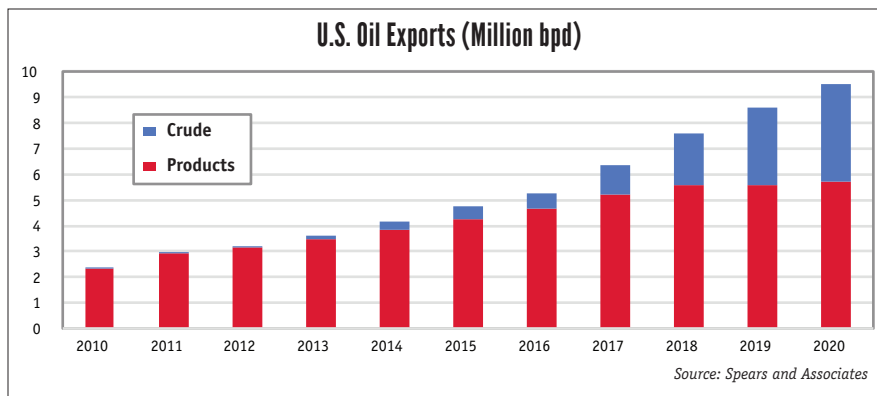
On the production side, OPEC+ (the supercartel of OPEC and some non-OPEC countries) extended its agreement to restrict output until 2020 to limit inventory and maintain price. Meanwhile, the U.S. is expected to supply all the additional global demand for 2020.

According to the Organization for Economic Cooperation and Development, oil inventories are currently at their third-highest level as far as the number of barrels and second lowest level in terms of days' worth of supply, Spears said.

In the U.S., the spot oil price will rise by 8% for the year while supply is expected to remain adequate. Historically, rising prices mean an increase in oil rig activity, Spears said.

The average output in 2020 is expected to be up by 7.5%, an increase that will be good for the pumps business and associated equipment, such as valves, Spears said.

Of the wells in the U.S., 85% are now horizontal, Spears said. The reach for those wells now averages about 8,000 feet. Despite this increasing lateral length, initial productivity—the first month's output of a well—for shale oil and gas wells seems to have peaked in 2018. For U.S. oil and gas output to continue to grow, post-2020 drilling and completion must increase, Spears said. A key issue here is "parent-child" well interference, which is where multiple wells, typically three or four, are commonly drilled from a single well pad. In such situations, the fracking zones of the wells may touch each other—parent-child interference—resulting in decreased output



per well, Spears explained.

U.S. EXPORTS

In 2020, U.S. oil exports of both products and crude are expected to average 9.5 million barrels per day (bpd), a number that has been increasing year over year. "Our refineries are set up for heavy, sour oil," Spears said, "but what is produced is light, which is better processed at foreign refineries." In 2020, crude exports are expected to be 3.8 million bpd, up 25%, he said.

U.S. GAS

Gas production is forecast at 92.2 billion cubic feet per day (bcfd) in 2020, up 2%. The condition of pipeline infrastructure is a concern, as is well productivity, Spears said.

U.S. gas exports are forecast to reach 13.8 bcfd in 2020, up 6%. A significant development in this area is that the proportion of LNG gas has been rising since 2016, when the first terminal for exporting in the U.S. opened in Louisiana. For 2020, LNG is expected to be about 40% of the market.

DRILLING, CONSTRUCTION AND EQUIPMENT

In the U.S., 21,600 new wells are expected, Spears said, which is down

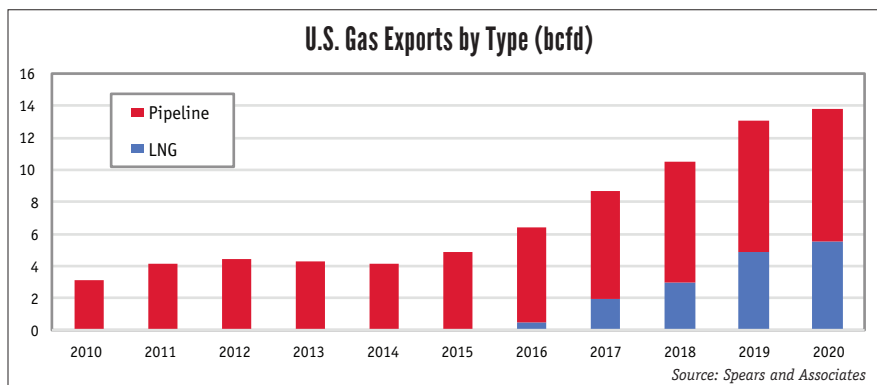
by about 5%. Maintenance and capital expenditure budgets will likely remain steady.

About 10,000 miles of pipeline construction is expected in 2020, down about 10%.

Expenditures on surface equipment such as wellheads and Christmas trees is projected to drop 4% to \$4.8 billion in the U.S. Rig equipment spending in 2020 is likely to run \$5.7 billion, down 14%.

FORECAST

- The worldwide oil forecast for demand for 2020 is about 102.4 bpd up 1.4%. The average oil output in the U.S. for 2020 is expected to be up 1 million to 13.4 bpd, up 7.5%. The U.S. spot oil price is expected to average \$64/barrel in 2020, up 8%.
- U.S. gas production is forecast at 92.2 bcfd in 2020, up 2%.
- Midstream investment will continue to be strong to handle record levels of U.S. oil/gas production and exports, including transmission pipelines and oil export terminals.
- Valve demand has a mixed outlook with U.S. upstream weaker; international upstream up from a cyclical low; and U.S. midstream holding steady.



PROFITS NOW, TROUBLE AHEAD?

Mark Eramo, vice president, global business development at IHS Markit, noted an extended upcycle in petrochemicals and said profitability has been good.

A combination of high crude prices and stable natural gas is attractive for North America's gas-based chemical investments, he said.

"Globally, petrochemical producers have been making good money into 2018, but since 2019, it has slowed down around the world," he said. While the U.S. has not yet felt the downturn as much as some other countries, several factors could change the scenario in the next year.

The last four or five years of strong performance profitability led to reinvestment in the sector, so a wave of new capacity is on the way at the same time as a slowdown in demand.

"This is a bad combination, a classic train wreck, as they say in the industry," Eramo warned.

THE GENERAL PICTURE

Because global trade is slowing down, there is pervasive evidence of weakness in Europe, particularly in Germany, and despite recent signs of strength, Japanese growth is slowing. In the near term, the downside risks to growth for China will be mitigated by that country's own government's stimulus, but for other large, emerging markets, there is no winning this trade war.

"The bottom line is: We are a long way from being out of danger with

respect to the trade wars," Eramo said, and a truce would neither help nor hurt the ongoing global slowdown, he pointed out.

Meanwhile, companies are increasingly being asked to assess business models and investments under different scenarios. For example, they are being asked: What is the impact of electric vehicles on future energy demand? How will pressure from investors and society for a lower-carbon, highly sustainable footprint impact investments in the future? How will the competition between natural gas and renewables play out? How will solutions to the plastics waste issue impact long-term demand growth for plastics, monomers and feedstocks?

These kinds of questions have created a need to test business strategies in different future environments, Eramo said.

MEGATRENDS FOR THE 2020S

A huge focus right now is on reducing the hydrocarbons used to get people around. Most of that emphasis is on improved energy efficiency, especially mileage per gallon in cars, trucks, shipping and aviation. These industries must become much more efficient to meet what's expected of them, which is creating an issue of plateauing oil demand.

This could result in a movement of oil formerly slated for mobility going into the petrochemical industry, which will influence where plants are located, and how energy and refining companies allocate resources.

This is happening at the same time use of plastics is under the highest

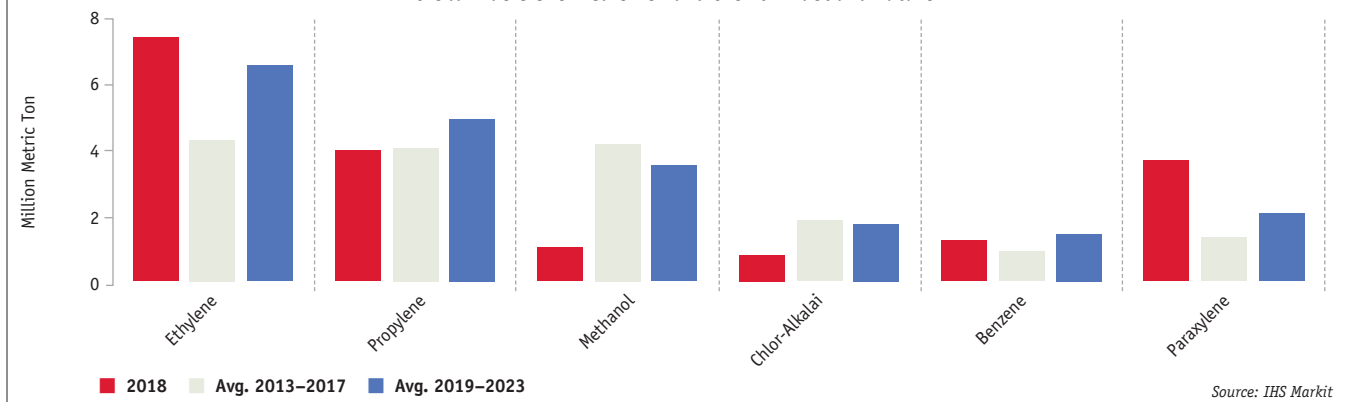
scrutiny, Eramo said. The plastic waste issue accelerated into the global consciousness during 2018 and is considered the most critical issue that will influence the industry during the decade of the 2020s, he said. Local communities and corporations are imposing bans on single-use plastic, and the United Nations World Environmental Day had plastics waste as a central theme in 2018. Since plastics account for about half the demand for petrochemicals, sustainability risk assessment is essential to long-term planning for this sector.

