

WALWAVE

MAGAZINE | FALL 2014
VOL. 26, NO. 4

Market Outlook 2015

Oil Joins Gas in the Spotlight



ENHANCED OIL RECOVERY

COMBINED CYCLE POWER PLANTS

THE CRITICAL ROLE OF FLANGES

EMERGENCY REPAIR FOR PIPELINES

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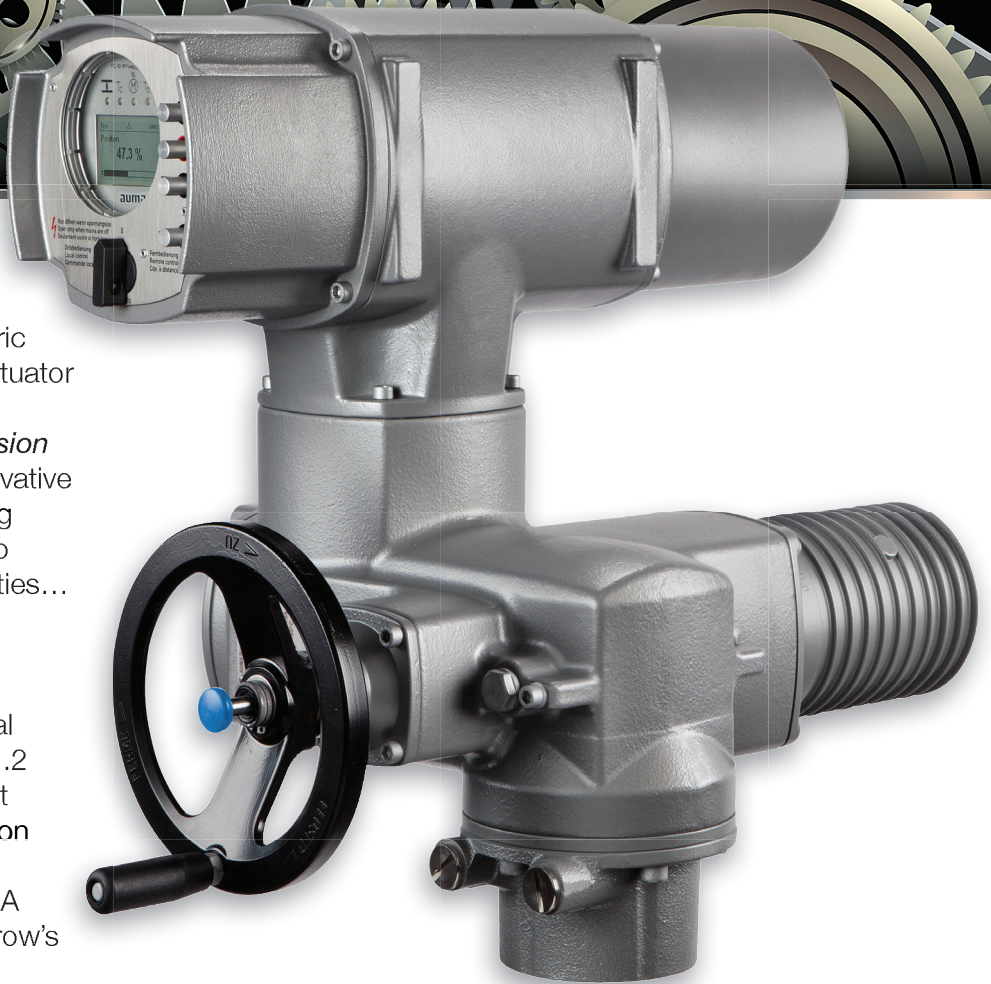
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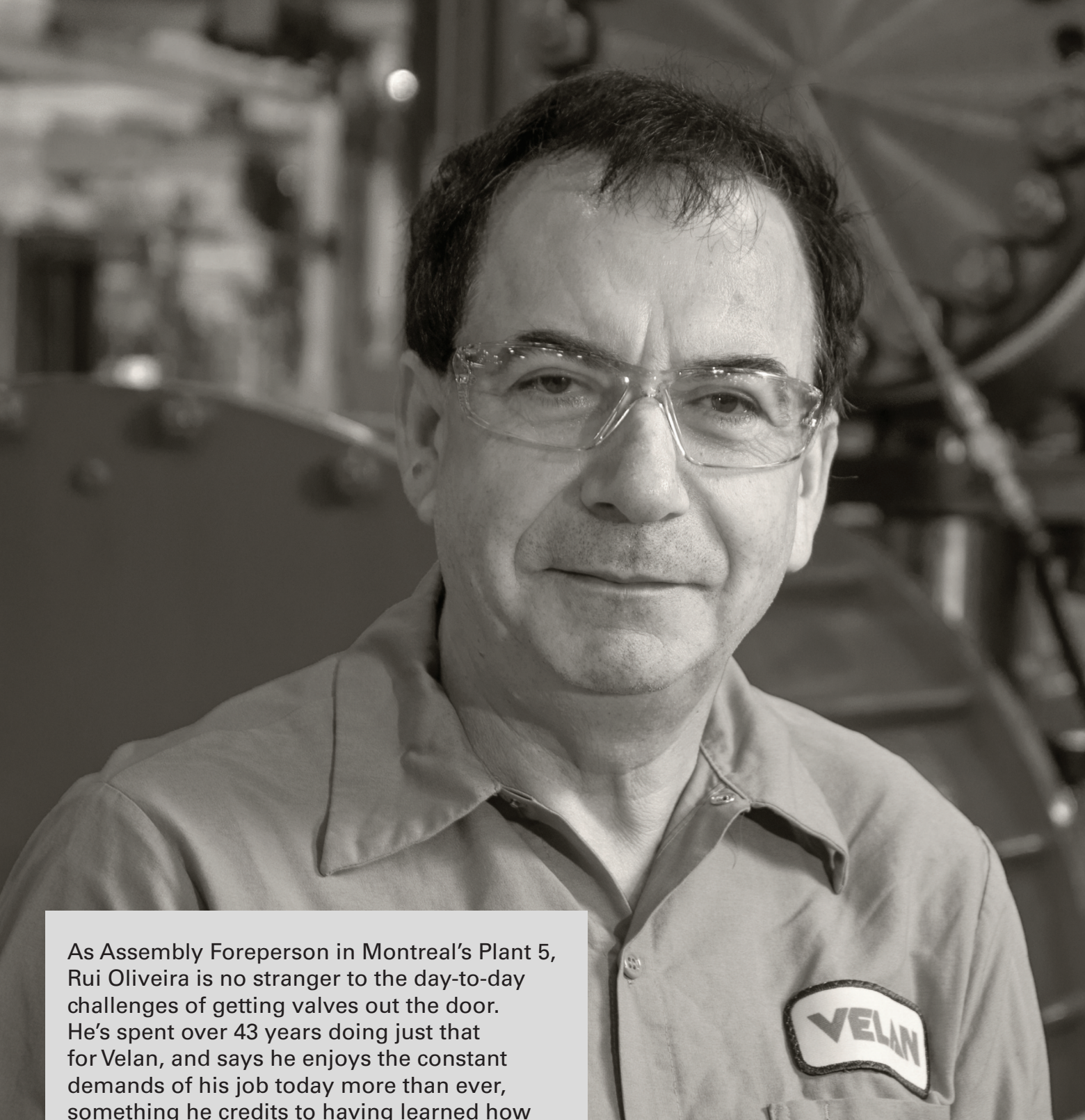
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As Assembly Foreperson in Montreal's Plant 5, Rui Oliveira is no stranger to the day-to-day challenges of getting valves out the door. He's spent over 43 years doing just that for Velan, and says he enjoys the constant demands of his job today more than ever, something he credits to having learned how to balance work and family life successfully.

What you might not know about Rui is that he also has a deft hand with a tennis racquet and plays every week. One of his more memorable games was with Velan founder A.K. Velan, who, even though he was then 80 years old, still gave him a run for his money.

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WHERE VALVES ARE USED: CO₂ FLOODING SYSTEMS

North American ingenuity has come to light through a third type of system used to extract precious oil from already tapped oil fields. This enhanced oil recovery system adds carbon dioxide to the mix and creates new valve opportunities.

BY GREG JOHNSON

14 MARKET OUTLOOK 2015: OIL JOINS GAS IN THE SPOTLIGHT

VMA's Market Outlook speakers said they believe both gas and oil will soon tip the North American trade balance toward exports. Presenters gave their 2015 forecasts for a wide range of user industries.

BY KATE KUNKEL

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Power generation is moving from coal to alternative fuels and different types of facilities such as combined cycle plants. Applications for both cast and forged valves are discussed.

BY STEVE BROWN

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Flanges play a critical role in piping, but can also be the weakest link. We review what goes into a flange, what designs are available and what standards must be followed.

BY JOHN V. VALLUN, P.E.