There also are significant changes underway in China that Eramo says require close monitoring and analysis. That country's economy is transitioning to high-value manufacturing and services, and there is a change in the balance of chemical company ownership between the central government and the private sector. This leads to value-chain integration and a push to be self-sufficient and to develop specialty chemicals.

OUTLOOK

- *The overall financial outlook is down from 2018. Slower economic growth and lower crude oil pricing are predicted for 2019/2020.*
- *A slowing economy and too much new capacity are of concern.*
- *The issue of plastics and sustainability will be a big influence on the petrochemical industry in the coming years.*
- *Steady demand will soften the outlook for ethylene and propylene. Chlor-alkali is expected to strengthen and paraxylene faces a situation of significant over-supply.*

Global Basic Chemicals Demand Growth: Past and Future



Source: IHS Markit

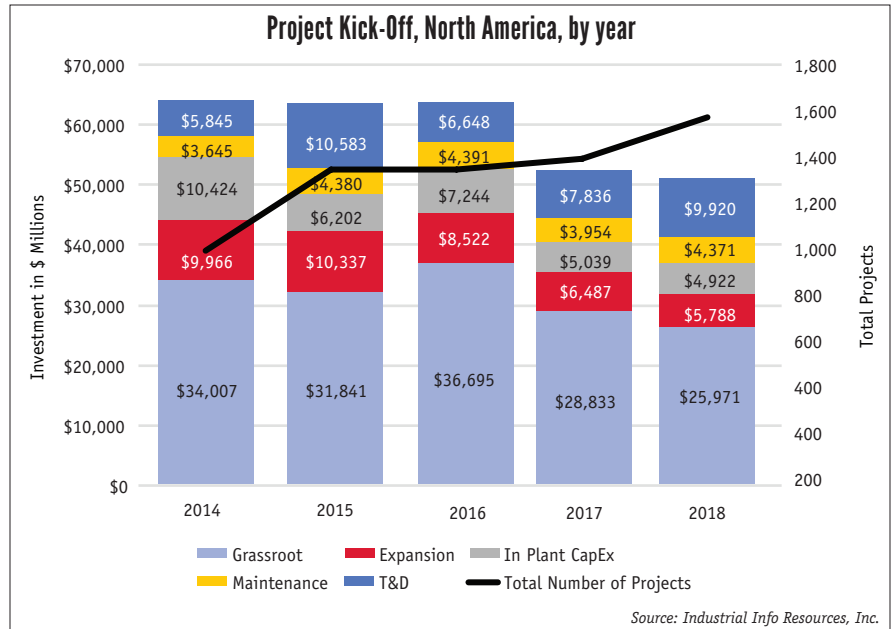
RENEWABLES/ NATURAL GAS RULE

Britt Burt, vice president of global research for the power industry, Industrial Info Resources, presented a moderately optimistic outlook for the power sector for the next two years.

Demand growth in the U.S. and Canada has been fairly flat with the exception of Texas and in places where reserve margins are tightening such as the eastern seaboard. However, he doesn't see tremendous growth anywhere.

Currently, there are just over 3,000 power projects with a value of about \$1 trillion worldwide in which maintenance is taking place or construction has begun. Globally, about 35,367 power projects are planned, with many of those in Asia and South Asia where a large percentage of the investment in nuclear and coal-fired grassroots projects exists.

Meanwhile, the 6,890 North American projects currently on the radar are worth nearly \$781 billion. Grassroot projects, which include new builds



and brownfields, are worth more than \$463 billion of that figure while 347 expansions and unit additions to existing power plants are worth almost \$114 billion.

The grassroots and expansion projects kicking off between 2019 and 2021 are mostly in renewables—solar and wind—and some natural gas. New build renewables also include hydro

and less traditional areas such as geothermal, landfill-gas-to-energy and biosolids.

For the long term (by the year 2040), solar power is expected to surpass every other type of power growth except natural gas. Increases in solar will most likely be in photovoltaic because concentrated solar project technology has not come down



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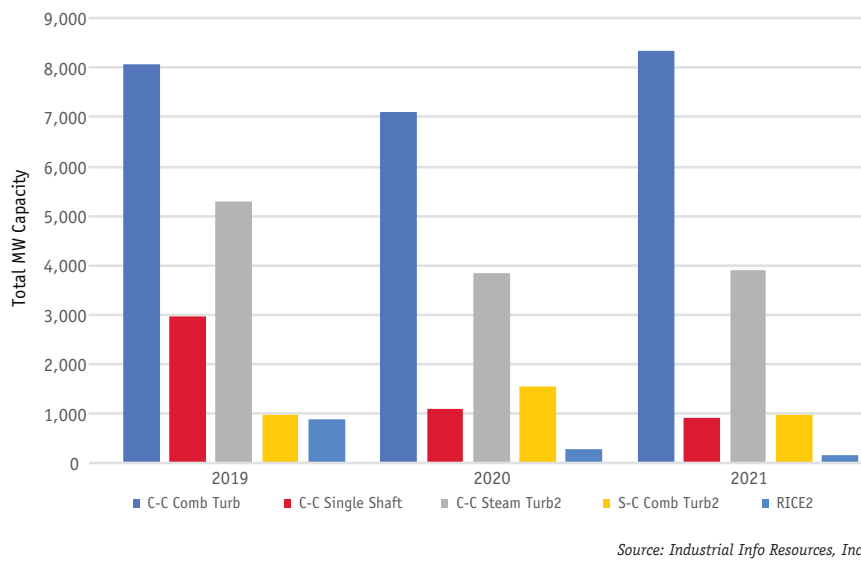
Send inquiries to standards@msshq.org

www.msshq.org



The Manufacturers Standardization Society
of the Valve & Fitting Industry

Unit Types with MW Capacity



enough in price, Burt said.

Wind hasn't expanded on its own and cannot yet compete with natural gas-fired facilities, especially since storage technology and cost have not come down to a level where it can offset the need for backup from traditional sources such as natural gas.

As a result, Burt believes the potential for more natural gas is still good. For the next five years, about 45% of new builds will be natural gas, he said. The rest will be wind and solar.

Most of the natural gas grassroots and expansion projects between 2019 and 2021 will be centered around developments where the Marcellus and Utica Shale fields exist in Ohio and Pennsylvania. This does not include repowering or fuel switching.

The types of equipment installed will include combined cycle with a slight uptick in single-shaft generators. This area is already growing in Europe and beginning to grow in North America. There also is some potential in reciprocal internal combustion engines (RICE) for peak loads.

"Some of the microgrid involves installing these reciprocating engines so there is potential for growth there," Burt said.

For the existing fleet, expenditures will be for modernization and efficiency upgrades. Digitization is part of that effort, which applies to digitizing records but also controlling system upgrades and giving efficiency

upgrades on hardware, SCADA systems and turbine controls.

Burt said there is no real potential for new generation of power in coal or nuclear. Any expenditures in those areas will be for modernization and life extension programs. For example, Ontario is modernizing its nuclear fleet so there is opportunity there.

Areas of opportunity also are showing up in onsite power generation at manufacturing facilities. Across the U.S., about 594 such units are operating about 10 GW of facilities. Burt believes there will continue to be growth because of the movement away from traditional power generation and toward more distributed generation. This, and microgrid facilities (sometimes in conjunction with the grid and sometimes operating independently) will continue to grow.

THE OUTLOOK

- *Development of natural gas-fired generation will continue, driven by fuel price and availability. Don't expect natural gas prices to go up, however, even taking exports into consideration.*
- *Increases in project opportunities in the industrial power generation sector will occur.*
- *Long-term potential exists for increases in project spending for expansion and modernization of the hydroelectric fleet.*
- *Development of microgrid ("off grid") systems will increase.*

WATER AND WASTEWATER

EXPLOSIVE GROWTH IN THE U.S.

After a construction downturn in 2016-2017, the water/wastewater market experienced significant growth in 2018 at 12-13%, according to Thomas Decker, Thomas Decker Consulting. Compared to 2018, construction for water projects was up 20% by mid-2019 and up 13.4% in wastewater.

Decker predicted this boom will continue and said double-digit growth is possible for 2019. In fact, the market probably won't slow for a few years—it typically lags behind the overall U.S. economy by about 18 months, Decker said.

Pent-up demand was the reason for much of the growth, Decker said. Water/wastewater utilities have delayed projects needed to solve problems and increase capacity, but those can no longer be ignored. One of the reasons growth could happen is approval of more than \$40 billion in construction bonds for improvements to infrastructure. Growth will continue because projects funded by the bonds start with engineering, design and planning, which takes a year or two, followed by the stage where construction begins.

In the U.S., water and wastewater utilities spent \$113 billion in 2017—\$45-\$50 billion of which was for outside goods and services including capital and operating expenditures. Meanwhile, the estimated global spend for water and wastewater in 2017 was \$700 billion.

Decker pointed out the balance in the industry is changing. In the last eight or nine years, spending was higher for wastewater than for water. As of 2018, the reverse is true with 57% of spending going to water and 43% going for wastewater, Decker said.

BUILDING BOOM

Because of all the building, engineering and contracting companies in the industry and equipment sellers all saw solid positive growth in 2018, Decker said. Competition for the work is fierce, especially in engineering and construction.

CONTINUED ON PAGE 26

DEALING WITH CENTRALISM

Scott Nelson, partner at EY in Shanghai, and Andrea Yue, managing director at EY in New York, closed out the 2020 Market Outlook by addressing the hot-button issue of China and the trade wars.

Yue noted that China's current President Xi is a strong leader and that new regulations have been issued this last year that decree he could serve for an indefinite period. He is centralizing power and is focused on party and fundamental socialism.

Because of this, much emphasis is placed on state-owned enterprises, which are receiving preferential treatment, the speakers said. The government is also focusing on eliminating bribery and graft within the governing bodies. This has led to restructuring in which state and local authorities are merging into one. For example, the commerce department and finance department in some local cities may now be the same. While the resulting governing bodies will give investing companies local subsidies to attract business in their cities, they also are responsible for taxation and could impose fines for infractions.

INVESTING IN CHINA

Despite difficult times and trade tensions, the Chinese government is willing to give various incentives to companies doing business in China, the speakers said.

Because in the past private industry had a difficult time getting credit, the government is pushing hard to get small- and medium-sized banks to lend and finance smaller businesses. Another significant change occurring is that, in the past, a U.S. or other manufacturing company dealing in technology that came into China often had to transfer the knowledge of that technology to the Chinese. That's not as true anymore.

The Chinese population's emerging middle class, which is consuming more and demanding better and safer products, has resulted in an increase in environmental and safety laws.



That has created a more level playing field for multinationals against Chinese-owned companies.

Nelson warned, however, that anyone doing business in China must "make sure you know what's going on in your Chinese companies. You do not want problems with compliance. Always be in touch with your team there, and make sure you are reviewing things frequently."

THE TRADE WARS

As a result of increasingly strong rhetoric from President Trump, it has become difficult for the Chinese government to negotiate and accept U.S. terms. Sentiment and messaging in China have evolved to a more hardened position of "No deal is fine" [meaning the Chinese are much more willing these days to walk away from negotiations].

However, because of the imbalance in trade, China can't impose tariffs dollar-for-dollar with those the U.S. has issued. Because of this, China may retaliate with other actions.

According to Nelson, the most important of these actions for U.S. businesses could be to leave them out of the opportunity to benefit from reforms that increase access to foreign investors. This means U.S. companies would be at a disadvantage relative to competitors from Europe, Japan and other countries.

Also, anything coming into China from the U.S. is already facing

increased regulatory and investigative pressures (e.g., an increase in health & safety inspections, tax audits, license approvals, etc.) as well as an increase in customs inspections.

Retaliation may also come in the form of curbs on outbound tourism. Many Chinese people go to the U.S., but they could be barred from doing so, which would have an effect on U.S. hospitality and other tourist-based industries.

Yue offered some workarounds for American multinationals that want to do business in China, including restructuring the supply chain to buy more of the materials needed for manufacturing from Chinese companies. She also suggested that, for materials destined for importation into the U.S., manufacturers could use the First Sale concept, meaning that the first sale would go to another, free-trade country before coming to the U.S.

OUTLOOK

- *There are incentives for foreign investment, but it is NOT a level playing field with government-owned businesses.*
- *The sentiment from official China is hardening with respect to rhetoric and the trade war with the U.S.*
- *China's Ministry of Commerce announced last May it will introduce an unreliable entity list "in reaction to" practices distorting the market. The list has not yet been issued but is expected in the near term.*

Decker cited the five top-ranked issues selected by respondents to the American Water Works Association annual survey:

1. Renewal and replacement of aging infrastructure
2. Financing for capital improvements
3. Long-term supply availability
4. Public understanding of the value of water systems and services
5. Watershed/water source protection

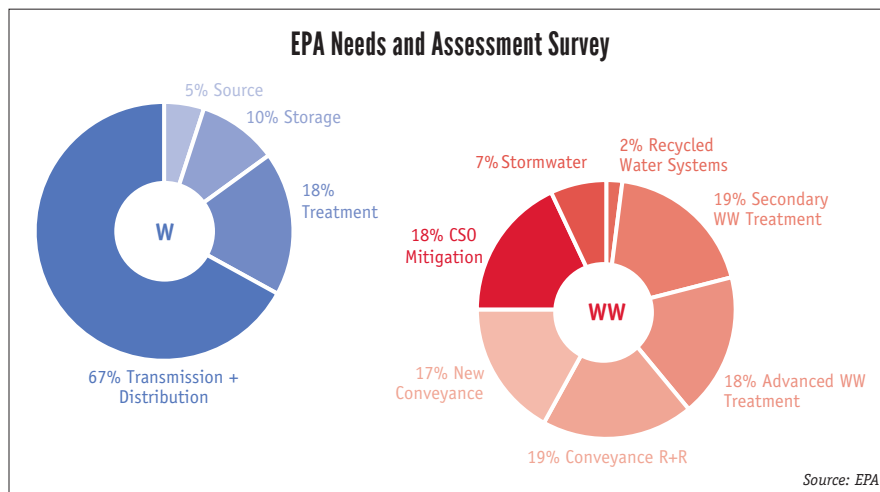
The Environmental Protection Agency (EPA) highlighted similar issues in its most recent infrastructure needs survey and assessment. In wastewater, for example, needs are split almost evenly among five areas: conveyance replacement and refurbishment (19%); secondary wastewater treatment (19%), advanced wastewater treatment (18%), combined sewer overflow mitigation (17%) and new conveyance (17%).

On the water side, the needs were greatest in transmission and distribution (67%); followed by treatment (18%) and storage (10%).

PAYING FOR IMPROVEMENTS

Financing is available for projects, Decker pointed out. Besides local funding, sources such as the Clean Water State Revolving Fund (\$1.7 billion) and the Drinking Water State Revolving Fund (\$1.2 billion) help to provide the needed money. Nine projects also have been funded under the Water Infrastructure Finance and Innovation Act—38 applications await decisions and 51 new letters of interest were filed in 2019.

On the local funding front, the municipal bond market was solid;



interest rates had stabilized; and construction and materials costs increased less than 3% for the first half of 2019.

TRENDS TO WATCH

Urban migration, which affects this industry, continues to increase in many areas of the country, which today include much more than major cities. Population increases in so-called second-tier cities, such as Fresno and Bakersfield, CA, have placed stresses on utilities. In other places, urban areas are shrinking. The population of St. Louis is down 11% while Cleveland has lost 19% of its residents. With lower populations, these cities have lower flow rates, resulting in water/wastewater problems such as corrosion, flow stagnation and microbial growth.

Meanwhile, desalination is showing its highest investment growth ever with capital expenditures at more than \$6 billion in 2019, Decker said. Currently, 20,000 desalination facilities are in operation worldwide, though only a few are in the U.S. One of the reasons for the increased focus in this area is that operating costs have fallen more than 50% in the last 30 years because of improved membrane technology.

In wastewater, reuse projects are receiving attention. More than a dozen states now have these projects. Arizona allows direct potable water reuse while Los Angeles and San Diego have committed billions of dollars for recycle/reuse projects and the Hampton Roads Sanitary District in Virginia has an initiative for no-discharge treatment. For that project, treated water, instead of being returned to surface water sources, is injected deep into the aquifer to replenish groundwater and reduce subsidence.

FORECAST

- Some contraction is possible in 2020-2021 because of the slowing U.S. economy, but the water/wastewater market should continue to grow.
- In the U.S., double-digit growth is possible for 2019.
- The five-year global compound annual growth rate (CAGR) in water/wastewater is forecast to be 4.7%; it is expected to be even higher in the U.S. VM

KATE KUNKEL is a freelance writer and former senior editor of VALVE Magazine. BARBARA DONOHUE is web editor of VALVE Magazine. Reach Donohue at bdonohue@vma.org.



READ MORE ON THE WEB

Coverage of the 2019 VMA Market Outlook Workshop continues online at www.valvemagazine.com with stories on the situation for mining and commercial construction. The mining industry is holding its own with revenue increasing by 8% from 2017 to 2018 and more growth expected going forward. The indicators for commercial construction are also positive though the industry is facing a major pressure: lack of workers.



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Managing Valves in EPCM Projects

BY KARAN SOTOODEH

Engineering, procurement, construction and management (EPCM) is a form of contract agreement between a client (end user) and a contractor. The EPCM contractor is responsible for implementing the various phases of a project, including design, procurement and construction, and providing overall project execution management. Because successful implementation of any project requires balancing cost, quality (scope) and time, successful EPCM means completing a project on time, on budget and with all project requirements met. That translates into a satisfied end user.

Piping systems in oil and gas projects, including the valves used, can take 20–25% of total engineering man-hours and construction work in the projects. Piping systems connect equipment and components all over plants. This article delves into the valve cycle in EPCM projects and addresses some of the challenges related to managing valves based on real industry experiences.

VALVE LIFECYCLES

For EPCM projects, the lifecycles of valves include:

Early Engineering

Valve lifecycles normally start during the early engineering phase of a project (the basic engineering or feed phase). The type of valves, as well as size, pressure class, material, end connections and other parameters, are selected through cooperation between process and valve engineers, who work with piping and instrument diagrams (P&IDs). Project documents that show valve selection, material selection

Executive Summary

SUBJECT: EPCMs carry their own set of challenges, including issues that must be faced by valve suppliers and makers.

KEY ISSUES:

- Valve lifecycles in EPCM
- What a P&ID shows
- Challenges at each phase of the project

TAKE-AWAY: A thorough knowledge of EPCM phases and constraints can go far in ensuring the end users are satisfied with the final results of the project.

and piping material specification (PMS) are used for P&ID development. Also identified on the P&ID are actuated valves and actuator types such as pneumatic, electrical and hydraulic.