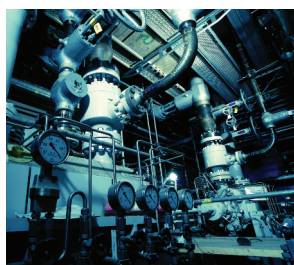
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- Upgraded SCADA Software
- Trunnion Ball Valve
- Fire Protection Valve

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A Refinery Improves Its Leak Detection and Repair Program

A facility in Indiana that has 80,000 valves in its leak detection and repair program has been working on improvements around that LDAR since 2011.

BY STEVE McJONES AND RICH SOBILO

- » Understanding and Selecting Valve Flanges, Part 2
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Tomorrow and Beyond



Although many people work past the traditional end-of-career age of 65, the industrial valve industry, like most of manufacturing, faces the immediate prospect of losing an entire tier of professionals to retirement. Is the industry prepared?

VMA is trying to make the transition less painful by providing tools for our membership, other valve companies and end-user industries to obtain and retain professionals:

- **Valve Basics Seminar & Exhibits** – VMA's biannual education program is geared to new industry personnel, those seeking a refresher course or college students contemplating a career in the valve industry. Attendees learn the basics of valves, actuators and controls, and get hands-on demonstrations of the different types and how they work. Our next program will be Oct. 30-31 in Las Vegas. Because of the huge success we've had with these seminars, we plan to add a third day to the program beginning with one held next May in Charlotte and another in October in San Antonio.
- **Annual Meeting Presentations** – We use our regular meetings to tackle the topics involved. At VMA's recent 76th Annual Meeting outside of Tucson, for example, we listened to Marilyn Moats Kennedy discuss, "Twenty Somethings in the Workplace." Her talk was followed by an industry panel of four young professionals. Both Kennedy and the panel addressed the issue of how companies can attract and hold on to a larger portion of a shrinking pool. Watch for more on this subject in the next issue of VALVE Magazine.
- **Career Initiative** – At the same meeting, the VMA Board of Directors approved a new 2015-16 Career Initiative. The details are in the works, but some of the planned elements are:
 - A dedicated website
 - Informational materials
 - Videos
 - Career fairs
 - Outreach programs
 - Scholarships

Our goal with all of these actions is to fill the large gap being left by the retirees who made this industry what it is today and hope to make it better in the future. If you have thoughts on future programs addressing this issue, please share them with me at wsandler@vma.org. VM

Bill Sandler

President, Valve Manufacturers Association of America



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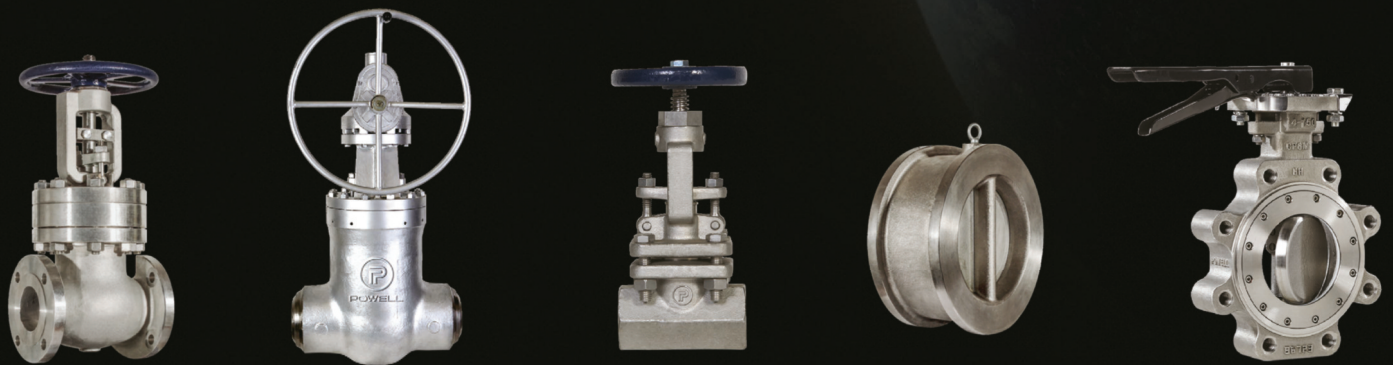
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MERGERS & ACQUISITIONS

Rotork Acquires UK-Based Valve Business

Xylem Inc. has sold its Wolverhampton, United Kingdom-based valves business, Xylem Flow Control Limited, to Rotork plc for about \$30 million. The business provides a wide range of pneumatic and hydraulic valves and related products to OEMs, primarily in the oil and gas sector. In 2013, it reported sales of \$25 million.

MRC Global Adds Norwegian Offshore Equipment Provider

MRC Global Inc. has entered into a definitive agreement to acquire privately held Metron Holding AS, the parent holding company of Hyptek AS. Headquartered in Skotselv, Norway, Hyptek is a provider of instrumentation and process control products to the offshore, marine and onshore industries with a focus on the Norwegian Continental Shelf. The company also provides instrumentation and process control system solutions to capital offshore projects around the world. After the deal closes, it will operate as MRC HypTeck.

Curtiss-Wright Buys Brazilian Valve Company

Curtiss-Wright's Industrial division has purchased the valve division of Brazil's Engemasa Engenharia E Materiais Ltda. The business currently manufactures a proprietary brand of pressure relief valves for the Brazilian petroleum, petrochemical, sugar cane and chemical industries. The new acquisition will join

Prepare Now for 2019, but Before Then: Growth, Beaulieu Says

Although ITR Economist Alan Beaulieu was generally optimistic about the U.S. economy in his address at VMA's Annual Meeting in mid-September, he reminded attendees the U.S. is still on track for a notable recession in 2019. He said the 2019 event won't be as severe as what occurred in 2002, but will be worse than what struck in the mid 1990s. It will begin in the second half of 2018, "but between now and then, there will be continued economic growth."

Meanwhile, "Life is good right now in the U.S.," Beaulieu said. The rate of growth this year will be somewhat higher than the 3.8% he originally projected, and while that growth will slow in 2015, it will still be 2.4%.

THE SITUATION

Beaulieu said his current optimism springs partly from the reality there is no appetite for austerity in Washington, DC, and noted that if the government were to rein in spending, a recession could occur. He also pointed out that delinquency rates for consumer loans are very low right now and that banks are lending more.

Private sector job growth is at 2.1%, and job openings are occurring. However, "We want people with skills; we get people with attitudes—and people who don't pass drug tests!" he said.

Also, the average hourly rate is up 2.3% over last year, so it is costing more to hire people. "The only way to counter this is, rather than hiring more people, look more to automation," Beaulieu said.

Beaulieu expects inflation to be a major issue in the next few years and said it will rise to the rate it was in 1980 by 2030—when he is forecasting the U.S. will experience the biggest economic disaster since the Great Depression in the 1930s. He also

expects interest rates to rise and advised borrowing now for business expansion or real estate purchases.

On another positive note, he pointed to the decrease in the country's dependence on foreign oil, which dropped from 60% in 2005 to 32% in 2013. He said that globally, shale oil and fracking will make the world more stable. "I envision a time when we are not going to care [economically] about the Middle East," he said. "If this region is irrelevant, we won't need as much defense, so the DOD [Department of Defense] budget will go down and give us more dollars to spend on other things such as the aging population."

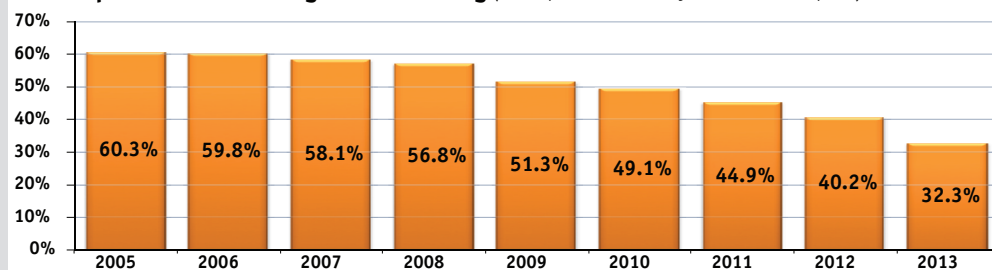
CONCERNS AND THE FUTURE

Beaulieu warned that if China's economy slows, the U.S. will also slow because China is a major market and because, if China stops buying U.S. debt because of its own debt, it could cause major problems.

Europe's continuing woes, decelerating corporate profits and higher affordable care costs, are a concern. Also, in the U.S., the aging population is a problem because fewer younger people are working and the U.S. spends more on the aged than any other country. Since there is no real plan to balance the federal budget, Beaulieu expects the country will add a trillion dollars a year average to the debt between now and 2038. By 2035, the debt will consume 25% of our budget.

Although growth will slow in 2015, the upward trend will continue in 2016 and 2017. To avoid the pain of the recession that will hit in 2018-19, Beaulieu recommended developing growth strategies now, finding and eliminating bottlenecks, and investing in customer market research. **VM**

U.S. Dependence on Foreign Oil Declining (Net imports as a share of domestic consumption)



Source: Energy Information Administration

Curtiss-Wright Industrial's Farris Engineering business unit to form Farris Brazil Industria de Valvulas Ltda.

Farris Brazil will service Farris' large installed base of pressure relief valves within Brazil, as well as all South and Central American customers.