Figure 1 illustrates a P&ID for a compressor station. A compressor (Tag number K-101) increases the gas pressure and reduces the volume to facilitate gas transportation in the pipe. A suction knock-out drum (Tag number V-101) on the upstream side of the compressor is a liquid-gas separator to remove liquid droplets from the gas. Liquid present in the compressor damages this equipment, and this scenario is one of the main reasons for compressor failure. Water can wash the lubricant and cause wearing of the compressor internals. The gas discharged from the compressor is hot. Thus, an after-air cooler (Tag number E-101) is used as a type of heat exchanger for cooling down the compressed gas. The P&ID shows different types of valves with a symbol like a "bow-tie" or "90-degree rotated bow tie." Two gate valves are connected to the top and bottom of the suction knock-out drum for venting and draining. The Figure 1 P&ID also shows more gate valves, a level control valve (LV 101) as well as a pressure safety or pressure relief valve (RV-101). The size and pressure class of the valves are parts of the line numbers (e.g. B14-RF1780-6-inch).

Detail Engineering

During the detail engineering phases, P&IDs are more mature and developed. At this phase, the list of valves named as first material take-off (MTO) are normally put into an excel sheet. An MTO should contain size, pressure class, material, end connections and other special valve requirements such as bore types (full or reduced) for ball valves. General valve requirements such as factory acceptance tests (FAT), packing, preservation, documentation, etc. are provided in project specifications. The MTO plus relevant valve specifications and datasheets are sent to potential valve suppliers or manufacturers for purposes of soliciting technical and commercial quotations. At this stage (the bid phase), a series of clarifications can be done through

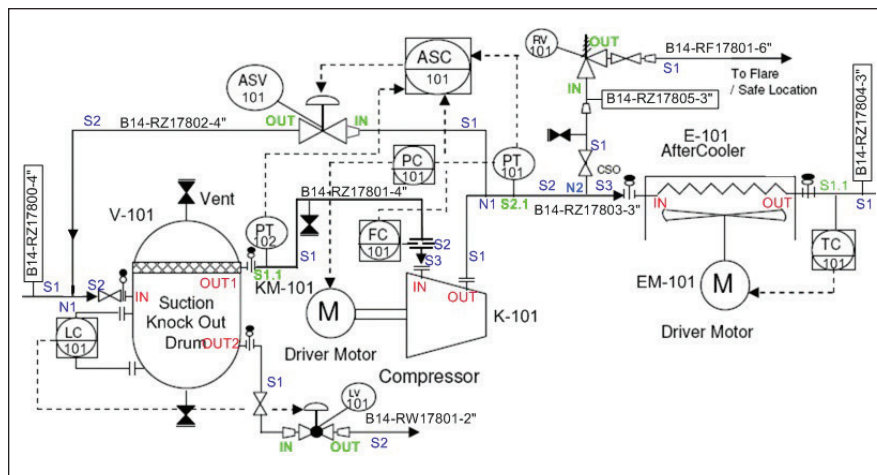


Figure 1. Sample P&ID of a compressor station

emails and meetings between valve suppliers and the valve technical engineer/procurement buyer. The bids are analyzed both technically and commercially and given scores, and valve manufacturers are ranked. The winning manufacturer or supplier for each bid is eventually selected for the kick-off meeting, and a purchase order is signed.

Procurement

A major milestone in the procurement phase is the purchase order. Valve suppliers or manufacturers deliver their products (valves) as well as relevant valve documents such as drawings, procedures, reports and more. Engineering for valve procurement includes tasks such as receiving and reviewing the vendor documents, vendor follow-up regarding documentation and follow-up during the manufacturing and during FAT. Valves are then

released to the construction yard. Some valve manufacturers' documents such as dimensional drawings for valves and actuators may be categorized as vital interface information. The dimensional drawings are modeled in a software program such as a plant design management system (PDMS), which is similar to a 3D AutoCAD. This design software is used to make 3D models for piping and valves, equipment and structures (Figure 2).

Construction

Some valve engineering support and activities occur during the construction phase.

Chart 1 illustrates the lifecycle of valves from the early phase of engineering until construction in an engineering, procurement, construction (EPC) project.

The valve engineer, in cooperation with the valve supplier, should

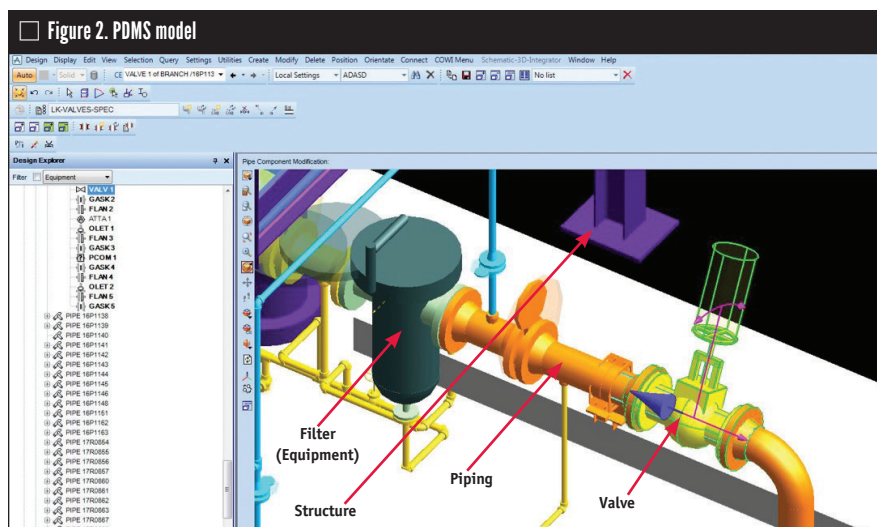
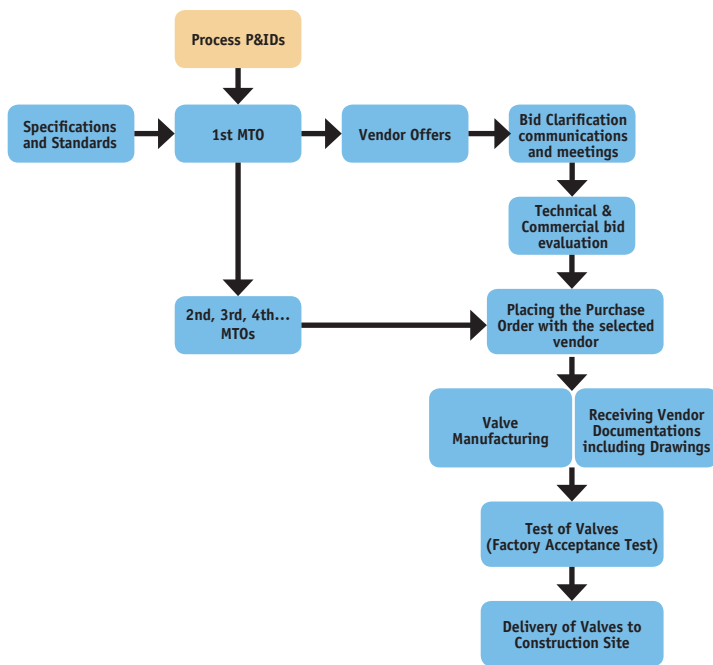


Figure 2. PDMS model



□ Chart 1. Valve's lifecycle in EPC projects

solve some issues related to valves during installation. For example, in Figure 3, a pneumatic-actuated wafer double-offset butterfly valve is installed in the wrong direction at the construction site. The small figure on the left and bottom side shows the direction of installation of the butterfly valve in a PDMS model. The butterfly valve and its actuator are shown in pink. The flow direction in the PDMS model is parallel to the actuator on the same side, which is incorrect. The real flow direction is on the opposite side of what the model shows. Although double-offset butterfly valves are bi-directional and tested from both sides, they have a preferred flow direction. In this case, the butterfly valve was installed wrong in the yard. The best solution would be to remove the valve and actuator from the line and rotate the valve and actuator 180 degrees, then install them in the preferred flow direction recommended by the valve supplier. If no space exists for the actuator to be rotated 180 degrees (because of clashing with a structure, for example), the solution would be to disassemble the valve from the actuator and rotate the valve 180 degrees. This should be done by the valve supplier so it triggers after technical services (ATS) charges as well as technical support

from the valve supplier in coordination with the valve engineer.

CHALLENGES

Challenges are attached to each of the various phases of the EPCM. Some of them include:

Early Vendor Selection

The end user generally selects vendors from the approved vendor list, which could be limited to two or three valve suppliers or manufacturers. In fast-track projects, valve vendors may need to be selected during the early engi-

neering stage.

Early selection of valve manufacturers during the basic or feed phase of engineering design can provide advantages such as reducing the workload associated with vendor selection that would occur in the detail engineering phase as well as presenting the possibility of using vendor documents such as dimensional drawings earlier in the process. The challenge here is that, during the vendor bid evaluation at the early engineering phase, the scope of work in terms of valve quantities and qualities is not completely clear. This is true especially for smaller valves because of the immaturity of the engineering design at the earlier phase of bid evaluation. Sometimes, a so-called "false material take-off" that covers all possible sizes, pressure classes, materials and design of the valves within the project can be prepared and sent for seeking quotations from vendors. In some cases, an analysis may be required to see different possible scope-of-work scenarios for valves including commercial and technical impacts. For example, suppose that 200 butterfly valves in one project are made of 25 chromium (Cr) super duplex or titanium in size ranges between 4–20 inches: 80% of the scope is titanium and 20% is super duplex during the bidding. However, the percentage of the valve materials can be changed to 50% titanium and 50% super duplex in the future. Vendor X proposes a very cheap price for the

□ Figure 3. Actuated butterfly valve installation problem



titanium-made valves so it can win the bid commercially on the condition that most of the valves are made of titanium. However, Vendor Y might give the cheapest offer based on the condition that half of the valves will be made of titanium in the future.