FCX Performance Acquires Corrosion Fluid Products

FCX Performance, Inc. has acquired Corrosion Fluid Products, Corp. (CFP). Based in Farmington Hills, MI, CFP is a regional distributor of pumps, valves, FRP fiberglass and specialty lined pipes, hoses and fittings from its eight branch distribution centers located across the Midwest.

FCX and CFP will combine vendor relationships, which consist of over 400 sales, technical support, and service and repair professionals; broad flow/fluid control product offering; complete lifecycle service offering; 33 sales and distribution locations; and strategically located inventory.

Metso Restructuring to Focus Resources on Higher-Margin Businesses

Metso Corporation has decided on a new strategy and operating model designed to drive growth in the company's core businesses and strengthen its financial performance and value creation. Under the new strategy, Metso's core customer industries will be mining, oil and gas, and aggregates. As part of the new strategy, Metso will study strategic alternatives, including potential divestment, for its current Process Automation Systems business, which primarily serves

the pulp and paper, and power industries. Metso will update its operating model to include three business areas: services, flow control and minerals.

Peru's VAMSAC Joins Emerson Management

Emerson Process Management has acquired Valvulas, Accesorios y Maquinarias SAC (VAMSAC), a provider of automation and industrial control solutions to companies in Peru in the mining, oil and gas, refining, chemicals, and food and beverage industries. VAMSAC, based in Lima, has been in business since 1989 and has been an authorized representative of Emerson Process Management since 1993.

The acquisition provides Emerson Process Management with a direct presence in Peru and builds on its strategy to establish the company in Latin America. Emerson also recently opened a Mining Center of Excellence in Santiago, Chile, to serve as a regional hub for mining industry customers.

NEW FACILITIES

Teadit North America Moves into New Facilities

Teadit North America has

moved into new headquarters in Pasadena, TX. Located at 10545 Red Bluff in the Bayport South Business Park, the facilities feature a 92,000-square-foot production and manufacturing warehouse, and a 20,000-square-foot office with a second-story mezzanine. This new building is nearly 70% larger than Teadit's last Pasadena location.

Emerson Commissions New Density Calibration Facilities

Emerson Process Management has commissioned new liquid density meter calibration facilities in Boulder, CO and Slough, U.K. The new calibration facilities enable calibrations at real-world temperatures and pressures that mimic true application conditions, ensuring high accuracy.

These new facilities are part of Emerson's global investment in calibration facilities and services. The new capability adds to Emerson's existing flow calibration network, with primary centers located in the U.S., Brazil, Mexico, the Netherlands, Norway, Romania, the United Arab Emirates, China, Japan, Singapore and Australia.

CONTINUED ON PAGE 8

□ Teadit's new headquarters in Pasadena, TX



OCTOBER 2014

30-31 VMA Valve Basics Seminar & Exhibits

Las Vegas
www.vma.org

DECEMBER 2014

2-4 Valve World Expo & Conference 2014

Düsseldorf, Germany
www.valve-world.org

9-11 Power-Gen International

Orlando, FL
www.power-gen.com

MARCH 2015

5-6 VMA Technical Seminar & Exhibits

San Antonio
www.vma.org

MAY 2015

4-7 2015 Offshore Technology Conference

Houston
www.otcnet.org

12-14 VMA Valve Basics Seminar & Exhibits

Charlotte, NC
www.vma.org

JUNE 2015

7-10 ACE15

Anaheim, CA
www.awwa.org

9-11 Global Petroleum Show

Calgary, AB, Canada
www.globalpetroleumshow.com

JULY 2015

15-16 Valve World Americas

Houston
www.valveworldexpoamericas.com

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GE Oil & Gas Expands Presence in UAE

GE Oil & Gas celebrated the groundbreaking of a new facility that will further expand its presence in the United Arab Emirates in Jebel Ali Free Zone. Scheduled to open in 2015, the new facility spreads over an area of 22,700 square meters and can accommodate over 300 employees.

The new GE Oil & Gas Manufacturing & Technology Center will offer tailored training programs and also feature a dedicated repair

center that will improve speed of service by being closer to customers.

Franklin Valve Opens New Houston Manufacturing Facility

Franklin Valve announced a move into a new state-of-the-art, 63,000-square-foot manufacturing facility in North Houston. Located in the Prologis Industrial Park at 500 North Park Central Dr., Suite 100 Houston, TX 77073, the new facility replaces the previous facility at 7720 Bluff Point Dr., also in Houston.

AWARDS & MILESTONES

Mueller Co. Affiliate Wins Top Water Industry Prize

Echologics, an affiliate of Mueller Co., won the Water Industry Achievement Awards' Most Innovative New Technology of the Year and the overall Outstanding Innovation 2014 awards. The company shared the honor with Severn Trent Water and Loughborough University.

The awards were presented for LeakFinderST, an

CONTINUED ON PAGE 10

PEOPLE IN THE NEWS

CRANE CHEMPHARMA & ENERGY... has appointed

Alejandro Alcalá as president of its global business. He brings more than 20 years of relevant industry experience to his new role, having recently served as the president of Crane's Pumps & Systems business. Prior to Crane, Alcalá had a successful 17-year career with Eaton Corporation.

AUGE INDUSTRIAL... named **Steve Cabral** vice president of sales and **Richard Cowen** director of business development.

Cabral has more than 45 years of experience in industrial manufacturing and fastener distribution. He spent 38 of those years with the LoneStar Group, where he held various leadership positions in sales and marketing. Cowen has 28 years of management experience in industrial manufacturing and fastener and gasket distribution with Teadit, Utex and NOV. He co-founded the Lonestar Group's Sealing Technologies division.

VALVTECHNOLOGIES... selected **Tom Singh** as vice president, supply chain operations, and **Oliver Perez** as industry director of service.

Singh brings global supply chain operations experience from the automotive, telecommunications, heavy manufacturing and valve industries. He recently served as vice president, global supply chain with JB



Alejandro
Alcalá

Poindexter & Company.

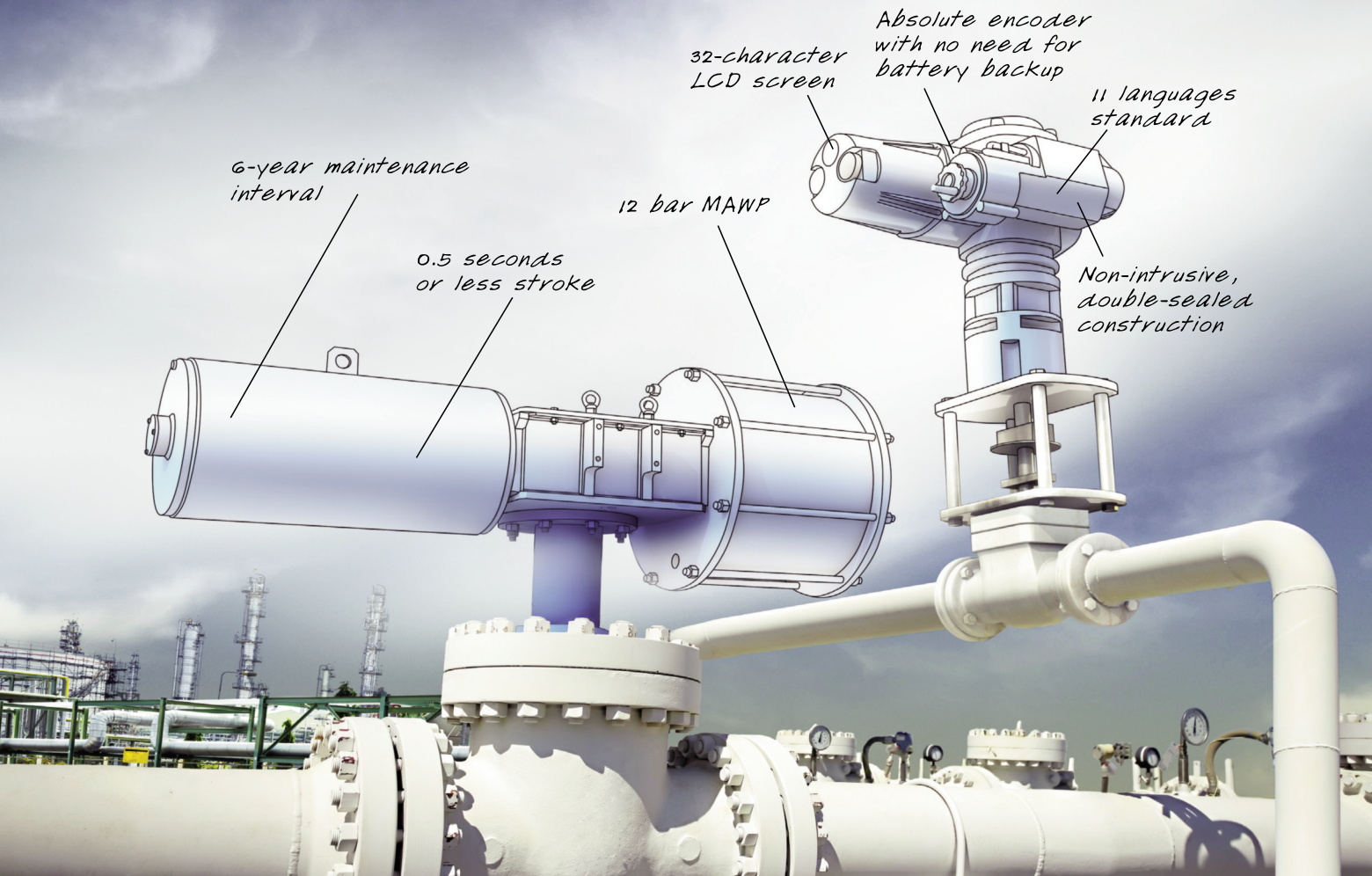
Prior to joining ValvTechnologies, Perez held service and operations management positions in the Fisher Controls' Instrument and Valve division of Emerson Process Management for more than 14 years. He also worked for Flowserve and Parker.