New and Multiple Manufacturers

In rare cases, valves may be purchased from vendors out of the frame agreement or the approved vendor list because the clients want fast delivery times at reduced costs. These strategies incur several risks because of factors such as unfamiliarity by the valve manufacturer as far as project specifications and client requirements. If two vendors have been selected for supplying specific valves of the same size and pressure class, dealing with two different sets of drawings and other documents is challenging. For example, suppose there are 10 manual, full-bore ball valves in a project in a 10-inch size with a pressure class of 1500 and 22 Cr duplex material. Eight of these valves were ordered initially from Vendor X inside the frame agreement in the first MTO and purchase orders. Two more are added to the project scope very late in the project because of the process engineer's requirements. Vendor X cannot deliver the valves on a fast track so Vendor Y is approached by the project procurement team. This is not inside the client frame agreement but enables fast valve delivery with reasonable cost and acceptable technical terms. That means there will be two different sets of drawings and other documents related to the same valves in the project. The weight and dimensions of the two valves are different from the other eight valves, which affects the layout and stress analysis of the piping system. Similar manual bulk valves ordered from different manufacturers should be coded separately to trace their impacts on weight and space.

Early Purchase Order Placement

Process, piping, valve and instrument engineers are working constantly on P&IDs to reflect possible changes such as size, pressure class, material, valve safety function, etc. In fact, maturity of P&IDs at early project stages such

as basic engineering or feed phases is low. Therefore, the earlier placing of purchase orders leads to more possibilities of order changes in the future. Thus, the challenge is to order the valves as soon as possible in consideration of the fact the scope of work will see the least change in the future. Early placement of purchase orders also speeds up the procurement process and assures receipt of vital vendor data for engineering. Meanwhile, changes or cancellation of the valves in a purchase order could cause high fees and cancellation costs.

Handling Several Valve Suppliers

Ordering valves in large projects is normally a divided task with several work packages created based on valve types and often sizes. Valve vendors in different parts of the world might be selected to design, procure the valve parts, manufacture and assemble, test, pack, and ship the valves. Multiple valve manufacturers or suppliers as well as sub-suppliers for forging or casting, machining, coating, etc. from different locations adds complexity to the project. Another consideration is actuator

manufacturers. The actuator suppliers will make and supply the actuators to the valve manufacturers to complete assembly and test. Lack of communication and coordination between the valves and related actuation suppliers can delay the valve procurement process. Valve packages such as manual valves (including check valves) are categorized as simple packages because they don't need actuation.

No matter the challenges, the important factor to remember is that knowing how EPCM works and what may happen provides a means to ensure a project will run the way it's supposed to run and end users will be happy. **VM**

*This article only had room for a few of the challenges in EPCM projects. Sotoodeh also addresses selecting actuator suppliers, special valve considerations, multiple locations, political considerations and more in a special online article entitled *Managing Valves in EPCM Projects: More Challenges*. Go to www.vma.org.*

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□ Steam leaks from an industrial valve in a heat pipeline.

Cycle Isolation: Monitoring for Better Usage

BY GREG C. ALDER

One of the largest controllable losses in power plants is leakage-based energy loss. These losses, which have been documented at more than 400 British thermal units per kilowatt hours (Btu/kWh) in some cases, are often overlooked because of the difficulty of spotting them in systems that have hundreds of potentially leaking valves.

For plants using combined cycles, the losses can be even greater since the overall cycle efficiency is based on excess energy used via a steam turbine cycle to generate electricity—energy that can be lost through leaks. The energy losses from these undetected leaks also damage the affected valves continuously, which increases the leakage and the losses in generation, and often the overall heat rate in the valve system. All those factors potentially lead to early failure or even forced outage for maintenance and replacement.

CYCLE ISOLATION AND ITS BENEFITS

Cycle isolation is the process of recapturing lost power by monitoring valve system flows for potential leakages through downstream temperature information. It is used in all types of power plants.

Executive Summary

SUBJECT: Leakage is a major cause of energy and efficiency loss in power plants. One tool for minimizing that loss is cycle isolation monitoring.

KEY ISSUES:

- How cycle isolation works
- Why it improves power systems
- How it can also help with repair and maintenance

TAKE-AWAY: This simple process of data collection can improve the health of the entire system.

These temperatures can be collected manually from plant walk-downs or from real-time data when available. The data collected is then used to generate leakage data and alerts. By monitoring the flows within a cycle (called internal isolation) and accounting for all flows entering and leaving a cycle (called external isolation), cycle isolation technology assures that all steam and water flows are going to their proper destinations, maximizing efficiency and minimizing energy losses from leaks.

By understanding and evaluating a valve system's performance data, users can balance energy production losses against unplanned outages. They also can determine the maintenance schedule most advantageous for a particular plant.

Establishing or modernizing a cycle isolation valve monitoring program reduces the time between when a leak begins and when it is found and resolved, which helps to eliminate major losses to plant efficiency. This potentially results in decreased heat rate, increased power generation, decreased fuel usage, decreased water production costs, elimination of potential valve damage and decreased maintenance costs.

Cycle isolation studies indicate a typical savings in a power plant of 1 MW per unit (which saves about \$250,000 per year at \$29 per MW an hour—\$29 to \$32 is representative of current domestic rates) and a 1.3% power generation increase as a result of cycle isolation improvements, proving both the devastating potential losses from leaks and the overall effectiveness of cycle isolation.

WHY VALVES LEAK

Aging plants, deteriorating valve performance and increased demand for electric power are all potential causes of efficiency and power generation losses in plant systems. Beyond these general circumstances are several more specific reasons for valve leakages, including high temperatures and differential pressure, severe service, and cycling of the valves open and closed, especially in cycling units. But these aren't the only reasons leaks occur; leakage also can result from main-

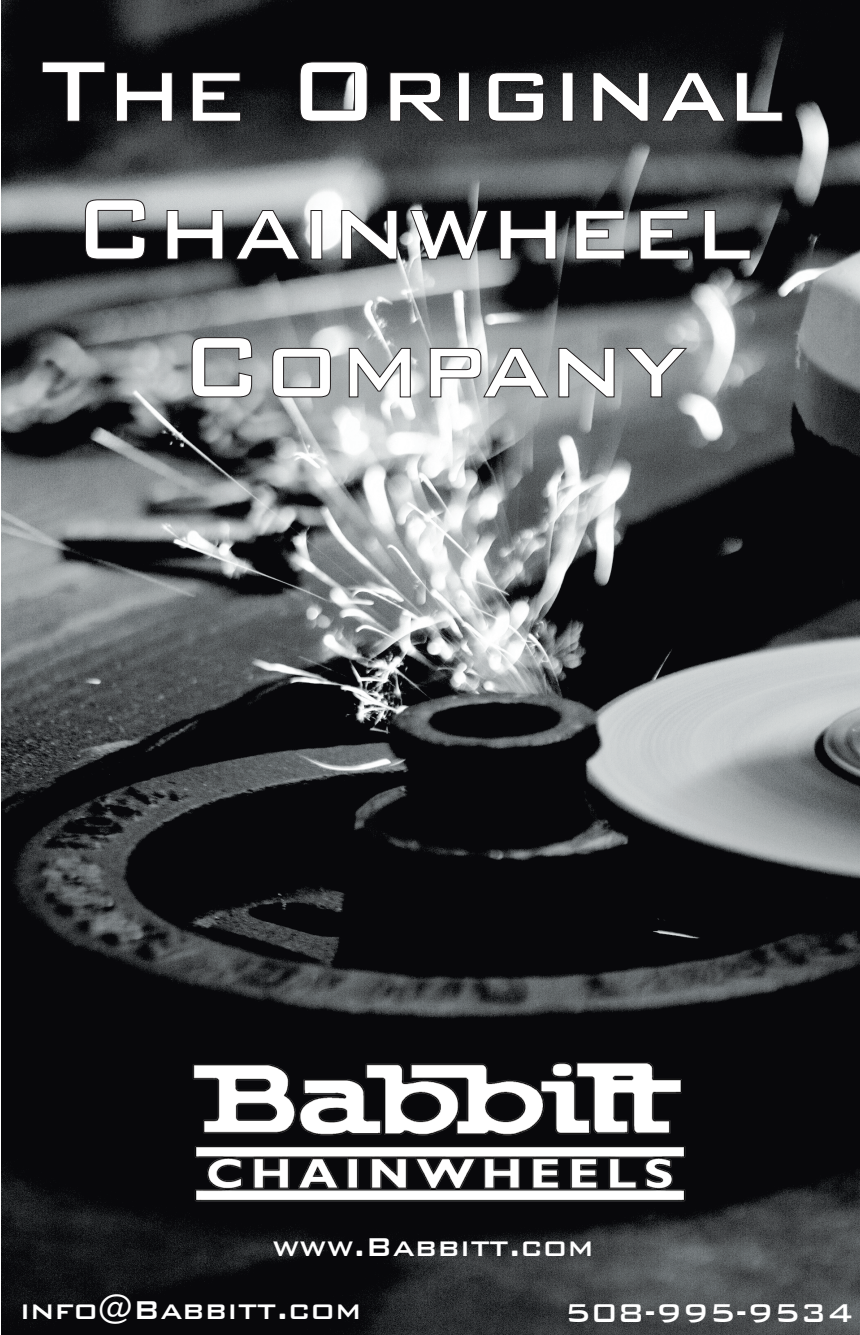
tenance on a system, foreign material in the valve, tank level control problems, air-operated valve setting issues, motor-operated valve thermal expansion, relief valve drifting, steam cutting of valves and improper valve alignment. All of these factors have documented impacts on the health of a system and its total leakage.

Though leakage can occur anywhere in a system, common loss areas highlighted by cycle isolation are places such as start-up drains, feed-water heater vents and drains, turbine bypass systems, soot-blower thermal drains, relief valves, pegging steam

valves, feed pump recirculation valves, steam seal systems, steam drain line orifices and steam traps.

HOW CYCLE ISOLATION WORKS

Cycle isolation works by gathering, monitoring and then calculating a system's flow and its changes to identify leaks and power losses in a plant's systems. First, site personnel identify a list of potential areas and valves at high risk for leakage through plant piping and instrumentation diagrams, isometrics, heat balance diagrams, and plant walk-downs. Though all valves in a system may not be able



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□ Safety valves at a gas plant help to control pressure.

to be monitored, establishing a list of high energy or frequently repaired valves will give a picture of the most optimal placements for cycle isolation monitoring. Also, ranking valves and prioritizing potentially leaking valves makes the process of cycle isolation more efficient. For example, large and vital valves are expensive to repair, so to maximize efficiency, their needs should be considered first. Consulting with plant operators and maintenance personnel helps to identify areas of frequent issue or repair, which identifies areas that will be ideal for monitoring.

Once this information is compiled, an ideal walk-down order for the most efficient data collection is determined, and a frequency for walk-down measurements to monitor valve changes over time is decided. Many plants even place numbers at the measurement locations to correspond with walk-down collection forms.

Plant operators often are involved with developing cycle isolation walk-downs and walk-down procedures, which benefits the process by increasing those operators' awareness of the importance of monitoring potentially leaking valves and efficiency losses for their plants. These walk-downs and procedures are designed to reinforce understanding of the measurement equipment and the locations monitored by cycle isolation for those performing the measurements.

Measurement monitoring equipment locations are then set up in

the most ideal locations in the valve system. A variety of sensors, including infrared, contact pyrometer, thermocouple and resistance temperature detector (RTD) measurement devices, have all been used in fossil fuel, combined cycle and pressurized water-reactor nuclear plants. Though the options are more limited because of radioactive environments, even boiling water-reactor nuclear plants can use cycle isolation monitoring through thermocouples or RTD devices to collect cycle isolation data.

In some cases, thermography readings can be used. Because temperature data can be affected by many factors—including other plant equipment, pipe diameter changes, headers, measuring too close to a condenser and other issues, such as plant geometry that doesn't allow measuring at optimum locations—the most important factor is the consistency of the measurement locations.

After an isolation list, walk-down order and measurement equipment are established, plant personnel can begin to use the data collected for optimizing isolation losses. The temperature data, which is either manually or digitally recorded, includes dates, valve information and valve temperatures. It is used to monitor changes. This data also allows for better scheduling of maintenance; however, because repairs can often cause a change in the system, it is critical to maintain documentation of each valve repair. After a valve is repaired, cycle isola-

tion should be used to measure the temperatures to make sure the valve is fully repaired, then monitoring is continued to make sure the leakage does not return.

Based on the user's preferred calculation methods, this data is then used to calculate the leakage flow and losses by inferring pressure inside pipes from downstream temperature measurement. To do so, valve upstream thermodynamic properties (upstream energy of the fluid), piping configuration (valve size, pipe diameter, length, geometry) and sink conditions (the recipients of the leakage, typically the condenser hot-well) are used to calculate flow and the value of leaking fluid (high-energy, high-value). Then, the flow-to-heat rate is converted, or generation loss and cost is figured. These calculations are vital for maintenance scheduling, especially in predictive maintenance. Beyond indicating what systems currently require maintenance, the calculations can show if a system can continue operating until the next scheduled outage or if immediate action should be taken for a potential leak.

CONCLUSION

Leakage reduces plant efficiency and power generation on a regular basis; however, cycle isolation technology can identify and gauge leaks and their level of severity to prevent and remedy the damage as well as energy loss from the leakage. Because valves can be expensive to repair or replace, estimating the impact leakage has on the cycle's performance helps to justify maintenance of valves; provides estimations for heat rate and generation improvements; and provides justification for valve repair and replacement. By establishing a simple process of data collection and calculation, cycle isolation can help users diagnose current issues, plan future outages and maintenance, and get a better grasp on the overall health of a system, which saves time, money and many megawatts.

GREG C. ALDER is the plant optimization manager for Curtiss-Wright's Nuclear Division (www.cw-connect.com). He is also a Technical Fellow for Curtiss-Wright Corporation. Reach Greg at galdere@curtisswright.com.



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Valve Standards: Yesterday, Today and Tomorrow

BY GREG JOHNSON

Valve standards are both the laws of the land and the roadmaps to be followed on the road to quality, especially for the oil and gas industry. But where do these standards come from, and why do they say what they say? What's more, what will they look like in 10-20 years?

One point about standards that is universally accepted is this: Today's versions are much more comprehensive than the originals were.

Going back to "the great generation of origination" for many valve standards (1920-1940), it is easy to see why standards were created in the first place. The oldest valve standards development organization is the Manufacturers Standardization Society (MSS). MSS was created for one primary reason: To develop valve and fitting standards that would allow the interchangeability of valves and fittings in piping systems. Up to this point each manufacturer created valves to whatever dimensions were convenient. The advantage of this situation was that it tied a valve and fitting user to a particular manufacturer's product. However, this was not a good thing for the valve buyer, and even the various manufacturers soon saw this as a problem as well.

THE QUEST FOR INTERCHANGEABILITY

Initially, the most-glaring need for standardization was for flanges so that all valves and fittings would be interchangeable. Before developing common flange standards, valves were offered with blank flanges, and the purchaser specified the bolt-hole drilling. Another issue was that end-to-end dimensions of valves varied.

The need for interchangeability was the primary focus of valve standards through the second world war. In fact, valve standards were generally left in the status quo position throughout that conflict. Many new piping and valve design developments were unleashed after 1945, however. New valve designs, new materials and new



□ Today's valve standards include many component dimensional requirements.

service conditions required greatly revised valve standards as well as the creation of new documents to meet all the requirements. At this time, valve standards creation was based upon near-universal agreement and acceptance by committee members (manufacturers and end users). This bilateral cooperation would last for another three decades or so.

Throughout this period, the one

constant was that both the location of manufacturing facilities and ultimate installation locations for the bulk of valves was in the United States. A door to offshore manufacturing was opening, but the crack was not yet big enough for beefy foreign players to enter.

IMPORTS AFFECT STANDARDS

During the late 1970s, the American valve market door was intentionally opened wider, and wholesale valve importation into the United States began. This brought some excellent manufacturers into the country, but also a large number of second-rate imposters. Valves from some of the imposters (low-quality manufacturers), began to fail at an alarming rate. In some cases, the valves met the letter of the current valve standards but did not meet the common-sense intent of the standards as they were initially developed decades before. This situation required aggressive revision of some valve standards as well as new standards to alleviate the problems that were occurring.

A disappointing side-effect to this

□ This old valve from Crane shows what blank flanges looked like.





□ API 6D pipeline valves are addressed in one of the new IOGP standards addendums.

situation was that it fostered a feeling of distrust between the valve-user community and some domestic manufacturers that chose to quickly outsource manufacturing to low-cost countries without performing the proper due diligence. The situation would drive valve standards to become much more detailed and stricter in many regards to police the imports.

This new reality of valve manufacturing and quality would become the overriding reason for new valve standards and revisions that came over the next 20 years. Gone forever was the deal of the handshake, trust of the spoken word, and confidence in decades of previous product development and quality manufacturing.

ISO VS. USA

While all this was going on in U.S. standards development meetings, groups such as the International Organization for Standardization (ISO) were creating competing valve standards for the European market. Although ISO meetings are open to participation from all countries, U.S. manufacturers and U.S. end users chose not to participate to any large extent. One important note is that, while multiple companies and end users can participate in U.S. standards development organizations (SDOs), in ISO, each country only gets one vote, so multiple companies usually do not attend the meetings.

Attempts were made by the Amer-

ican Petroleum Institute (API) during the late 1990s to work with ISO to jointly develop cobranded valve standards. This did not last long because the standards development and update processes of the two organizations were very different at that time. Another factor that virtually stopped such cooperation was a directive from the U.S. government that this country's companies could not participate in organizations where American intellectual property could potentially be shared with countries that were "enemies" of the U.S., such as Iran, which is an active member of ISO.

PET PEEVES AND NEWER TYPES

New valve standards and revisions of older standards should address specific subjects or issues and help solve industry problems. However, sometimes the personality of the SDO representative or the representative's company has resulted in an addition to a standard that was too specific and focused on a relatively obscure "pet peeve." Once published, it is usually difficult to get pet-peeve paragraphs out of a standard.

The newest type of valve standard to hit the valve industry landscape is the multiple end-user-created addendum. In the oil and gas industry, the current source for these types of documents is the International Asso-

ciation of Oil & Gas Producers (IOGP), a consortium of multinational oil companies. Under the guise of trying to lower the cost for commodity items (valve types most frequently purchased), IOGP has thus far issued documents to be attached to the requirements of API 6D and API 600 valves. IOGP standards are hefty documents that often contain more pages than the standards they are modifying. The creators of these documents are also closely aligned with ISO, and valve manufacturers are not allowed to be members of IOGP.

The development of valve standards takes a lot of time, time which comes from the schedules of the volunteer committee members. Although the U.S. is still the leader in the creation of valve standards, unless domestic SDOs do a better job of marketing their standards to a worldwide audience, the future of valve standards could be one that is led by ISO and IOGP-type documents: documents that are created with far less valve manufacturer participation. **VM**

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□ Valve standards assure interchangeability of valves and piping components.



Q- 3D printing and additive manufacturing have become buzz words in various industries, but what do they mean in the context of valves, and what materials are involved?