BALLUFF, INC... has named **Christian Dow** as its new director of industry development & key accounts. Dow has been a member of the sales team for six years, recently serving as industry manager – energy, oil & gas. He will report directly to **Jim Mick**, VP sales, and be responsible for driving growth through a diversified industry and product approach.

COLFAX... appointed **Darryl Mayhorn** senior vice president, and president and CEO of Colfax Fluid Handling. He will be responsible for leading the strategic direction and daily management of the business. Most recently, Mayhorn was president of the Rexnord Aerospace Group.

LINED VALVE COMPANY... announced **David Gambetta**, designer and engineer of the largest knife gate valve ever built in the U.S., has joined the company as engineering manager. Gambetta will manage the design team, which will conceptualize and create new product designs.

Gambetta was most recently the engineering manager at Pentair Valves and Controls for 11 years and also worked for Technaflo Inc.



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CONTINUED FROM PAGE 8

advanced leak noise correlator jointly developed by the three organizations.

A.K. Velan Honored by Order of Engineers

Velan founder A.K. Velan was awarded the Grand Prix d'Excellence from the Order of Engineers of Quebec at a gala in downtown Montreal. The award represents the highest distinction attributed by the order to one of its members.



□ A.K. Velan receives Grand Prix d'Excellence.

"This prize recognizes the innovativeness, entrepreneurial spirit and outstanding character Mr. Velan has shown throughout his career," said Stéphane Bilodeau, president of the Order.

A.K. Velan has received many awards and distinctions for his contributions to the profession, humanitarian causes and business: He was named a Fellow of the Canadian Society for Senior Engineers in 2013 and a Knight of the National Order of Québec in 2005.

Victaulic Receives Five New Type Approvals

Victaulic has received type approvals from American Bureau of Shipping, Bureau Veritas, Det Norske Veritas, Korean Register and Lloyd's Register for Vic-Press, a flame-free press system for joining small-diameter

stainless-steel pipe. The system is approved for use in class III piping systems for marine and offshore applications. Vic-Press works with Schedule 10S Type 316 stainless-steel pipe.

NEW CONTRACTS

Metso Wins Repeat Order from North American Pipeline Owner

Metso has won a significant repeat order for Neles ball valves with Neles Q-Trim noise attenuating technology from a North American pipeline owner that brings crude oil from Canada to U.S. refineries. Reducing cavitation, noise and related vibration to acceptable levels lowers the operating costs and minimizes the need for valve spare parts and other accessories.

Pentair Engineers Its Largest Wedge Gate Valves

Pentair Valves & Controls has supplied its largest-ever bolted bonnet flanged wedge gate valves in an integrated petrochemical plant located in the Middle East. Engineered and manufactured under the Fasani brand, the specialist carbon steel-bodied valves measure 78 and 84 inches in diameter with ANSI class 150-pressure rating.

The valves were designed for wet flare line applications within the plant.

Rotork Wins Malaysian Valve Control Contract

Rotork has received orders for the Pengerang Terminal on the southeast coast of Malaysia. Situated near the city of Johor Bahru, the 5-million-cubic-meter-capacity terminal is a part of the country's Economic Trans-

formation Program to create a more progressive oil and gas industry in Malaysia.

GE Oil & Gas Supplying New Wells in Gulf of Mexico

GE Oil & Gas will provide vital surface equipment to Mexico's national oil company, PEMEX Exploration and Production, for use at an offshore project in the Ayatsil heavy oil field in the Campeche Sound in the Gulf of Mexico. The multi-year

contract includes installation of GE's surface wellheads and trees in new wells that will be drilled by PEMEX.

GE also recently announced it is teaming up with PEMEX and the Mexico Institute of Petroleum to research and develop technologies to improve productivity and efficiency in mature fields, develop deep and ultra-deep water projects and modernize Mexico's energy infrastructure.

NEW MEMBERS

Six additional companies have joined the Valve Manufacturers Association in the last quarter, bringing to 22 the number of new members in 2015.

The following companies are now full VMA members:

Apollo Valves – Conbraco Industries, based in Mathews, NC, came about when two Detroit-based manufacturers of brass valves and fittings merged in 1928 forming Consolidated Brass Company. In 2005, the company brought all of its products—ball valves, actuators and mixing valves—under the Apollo Valves brand.

Founded in 1905, **Derbyshire Machine & Tool** provides products and other services to the U.S. Navy and marine industry from its 30,000-square-foot facility in Philadelphia.

Rejoining as a full member is **Western Valve, Inc.**, a manufacturer of double block and bleed plug valves that also repairs and reconditions valves and valve parts for its worldwide market.

New associate members are:

Engis Corporation, founded in Chicago, uses natural and synthetic diamond flat lapping, honing, grinding and polishing applications, as well as custom-designed finishing systems.

Saint-Gobain Seals offers a wide variety of seals, packings, springs, custom parts and more. In addition to the company's standard material grades, it also develops high-performance and engineering polymers.

Technetics Group is comprised of seven sealing and critical component design and manufacturing businesses: HELICOFLEX, Garlock France, Tara Technologies, Technetics, Wide Range Elastomers, Plastomer Technologies and Hydrodyne.

The Valve Repair Council also added two members:

Founded in 1976, **Precision Fitting & Gauge** of Tulsa, OK, has grown from a small local supplier of tubing fittings and pressure gauges to a multi-million dollar, regional distributor of instrumentation and controls.

With locations in Missouri, Illinois and Kentucky, **Pioneer Industrial** is an industrial distributor and service center for valves, pumps and fluid sealing products.

VMA's Annual Meeting: Elections, Awards and a New Initiative

Board members were elected, special members were recognized and a new career program was approved at the Valve Manufacturers Association's 76th Annual Meeting Sept. 18-20 at the Ritz-Carlton Dove Mountain in Marana, AZ. Association members also heard from several experts in the economic and consulting fields.

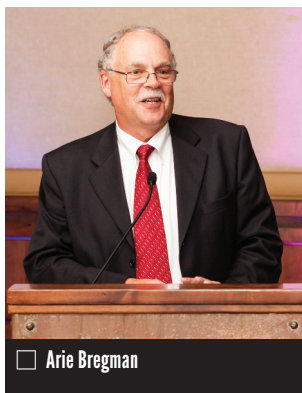
A NEW BOARD

Gregory Rogowski, president, Mueller Co., is the 2014-2015 VMA chairman, succeeding Ivan Velan, executive vice president, Velan Valve Corporation. **Bob Kemple**, executive vice president of sales and marketing, ASCO Numatics – Emerson Industrial Automation, is vice chairman while **Jim White**, general manager, Curtiss-Wright – Target Rock Group, is program chairman.

Newly elected to the board are **Arie Bregman**, general manager, DFT Inc., and **Jim Walther**, president, Kitz Corporation of America.

AWARD WINNERS

VMA's most prestigious award, Person of the Year, went to **Arie Bregman** of



□ Arie Bregman

DFT Inc. Bregman has worked tirelessly on behalf of the VMA Technical Committee, including serving as its chairman. He has also played a significant role in events planned by the VMA Education & Training Committee, including the initial development of the association's Valve Basics program and its 101 course.

Four individuals received Service Awards:

Jeff Kane, sales & marketing manager, DFT Inc., and **Paul Souza**, quality assurance training manager, AUMA Actuators, Inc., have been active participants, teachers and advisors for VMA's Valve Basics program. Kane has been instrumental in the check valve segment while Souza has helped with the actuation side.

Jim Storm, aftermarket sales/channel manager, GE Oil & Gas, has been an integral part of the Valve Repair Council and its board of directors.

Michael Halloran, CFA, senior research analyst, Robert W. Baird & Associates, was recognized for many years of insightful analysis of the economy from a Wall Street perspective

CAREERS INITIATIVE

At its Sept. 18 meeting, the VMA Board of Directors approved a new Careers Initiative proposed by VMA's Communications Committee. The program is designed to inform young people about opportunities in valve manufacturing. A multi-pronged approach will be employed that reaches from secondary to



□ Outgoing VMA Chairman Ivan Velan (left) and VMA President Bill Sandler

technical schools to colleges and universities.