A: “Additive manufacturing” and “3D printing” have become a phenomenon in the engineering and manufacturing communities. The terminology may refer to one of a vast number of different manufacturing methods and machines, however. This can lead to confusion because some people picture small plastic models while others imagine metal lattice structures and still others visualize complex jet engine parts in exotic materials.

In general, additive manufacturing refers to the concept of building a part—be it a valve component, jet engine nozzle or desk toy—in small increments until a near-net shape component is produced. It would take too much space to cover all additive manufacturing processes or go into much detail on any one in this column, but the table below summarizes the most common processes, the types of materials they typically use, what those processes are currently being used to produce, and how they might be used in the future—all within the context of the valve industry.

The most well-known advantage of additive manufacturing is the ability to produce complex geometries that would be difficult or impossible to produce with traditional manufacturing techniques. Machining a tortuous path into a severe-service cage limits the possible geometries; using small cores in a casting process is time-consuming, expensive and may lead to quality issues. Welding, brazing or assembling



□ A model with supports created in a laser sintering machine stays in the working chamber.

multiple components to make a single cage may be cost-prohibitive or unreliable.

When discussing metal parts, laser-powder bed fusion (L-PBF) is the process that stands out. Because parts start as powdered metal and are then fused by a laser, leaving a path for process fluid to flow through a cage requires that the laser be programmed to skip over the areas that won't be solid metal in the finished part. When

the machine finishes a build, the loose powder can be removed, and no machining is necessary to create a complex internal flow passage.

A major limitation of L-PBF is the equipment required. Current machines have fully sealed chambers that are purged with inert gas to prevent the powder from reacting with air as it is printed. The size of the chamber limits the size of the part that can be produced, and the technology to use larger chamber sizes effectively is under development. Directed energy deposition (DED) machines can bypass this limitation. While some do have sealed chambers, others blow inert gas only on the area at which the energy source is directed. Essentially, this is the same as using shielding gas in a welding operation. Because only a small area is shielded at a time, the limit on part size is the range of motion of the arm holding the material feed and energy source. Complex geometries can be produced this way,

Process	Typical Materials	Potential Applications
Laser powder bed fusion (L-PBF)	Weldable metals	Small precise parts
Directed energy deposition (DED)	Weldable metals	Overlays, large parts, reconditioning metallic parts
Binder jet	Sand, ceramics, non-weldable metals	Sand casting molds, non-metallic parts
Fused deposition molding (FDM)	Thermoplastics	Rapid prototypes, manufacturing aids, sealing components
Stereolithography apparatus (SLA)	Photopolymers	Rapid prototypes, sealing components, diaphragms

but the resolution of DED machines is much lower than L-PBF.

Binder jet printing is a process similar to L-PBF except that in place of a laser-melting metal, a nozzle sprays an adhesive binder to fuse powder particles together. When printing is completed, the loose powder is removed, leaving a 3D object. Currently, the most common application of this technology is in the production of sand molds for metal casting. Traditional sand molds are made by forming sand around a pattern, which means a pattern must be produced before a part can be cast.

Binder jet printing bypasses the need for a pattern, reducing the time required to produce a casting. This is especially useful for parts with low production volumes such as specially engineered valves or replacement parts for legacy products. In addition, since castings poured into printed sand molds are tested and certified the same way as those made with traditional molds, there are fewer barriers to the adoption of this technology than other additive manufacturing processes. Sand is not the only material that can be printed with binder jet technology. Ceramics and metals that cannot be welded can be formed into complex geometries as well. After printing, the parts are sintered and the binder is removed to produce a solid object. Typically, parts produced this way contain porosity, unlike with L-PBF and DED, which can produce parts with very low porosity. However, binder jet printing allows materials to be produced in shapes not possible with traditional manufacturing techniques.

Additive manufacturing of polymers has become commonplace with a variety of printers manufactured and sold for anything from home to industrial use. For valve manufacturers, the two primary technologies, fused deposition molding (FDM) and stereolithography apparatus (SLA), have not made their way to producing finished parts, but are used extensively to rapidly create prototypes and fixtures, jigs or other manufacturing aids. One of the largest hurdles for these processes to clear before they can be used in finished parts is the limited selection of materials. When materials suitable for components such as gaskets, diaphragms or other seals can be printed, innovative designs for sealing components made possible by additive manufacturing will emerge.

3D printing has already begun to transform the valve manufacturing industry, but standardization of these new manufacturing processes is lagging in implementation. Currently, it remains largely up to individual valve manufacturers and end users to ensure the quality and suitability of additively manufactured parts. However, some ASTM standards have been written that address additively manufactured 316L stainless steel and titanium: ASTM F3184 and ASTM F3302, respectively. Within ASME, there is a Board on Pressure Technology Codes Standards Special Technical Committee on the use of additive manufacturing for pressure retaining equipment. **VM**

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Implementing the Fourth Industrial Revolution

BY BARBARA DONOHUE

Many names have been given to the current state of technology in manufacturing including the Industrial Internet of Things (IIoT), the Fourth Industrial Revolution (4IR) and Industry 4.0. No matter the name, what's happening is garnering many headlines today.¹ The general goal of the new methodologies is to use sensors, data, artificial intelligence and other current tools to increase manufacturing productivity and profitability.

To track where this new industrial revolution stands, PwC (www.pwc.com) joined forces with The Manufacturing Institute (www.themanufacturinginstitute.org), the research arm of the National Association of Manufacturers (www.nam.org) in surveying 100 U.S.-based manufacturers on how they were navigating these new waters. Juliane Stephan, director of PwC Digital Operations, presented the results in a recent Industry Week webinar.²

Most of the manufacturers surveyed regard Industry 4.0 with measured optimism, Stephan said. Many are also already at some stage of making systemic changes using the new technologies.

"Companies are making progress," she said, "but scaling and linking investment to value remain a work in progress."

WHERE IS 4.0 NOW?

Around 40% of the businesses surveyed had not started to implement Industry 4.0 initiatives, Stephan said. Almost 20% said they are in the "awareness" stage, where they've heard of the technologies, but that's all. Another 20% are in an "immobile" state—they know of the technologies but haven't taken action. Stephan pointed out that the huge amount of information out there can result in decision paralysis on the part of some companies, which creates this immobility. Companies in this state want to start but aren't sure how.

A smaller number of companies



(14%) said they'd started experimenting and learning hands-on about Industry 4.0 transformation. The first projects of some of those companies demonstrate proof-of-concept, which can lead to working out how to adapt or change operations and processes to get the most out of the new technology.

Meanwhile, about half of the companies surveyed are in some stage of actively adopting and scaling Industry 4.0 solutions, moving beyond simple proof-of-concept. Stephan said these companies are thinking, "How do we take this beyond one successful line or one successful plant to the whole company?"

TECHNOLOGIES BEING DEPLOYED

The survey asked respondents which technologies they've invested in or deployed in the preceding three years. Table 1 shows the results.

IoT appears to be focused on collecting real-time data from the shop floor. That means connecting to machines, labor and materials, then creating the ability to determine the flow of product, bottlenecks and other realities without having to go into a plant.

AA makes use of the data collected from IoT and conventional

sensors. Such analysis can be useful in optimizing factory scheduling of machines and parts given current inventory levels and capacity. Analytics also can optimize setup time, minimize waste in the system and offer customers a high service level.

AI is closely related to AA, Stephan explained. The two "go hand in hand. Usually, you can't do AI until you understand AA." An AI solution, for example, might have a machine make an adjustment determined by the analytics from sensor data instead of having a human make that

Table 1. New applications/use cases in the last three years.

Technology	Operations
Applied Robotics	65%
3D Printing	37%
Advanced Analytics (AA)	35%
Internet of Things (IoT)	31%
Augmented Reality (AR)	28%
Virtual Reality	19%
Artificial Intelligence (AI)	18%
Blockchain	13%

Source: 2019 PwC/The Manufacturing Institute Smart Factory Survey

adjustment, Stephan said.

3D printing is another important enabler for Industry 4.0. Companies have been using it for rapid prototyping for some time. Now, it can substitute certain parts in the manufacturing process. Still, Stephan warned that companies "need to be deliberate about which parts." In the supply chain, 3D-printed spare parts made on-demand and onsite can prevent downtime caused by long lead times for certain equipment, she said. The 3D-printed part could either bridge the time until a spare can get there, or, for some parts made of certain materials, do the job itself.

Surprisingly, Stephan said, AR showed up as one of the technologies deployed in the last three years in 28% of the companies surveyed. AR projects images or other visual representations or data upon live images or visual representations. It is being used effectively to guide operators and maintenance staff in conducting best practices for running and repairing or maintaining equipment.

GROWTH AND RESILIENCY

Industry 4.0 transformations from small pilot projects to larger projects bring many opportunities and challenges, including the need to provide a return on investment.

Stephan offered summaries of goals and challenges for these transformations:

Long-term goals for implementing 4IR technologies

- Improved operations across traditional manufacturing dimensions (productivity, quality, reliability, responsiveness)
- Greater and real-time visibility into performance status and operating risks, including the ability to identify risks before they have an impact on safety or production
- Competitive advantages from differentiated and connected products and services, such as enhancing products with IoT capability to allow remote maintenance monitoring
- Faster and more proactive customer service, including better

and quicker anticipation of customer needs, the ability to recommend additional products or services, and other features consumers are accustomed to because of their experiences with Amazon

Challenges of complex transformation

- Increased investment/cost, especially in older or outdated plants
- Lack of expertise/knowledge/skillsets within an organization
- Uncertain/ambiguous results: it's not easy to quantify or calculate return on investment.

DEPLOYMENT OF SMART SENSORS

Industry 4.0 innovations using smart sensors are widely accepted as necessary tools going forward; however, companies are implementing them in different ways in different time frames.