Among the program's key components are a ValveCareers.com website, informational materials, videos, a public relations/outreach program and participation in a variety of career fairs. Employees of VMA member companies will serve as "young ambassadors" to tell students what it's like to work in the world of valves.

The program will kick off in January 2015. For more about VMA's Careers Initiative, please email Judy Tibbs at jtibbs@vma.org.

PRESENTATIONS

Speakers at the annual meeting addressed a diverse range of informative topics:

Alan Beaulieu, president, ITR Economics, discussed the state of the U.S. and global economy and described how the world could achieve "Prosperity in the Age of Decline" (the title of a book he co-authored). See page 6 for what he said.

Marilyn Moats

Kennedy, a career consultant and coach, presented a detailed examination of the characteristics and work styles of various generations and how to work with each group, from "Boomers" and "Cuspers" to "Busters" and "Millennials."

Greg Link, senior vice president of the Covey Leadership Center and author of "The Speed of Trust," explained why trust is the "one thing that changes everything" and why it should permeate every aspect of an organization.

David Wasserman, U.S. House Editor for The Cook Political Report, offered attendees "a political roadmap to the 2014 elections." He pointed out how our country is more polarized than ever and what that means for this November and the 2016 elections.

These presentations will be highlighted in upcoming articles on VALVEmagazine.com and in future issues of VALVE Magazine. **VM**

Valve World Expo Opens Third Exhibit Hall

Valve World Expo, the 9th Biennial Valve World Conference & Exhibition, which is Dec. 2-4, 2014 in Düsseldorf, Germany, has grown so large the organizers decided to open up a third exhibit hall this year. This is the third time the expo has been in that city. The first year, 2010, had 535 exhibitors; by the second year, 2012, there were 591. This year, planners are expecting even more so they expanded the hall to a total exhibit space of more than 190,000 feet.

One of those exhibits will be a booth co-hosted by the Valve Manufacturers Association and the British Valve & Actuator Association, along with several member companies from each of the two associations.

The Expo, which is the world's leading trade fair for industrial valves, also has seen constant growth

in attendance with more than 10,500 visitors from 57 countries at the last event. Over 70% of them came from abroad.

The exhibits at the expo include everything from plant equipment and machinery to components and systems with valves the star of the show. Conference seminars, workshops and lectures go into great depth about valve applications and innovative solutions to different challenges in the process industries. Topics range from emissions, seals and casting to standardizations, materials, testing and new designs.

Valve World Expo, which is organized by Messe Düsseldorf and KCI Publishing B.V., is part of a global lineup of flow-technology trade fairs that also encompasses international spin-off events in China (Valve World Expo Asia) and the



U.S. (Valve World Expo Americas).

Besides opening a new exhibition hall, December's expo has another first: It will be held in conjunction with the Pump Summit, which is Dec. 2 and 3. That means in addition to the many valve and actuator professionals, there will be manufacturers, suppliers and end users of pumps, compressors and seals.

Valve World Expo and the Pump Summit trade fairs and seminars are

designed to appeal to end-user market professionals in fields such as water and wastewater; food and beverage; mining; petrochemicals; oil and gas; energy generation and more.

For information on the event, go to www.valve-worldexpo.com. VMA's booth is at Stand #4C21, where VMA President Bill Sandler will be on hand to answer questions about the association, VALVE Magazine, VMA's education program and more.

PowerGen to Take Place in Orlando Dec. 9-11

More than 22,000 power professionals from 90 countries are expected at this year's Power-Gen International, which is Dec. 9-11 in the Orange County Convention Center, Orlando, FL.

PowerGen provides a world stage for the innova-

tions, ideas and solutions that power professionals need to run today's energy facilities. The conference brings together people from every aspect of the field from utility company officials to project developers to the companies and peo-

ple who build and run the world's power plants.

The conference has been around more than 26 years and draws some of the top experts in the field as speakers who address industry trends and the latest in technology and techniques for plant performance. More than 200 speakers will be featured in 13 tracks of subjects. Keynote speakers are top executives from Mitsubishi Hitachi Power Systems America, NRG Energy, Southern Company and Florida Power & Light Company.

The conference is run in

conjunction with other power conferences including Nuclear Power International, Renewable Energy World North America Conference and Expo for North America, Power-Gen International Financial Forum and GenForum.

PowerGen's exhibit hall will include more than 1,400 companies showcasing the latest products and services. Those exhibitors will include VMA and VALVE Magazine, which will be on hand to promote the valve and actuator industry.

For information, go to www.power-gen.com.



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Oil Joins Gas in the Spotlight: **Energy will Lead North American Growth**





BY KATE KUNKEL

Natural gas returned as star of the show at the 2014 VMA Market Outlook Aug. 14-15 in Boston, but it shared the stage this year with oil. Speakers said those two commodities promise to alter the flow of trade around the world and rebuild the North American economy. Speakers also said the economy has met the expectations for growth that many predicted would finally bury the Great Recession in the past.

Still, problems linger, in particular with employment. Joblessness has dipped somewhat, but many presenters voiced concern about the labor force participation rate, which has shown a loss of 3 percentage points, and about the loss of skilled workers to retirement. This mismatch from what businesses need to what workers have to offer appeared to be on the minds of many attendees and speakers during the outlook conference.

On the positive side of the economic picture, the boom in tight oil and gas production has been proclaimed as a way to tip the North American trade balance toward exports, not just of natural gas and oil but also petrochemicals and the high supply chain intensity goods made from those petrochemicals. That will bring more employment as well as a demand for more goods, including valves, pipes, pumps, actuators and controls, to build the refineries and pipelines.



UPTICK BY YEAR'S END

Michael Halloran, senior industrial analyst for Robert W. Baird & Co., reiterated the important role industrial equipment markets play on Wall Street and how important Wall Street is in how the world sees industry here.

"The stock market helps to define the characteristics of best-in-class industrial companies and to determine what the best investors in the world are looking for," he said. Still, while many process control companies have favorable characteristics, their stocks underperformed in 2014, partly because they outperformed in 2013 and partly because of underlying demand trends. An uptick is expected going forward because levels of investment in the oil and gas industries (primarily mid- and downstream) are high, and the automotive and residential end markets are seeing ongoing gradual improvement.

The Trends

A Robert W. Baird survey of process control professionals for the second quarter of 2014 showed sales and order trends have been better than expected, though there is more optimism on the order side than the sales side. Still, sales are trending positively toward single-digit growth in 2014.

Halloran pointed out that near-term power trends in this nation remain constrained by global economic uncertainty and delays in finalizing environmental regulations. Additionally, U.S. power capacity utilization levels remain well below peak levels of the late 1990s. More power was consumed in early 2014, but Baird analysts believe cold winter weather was the cause. Halloran said he does not expect a material global power infrastructure recovery until at least 2015, and natural gas and non-hydro renewables, including wind and solar, will lead any growth in the U.S.

In upstream oil and gas, activity and productivity is beginning to rise both on- and offshore. On the downstream side, Halloran says feedstock is the key and is driving investment opportunities.

Residential construction is aggressively pushing toward multi-family dwellings while non-residential construction markets look at 2014 as the first year of hope for growth. The huge inventory of buildings that remained empty following the recession has been reduced so demand is once again appearing, he said.

Another positive trend, according to Halloran, is the increased focus on cost reductions and stricter environmental regulations. That means industrial companies are seeing good demand for energy-efficient products across the heating, ventilation and air conditioning; power; municipal water/wastewater sectors; and in general industrial applications.

Value-Added Content

The most successful players in the process control sector will be those who are leaders in technology in areas such as variable speed drives, actuation, smart electronic controls, instrumentation and process management software, Halloran said.

"Given the critical need for valves in the operating process, a wide variety of manufacturers are accelerating capital investments in automation equipment or design to improve performance, reduce costs, and lessen potential downtime or lost production," he said.

Greater aftermarket focus is also occurring, which creates a more consistent and stable flow of revenue and greater customer interaction and retention levels. According to Halloran, manufacturers are not giving away original sales to gain the aftermarket/maintenance, repair and operations business, but potential revenues from that business are increasingly a part of the original pricing.

FORECAST: *In the industrial markets, spending appears focused on maintenance/replacement activity and brownfield projects near term; larger new-build infrastructure projects will come to fruition later in 2014 and into 2015. Cycle dynamics favor healthy process control stock outperformance over the next 1 to 2 years, likely driven by late cycle infrastruc-*

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ture acceleration and a more material residential/commercial construction recovery through 2014 and beyond. In the chemical industry, global capital expenditures spending should accelerate 5% year over year and 7% in 2015. Energy used for power generation will grow about 2% per year from 2011 to 2030.



Some Balancing Problems

John Spears of Spears and Associates reported that the U.S. currently accounts for about 45% of the global market, and this nation will come close to having a \$425-billion market in 2014. He compared the market on this side of the ocean to those around the world and talked about how they will affect each other.

Oil

Spears noted that incremental growth in global oil demand is coming from emerging economies, which now

account for half of total demand. Meanwhile, oil use in developed economies is trending from flat to downwards because of energy efficiency improvements and sluggish economic growth.

In the U.S., consumption has stayed flat, while oil production was up 11% in 2013. He projected growth of another 11% for 2014, then 7% in 2015, to an average of 14.6 million barrels per day (bpd).

However, the balance could have problems going forward:

“If you have less demand and more production, and we can’t export, that means more oil than demand, and that has a negative effect on prices,” Spears said.

One of the reasons for the mismatch is that U.S. crude oil exports are restricted by law. Spears said that, while recent efforts have been made to amend the definition of crude oil so that very light condensates don’t fall under this category, he does not expect restrictions to be substantially lifted until after 2016. If a combination of increased crude oil exports and refinery expansions does not absorb most of the

expected growth in U.S. oil production, U.S. crude prices are likely to fall to the point (below \$80 per barrel) that operators cut back drilling activity to reduce growth in production.

Gas

Spears estimated shale gas production accounted for 45% of overall U.S. gas output in 2013, exceeding 30 billion cubic feet per day (bcfd) for that year. U.S. gas exports are projected to average 4.3 bcfd in 2014, which is unchanged from 2013, and 4.6 bcfd in 2015 (up 6.7%). U.S. gas exports are positioned to rise if several U.S. Gulf Coast liquefied natural gas (LNG) export projects that have a combined capacity of 18.3 bcfd are approved. However, Spears agrees with most observers that no more than 8.0 bcfd of this capacity will actually be built.

U.S. spot natural gas prices are estimated to average \$4.35 per million British thermal units (mmbtu) in 2014, up 19% in response to the drawdown in gas inventories. However, Spears expects gas prices will fall once storage returns to normal levels after an exceptionally cold winter in

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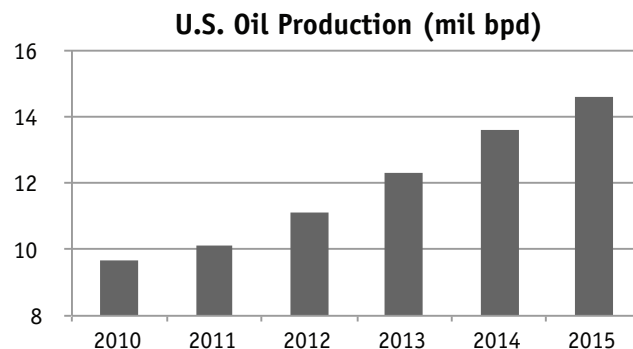
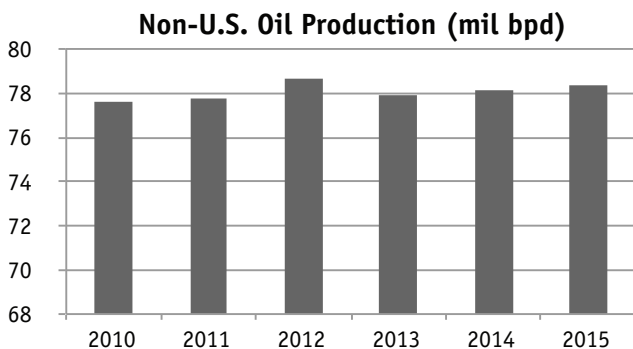
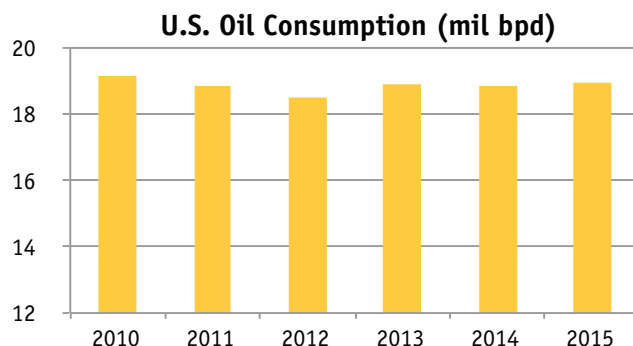
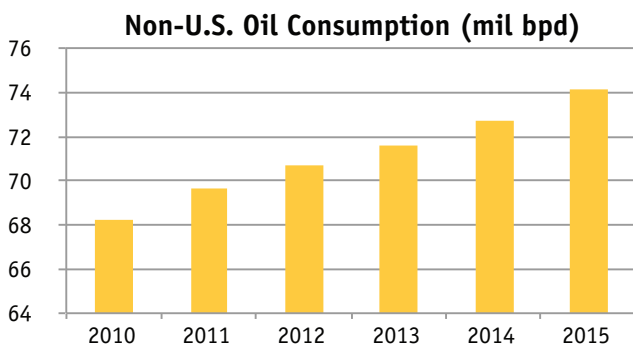
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Sources: EIA; Spears

2013/2014. U.S. spot gas prices are projected to average \$4.00 per mmbtu in 2015 assuming normal weather.

Rig Activity

The cost to drill and complete new wells has begun to increase: Spending on new wells is projected to be \$157 billion in 2014 and rise to \$165 billion in 2015. Rig count is forecast to average 1,870 active rigs in the U.S., which is up 6% in 2014 over 2013. However, drilling activity is expected to roll over in 2015 as prices decline from anticipated oversupply and lower prices.

U.S. well count is on track to approach 47,500 new wells in 2014, and Spears does not expect any changes in total count in 2015 although the number of new oil wells drilled will fall 3%, while the number of new gas wells drilled will increase 9%.

Canadian and International

Canadian drilling activity is forecast to increase 8% to average 380 active rigs while Canadian rig activity is forecast to fall 3% to an average of 367 active rigs in 2015. Over 230,000 producing oil and gas wells were working in Canada at the start of 2014, up 0.7% over a year ago. One

factor that will affect Canadian growth is the possibility of LNG export terminals that may get approved and built on the west coast.

Globally, Spears expects that spending on surface and subsea pressure control equipment such as Christmas tree valves; casing and tubing heads; chokes; safety shut-down systems; and actuators, gauges and fittings, etc., will exceed \$26 billion in 2014, up 10%, and is projected to total about \$31 billion in 2015, up 17%.

FORECAST:

- U.S. oil prices will average about \$100 per barrel in 2014 but decline to about \$90 per barrel in 2015 as oil production growth remains strong, demand growth remains sluggish, opportunities to displace oil imports grow scarcer and relief from restrictions on crude exports remain limited in the near term.
- U.S. gas prices are expected to rise 25% in 2014 in response to the drawdown in gas inventories but then weaken in 2015 ahead of an anticipated jump in gas exports.
- Overall U.S. rig activity is projected to rise 6% in 2014 but fall 1% in 2015 as oil prices weaken. Overall well count is projected to rise 3% in 2014 and hold steady in 2015.



Emerging Fundamentals

Kenneth Medlock of the Center for Energy Studies looked into the future as far as 2040 and said, "The world will still be very much hydrocarbon dependent, and that is not going to change quickly."

"Oil and natural gas demand will continue to grow, driven largely by very populous developing economies such as China and India," he said.

In the U.S., the oil market is saturated, and no real growth will occur in that time.

"Everybody has a car and everybody drives a car as much as they're going to drive it. Demand will fall or increase depending on how efficiency affects it. It is price sensitivity, not real growth that drives things in the developed world," he said.

The Effects of Coal

Medlock pointed out that many of the coal plants in the U.S. were developed in the 1970s, so they are reaching the end of their lifespan. However, in China, huge numbers of coal plants have been built in the last decade. Since the lifespan of

those plants ranges 30-50 years, they will stay in place.

"Other fuels can only capture margin," Medlock said. "They can't penetrate what already exists. China will eventually be the driver for LNG demand, but it will be by degrees."

Despite the carbon dioxide (CO₂) emissions from coal, demand is continuing to rise around the world. Indonesia and Australia are the largest exporters, but the U.S. is also increasing its exports, mainly to Europe. Meanwhile, "Germany is shutting down nukes," so it has need for a stable energy source. "There is an impetus to import coal, and they are building supercritical coal plants," he said.

Natural Gas

According to Medlock, the technological breakthroughs that made it possible to tap into shale resources mean available gas is now closer to its markets in North America, but it's much more than geography or geology that have made the U.S. able to capitalize on shale resources.

"Nowhere else in the world will you see the pace of development as in the U.S.," he noted, "because nowhere else in the world can a developer negotiate with a landowner for mineral rights."

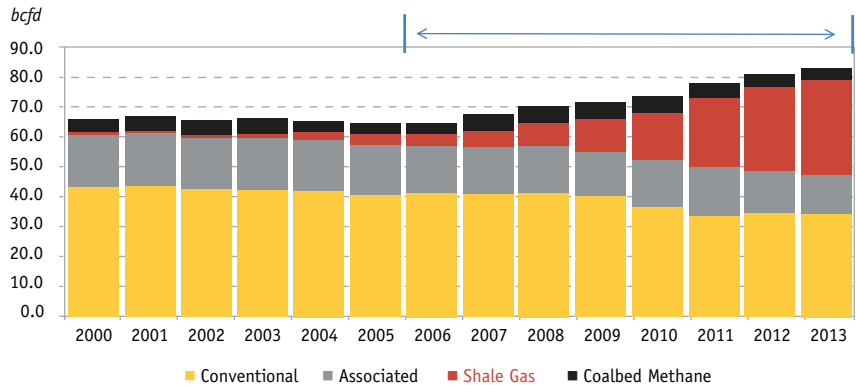
The U.S. also has a well-developed pipeline network that can accommodate new production volumes and a market where a well-developed service sector can facilitate fast-paced drilling activity and provide rapid response to demands in the field, he said. Still, the pipeline infrastructure will need to be expanded, Medlock said.