For example, 80% of manufacturers plan to deploy sensors to enhance manufacturing/operations processes within the next three years. The survey revealed the following implementation time frames (Table 2):

Table 2. Companies' timelines for collecting and using data generated by smart sensors.

Already implemented	38%
Plan to implement within a year	28%
Plan to implement within 3 years	19%
Plan to implement but do not have a timeline	10%
Do not plan to implement	9%

Source: 2019 PwC/The Manufacturing Institute Smart Factory Survey

As this table shows, 38% of the companies surveyed already have implemented smart sensors in at least some applications. An additional 47% plan to deploy smart sensors in the next three years. About 20% of the companies do not plan to implement smart sensors or do not have a timeline for deployment.

It can be costly to retrofit equipment with sensors, and sometimes the payoff is not clear. A sensor by itself does not provide value, Stephan said. To find cost-effective applications, manufacturers have to ask where it makes sense in the operation to

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Table 3. The most significant impact of robotics technology on companies in the two previous years.

Replaced human tasks with automation to increase productivity	40%
Replaced old automation technology with new technology	26%
Reduced employee safety risk via newly automated tasks	15%
Augmented human workforce with robotics	20%

Source: 2019 PwC/The Manufacturing Institute Smart Factory Survey

deploy smart sensors and where they will provide the most value. Typically, early deployments target pain points such as process steps that cause bottlenecks.

ROBOTS FINDING THEIR NICHE

Often, robots are seen as symbolic of new manufacturing technology. Companies that have deployed robotics in some way find significant benefits in different aspects of manufacturing (Table 3). Increased productivity is to be expected, but another significant benefit is that automating dangerous tasks can improve worker safety.

WORKFORCE OF THE FUTURE

While robots have been criticized almost from the time they were invented as a potential source of fewer jobs, the surveyed companies revealed that investing in robotics often has the opposite experience. Table 4 shows that 19% of the companies expected robots to replace some workers in the next three to five years, while 82% expected implemen-

Table 4. The most significant impact of robots on the U.S. manufacturing workforce expected in the next 3-5 years

More demand for talent to manage the robotic workplace	42%
New job opportunities to engineer advanced robots and robotic operating systems	26%
Replacement of workers	19%
Creation of more jobs as a result of increased manufacturing	14%

Source: 2019 PwC/The Manufacturing Institute Smart Factory Survey

Table 5. How companies are raising the level of employees' advanced manufacturing skills.

Train existing employees in-house to adopt advanced manufacturing technologies	31%
Identify talented STEM students at local academic institutions and try to recruit them	26%
Provide training outside the company (e.g., community college, online, technology vendors)	22%
Hire new employees from outside the manufacturing sector	20%
Hire from other manufacturing companies	10%

Source: 2019 PwC/The Manufacturing Institute Smart Factory Survey

tation of robot technology to increase their need for workers during that time. In many cases, the new jobs require stronger technical knowledge and skills. Because of this, a challenge going forward will be to have the right workforce talent to use the robotics effectively, Stephan said.

Companies seeking to bolster their workforce with advanced manufacturing skills take a number of different approaches (Table 5). Familiar methods include in-house and external training. In addition, some companies (26%) identify engineering and other STEM [science, technology, engineering, mathematics] students early in those students' academic careers then bring them into the plant. In such a case, a company benefits from the students' newly acquired expertise and introduces them to the company in hopes they will come to work full time after graduation.

A source for mature expertise is to hire from other types of businesses that have already been through the

Resources:

- 1) www.cnn.com/2019/01/16/fourth-industrial-revolution-explained-davos-2019.html
- 2) <https://www.industryweek.com/webinars/webinar-4ir-buzzword-reality-smart-factory-adoption-rates-best-practices-and-leading>

growing pains of adopting new technologies—20% of the surveyed companies took this approach.

BUILDING OUT AN INDUSTRY 4.0 PLAN

Stephan offered four strategies to help manufacturers scale their Industry 4.0 efforts and tie them to the bottom line:

- *Start with the outcomes that matter to the business—in the present and looking toward the future.* Which problems need solving? What are the worst pain points in an operation? Then, think about the best technologies and partners to get the right solution.
- *Think in the context of both growth and contraction scenarios.* Some technology improvements will work for both scenarios: They can increase production within a plant's existing footprint instead of requiring expansion to grow.
- *Look outside the organization to scale beyond the pilot phase.* It's hard to keep up with the technology, so look at ecosystem partners, such as academia, the National Association of Manufacturers and technology partners.
- *Prepare the workforce for Industry 4.0.* Many workers regard new direction as a threat to their livelihood. However, it can mean less risk and a better work life. Be clear in messaging about what the company is trying to achieve. Include the plant staff in those messages and remember they are the ones who will make it happen.

As Stephan said, "We see companies being most effective with their transformation projects when they think first of the outcomes they want to create. That means they usually have a much more focused and successful initiative, not only to succeed in the market today but also 5, 10, 15 years from now." VM

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For more information on joining the Valve Repair Council, contact Marc Pasternak at 202.331.0104 (mpasternak@vma.org).

Valtorc International presents its first-ever 316 stainless-steel, 3-way butterfly valve assembly. Fabricated in the company's U.S. facility, the 3-way automated butterfly valve is available with pneumatic or electric actuation.

Features include high-performance T-Link-age assembly and all-316 body materials.



Emerson introduced two new Rosemount 628 Universal Gas Sensors to measure carbon monoxide and oxygen depletion in addition to the existing capability to monitor hydrogen sulfide. The monitor watches for hazardous conditions in process plants,

remote wellheads, pipelines, storage terminals and other process plants and facilities, with easy deployment via a WirelessHART network for areas too impractical or expensive for conventional wired infrastructure.

AUMA actuators are now available with an Ethernet/IP interface. They are already available via Profinet and Modbus TCP/IP.



Ethernet/IP offers superior connectivity and enhanced network flexibility. With bandwidths up to 100 Mbit/s, Ethernet/IP capability provides reliable and rapid exchange of both cyclic process data and acyclic diagnostic data from the actuators.

BHGE announces expansion of the Consolidated ASME



Type 2900 LA Liquid Pilot Operated Safety Relief Valve

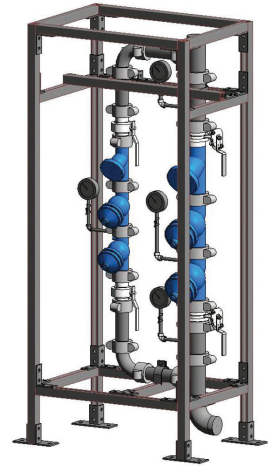
Type 1900 LA Liquid Spring-Loaded Safety Relief Valve

Type 2900-40 Steam Pilot Operated Safety Relief Valve

Section I portfolio, which now includes 1900 LA1 spring-loaded and 2900 LA1 pilot-operated B&PV code-approved liquid safety relief valves. These valves are solutions for liquid over-pressure protection for economizers and thermal fluid heaters used in combined cycle power plants.

Victaulic series 386-V vertical pressure-reducing valve stations come fully integrated and ready to install. The PRV can be used in potable water systems to reduce and control system pressures to specified safe levels and can be independent of upstream pressures and flow variations.

The PRV is offered in four standard configurations that have allowable pressures of up to 300 psi. The new PRVs can be used in tight-space installations where a standard 386 PRV station may not fit.



Conval offers more than 12,000 configurations of Clampseal Y, angle and T-pattern globe stop, check, and stop check valves for applications as extreme as cryogenic and fire-safe. Parts can be interchanged across installations, which means an entire plant can be supported with small parts inventory.

Features include conformance to ASME B16.34; pressure seal bonnet for maintainability; quick-replacement packing chamber; single-piece gland with integral gland wrench; solid Stellite seating surfaces; and two-year warranty.



Garlock launched FLOOD-GARD Bearing Isolators. The patent-pending seal design provides bearing protection in the most challenging flooded environments, extending the life of rotating equipment such as gearboxes, pumps and motors.



The new product combines improved safety and overall process efficiency with cost savings through extended equipment and bearing life. The design provides excellent bore retention while allowing easy installation by hand, without the need for an arbor press.

“I’ve been active in many different associations over the years. VMA is by far one of the best run and most beneficial in terms of content, quality and people!”

–Robert Kemple, Jr.,
Former Executive VP, ASCO-Emerson



Become a member of the Valve Manufacturers Association or its affiliate the Valve Repair Council and you’ll learn why so many others have joined... and stayed members for many years—even decades!

You could be eligible if you are a U.S. or Canadian company that fits one or more of these categories:

✓ **MANUFACTURERS**

OF VALVES, ACTUATORS & CONTROLS

✓ **SUPPLIERS**

TO VALVE, ACTUATOR & CONTROL MANUFACTURERS

✓ **DISTRIBUTORS/CHANNEL PARTNERS**

TO VALVE, ACTUATOR & CONTROL MANUFACTURERS

✓ **OEM MAINTENANCE, REPAIR & SERVICE**

VMA MEMBERS AND FIRMS SERVING THOSE MEMBERS

Once you’ve applied and your membership approved, you’ll be eligible for a wide array of benefits:

- Numerous Networking Opportunities
- Special Member-only Events
- Quarterly Economic Forecasts
- Annual Global Valve Forecast
- Reduced Fees on Advertising, Exhibits, Meetings and Educational Materials
- Free Job Listings on VMA and Valve Careers Social Media
- Access to VMA’s Legal Counsel



To determine if your company meets the criteria for membership, visit VMA.org > Members for information on Qualifications, Benefits and Dues, and then apply Online.

Questions about VMA? Contact VMA President Bill Sandler (wsandler@vma.org).

Questions about VRC? Contact Marc Pasternak (mpasternak@vma.org).

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