Shale and LNG

Medlock noted that oil production increases from the deposits in North Dakota and South Texas are two of the three largest increases by any country anywhere in the world. With that abundance of oil comes gas production associated with the shale, which adds to the natural gas abundance in North America.

While the supply is plentiful, much more is needed to tap into that windfall, he pointed out. "A variety

The Recent U.S. Natural Gas Supply Surge
The last 7 years have seen tremendous growth in U.S. natural gas production, largely driven by shale gas resource development.



Source: EIA

of regulatory and market institutions must be in place if regions outside the U.S. are to reach full development potential."

Medlock said U.S. exports of LNG and other supply abundance will put downward pressure on prices. This will be exacerbated by demand reductions from re-activation of the nuclear fleet in Japan and increased supplies from shale originating in China, East Africa, Australia and Russia.

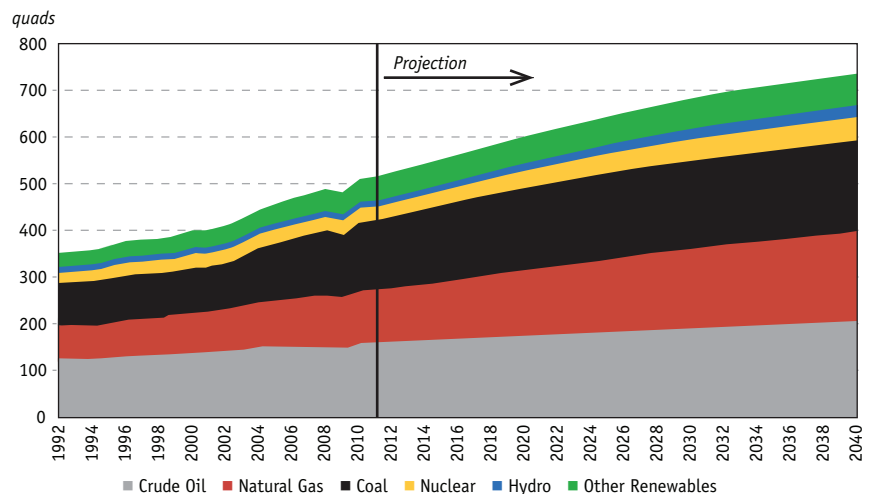
"Small changes in demand can create a huge increase in price because of supply constraints, but if you reduce the deliverability constraint, you drive down the price," Medlock said. "There is no way prices in the U.S. will rise to international rates. As U.S. gas goes out into the world, it will push all the liquidity from here to the rest of the world."

FORECAST:

- U.S. LNG exports will create a large infrastructure industry, to likely make this nation the third largest exporter in the world. However, the U.S. is also the largest gas consumer and industrial activity is rising, which will require more power generation. Because of the Environmental Protection Agency's (EPA) requirements to reduce carbon emissions, coal will be retired and replaced with natural gas.
- Strong growth will occur in total dry gas production through 2020 followed by stabilization, with shale gas continuing to increase share. Canadian supply will grow more strongly post 2020 as prices strengthen and U.S. LNG creates additional demand pull along existing pipelines.

Total Primary Energy Requirement

By fuel, 1992-2040



Source: Baker Institute CES Forecast



A Changed Global Environment

Mark Peters, publisher of the Oil and Gas Financial Journal, didn't venture into the future as far as Medlock in making his forecast, but he talked about the next decade and what factors will shape energy expansion.

"You can't discuss anything in this industry without talking about tight oil and gas," he said. Also, no matter which side of the fence policymakers are on as far as the effects of climate change, "policies aimed toward mitigating it are having an effect on the industry," he said.

Despite the fact the U.S. is reversing 40 years of declining oil production, oil prices remain high.

"There is a war premium because of ongoing strife," Peters said. He expects these prices will remain between \$100 and \$120 per barrel. Meanwhile, Texas oil production will reach an all-time high by 2017 when the Permian Basin comes online.

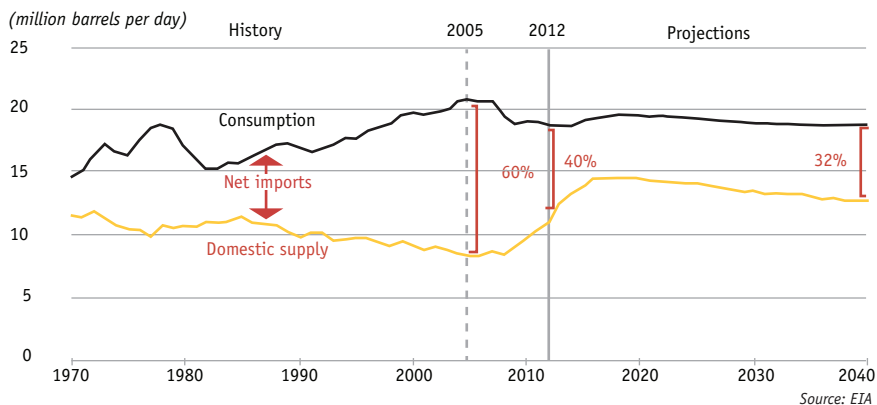
Peters suggested that lower prices of natural gas and long-term supply will drive industrial regeneration in the U.S. and additional gas exports will drive down global prices. "Gas intensive petrochemicals will see the strongest growth."

Environmental Factors

Peters pointed out several environmental factors that will have an ongoing effect on oil and gas. One of them is CO₂ levels, which he said are already much lower now than in the first decade of the century. Regulation in this area might threaten the slow growth manufacturing is now seeing. Some other countries are already addressing environmental effects. For example, "Australia recently began repealing their strong climate change taxes and rules due to damage to their economy," Peters said.

Regulation in other areas may also be in effect soon. For example, while fracking is still regulated by states, EPA is trying to make it a national issue.

U.S. Dependence on Imported Liquids Declines



Other Issues

Echoing the sentiments of other presenters, Peters said additional gas exports will drive global prices down. "Gas processing facilities and pipeline construction will be driven by changed production locations, and as LNG export facilities are added, more will be needed," Peters said. He also said a recent spate of derailments may spur pipeline construction, but this situation may be delayed by the difficulty of getting rights-of-way to lay the pipeline.

As far as refining, Peters stressed that capacity in the U.S. needs to change. While units were restarted and expanded in 2012 and 2013 for vacuum distillation, thermal cracking, catalytic hydrocracking, catalytic reforming and hydrotreating, more units are needed, and if the Keystone pipeline is approved, Gulf Coast refineries will need to expand. Meanwhile, "Gasoline as a motor fuel continues to decline as ethanol takes an increasing share of the market,"

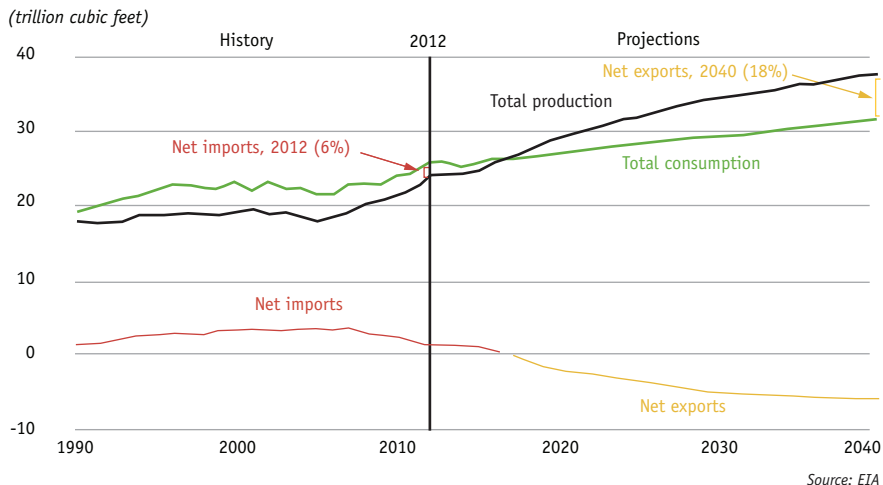
which will also require refinery changes, he said.

Inexpensive natural gas has also driven petrochemical expansions. The current value of U.S. chemical projects planned between 2014 and 2020 in the U.S. is \$71.7 billion, he said, and gas-intensive petrochemicals will see the strongest growth going forward.

FORECAST:

- Pipeline capital spending in the U.S. in 2014 will be \$15.6 billion.
- Capital spending in refining will equal \$12.9 billion in 2014, an increase of 0.8% over the previous year. Capital spending in petrochemicals will total \$5.6 billion in 2014, an increase of 51% from 2013.
- Going forward, the nation will see more export of refined products, more upgrades and expansion of petrochemical facilities and possibly new plants in U.S. Northeast because of shale gas production.

Natural Gas Production Grows and U.S. Becomes Net Exporter





On the Rebound in North America

Mark Eramo of IHS Chemicals had the same positive outlook as Peters when it comes to expansion of petrochemical facilities over the next decade.

He pointed out that modern life and its dependency on everything from packaging to carbon fibers has led to an increase in production from 290 million metric tons (MMT) in 2000 to an anticipated 640 MMT in 2020.

The make-up of products will change over the next few years for several reasons, he said. For one thing, environmental issues have reduced benzene use and increased methanol use. Gasoline use has decreased in North America, meaning less propylene derived out of the refining sector. Chlorine's primary end use is PVC resin, but electricity cost is a major factor and demand growth is driven by construction materials, which means those two factors will affect chlorine needs, Eramo said.

In general, chemical demand grows as world GDP rates rise, he said. That GDP is currently reaching about 3.5%, but will flatten over the next few years and fall beginning in 2017. Meanwhile, because feedstock costs make up 60-70% of the costs of chemical production, the prevalence of that feedstock creates competitive advantages for certain regions. Three primary regions of the world currently have low-cost feedstocks: the Middle East, North East Asia and North America.

In the Middle East, Saudi Arabia historically produced polyethylene, polypropylene, polystyrene, ethylene glycol and styrene. However, to create jobs, the area is focusing on performance polymers such as engineering resins and rubber, nylon, performance plastics and materials as well as acrylics and polyols.

In North East Asia, many petrochemical refineries, especially in China, are close to the coal mines. This is done to increase the country's capability and self-sufficiency by converting coal to propylene, monoethylene

glycol and other feedstocks. A strong surge of investment is occurring in China focused on reducing import dependencies as domestic demand evolves. Shale gas is also under development in China, but that may not affect matters until the late 2020s.

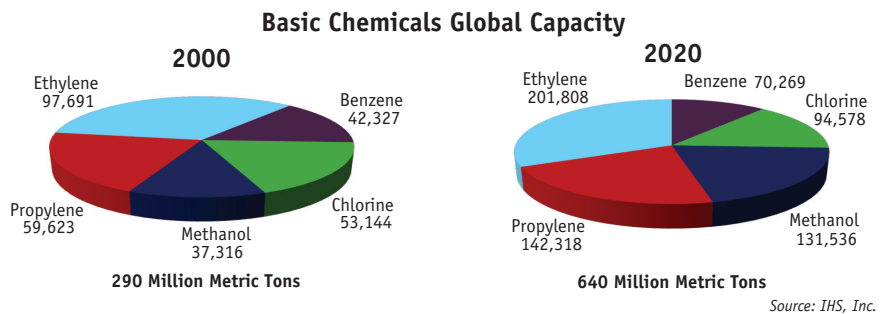
In North America, low-cost energy and abundant feedstock from shale oil and gas are driving new investments. Right now, the area has about a \$1,000-per-ton advantage over other potential producers. However, demand is weaker domestically and products are being sent to Asia and Latin America. North America also has access to trade and the technology to enable competitive production costs.

Still, North America is not going to

compete with China and South Korea on low supply chain products, Eramo said.

FORECAST:

- Investments in ethylene, propylene and methanol will accelerate in the near term, driven by "supply-push" dynamics as the U.S., China and the Middle East leverage competitive feedstock positions.
- Derivative trade will continue to grow as low-cost centers supply high-demand growth regions.
- Downstream manufacturing is expected to grow in North America for products with a high supply-chain intensity.



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Not Gone with the Wind

Thomas Decker, vice president and Atlantic Coast area leader of Brown and Caldwell, asked the outlook audience if the water and wastewater market was "Gone with the Wind." His answer to that question was a

resounding, "No!"

While the rough winter was a factor in the first quarter of 2014 for this end-user segment, signs are positive that the market will pick up in the second half of 2014, he explained.

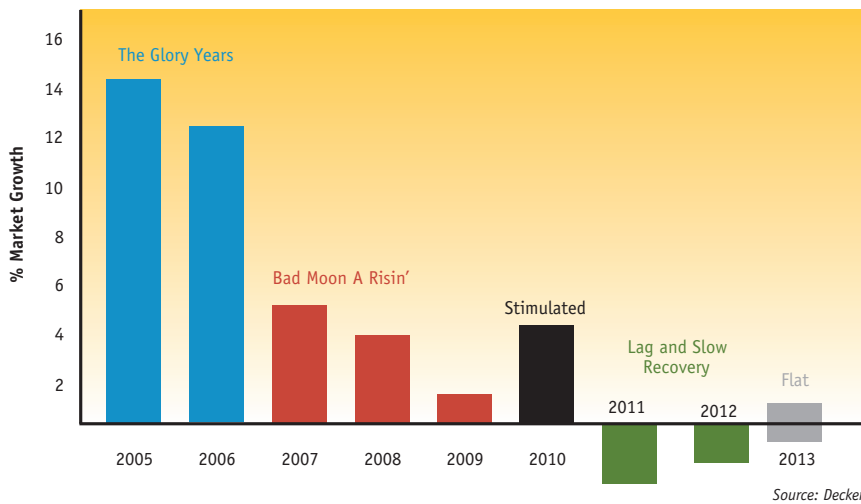
Municipal revenues are up slightly as the tax base is slowly improving. Rates are also going up slightly, and the public supports those rate increases. At the same time, people are conserving more water so the drop in con-

sumption is lowering income from water. That means municipalities cannot spend as much on improvements and capital projects.

Also, the U.S. population growth rate in 2013 was 0.7%, the lowest since the Great Depression, while housing growth has stalled, which means the demand for new water construction is down.

On the industrial side, a steady decline is occurring in industrial and commercial building. Even though small improvements have occurred in manufacturing in the U.S., the country is no longer a manufacturing-driven economy, he said, which means significantly less water demand for commercial and industrial companies.

Overall Market Performance for Water/Wastewater



No New Regulation

No comprehensive regulation that encompasses the entire marketplace, coast to coast, has occurred in 30 years, and the Safe Drinking Act of 1986 and the Clean Water Act of 1987 are both "expired." However, the country's infrastructure is deteriorating, which means some action must occur in the future. Studies show, for example, that in the U.S., 14-20% of water is treated and sent out but does not reach its destination. This is not just from leaking pipes, but also from outdated plants and pumping stations.

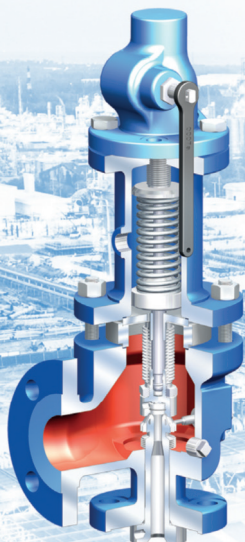
Although the government has not given this issue priority, EPA has taken action in the form of EPA enforcement activity, which is high right now. Ten new consent orders have been put into place in areas as diverse as San Francisco and Miami Dade (each has a \$1.6 billion agreement) to small cities such as Vicksburg, MS. Generally, the enforcement actions are triggered by overflows, but the fixes include many kinds of equipment from pumps to cleanup. Valve, pump, actuator and control manufacturers will see opportunities in these enforcement situations, Decker said.

Funding Challenges

A study by Black and Veatch indicated that 60% of water utilities say they will need a 5% increase per year for the next 10 years to meet their needs; 20% say they will need 10%. Los Angeles says it will need a 4% increase

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- ***Burst testing to 40,000 psi***

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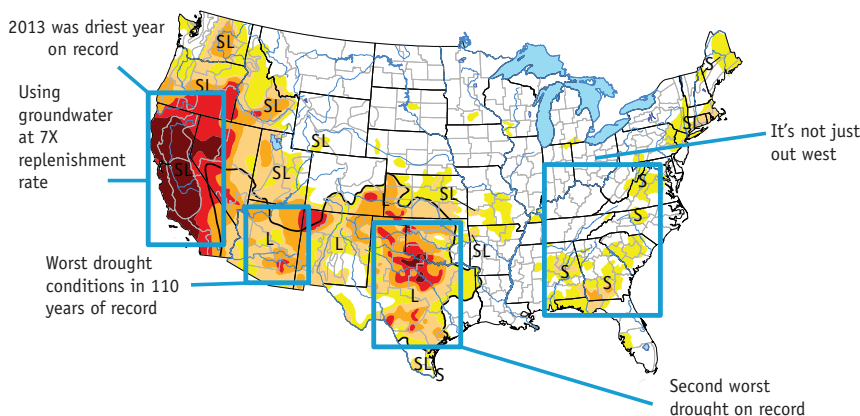


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Supply and Drought



Drought Impact Types:

- ~ Delineates dominant impacts
- S=Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- L=Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

Source: Richard Heim NCDC/NOAA

every year just to replace pipes that are 100 years and older. A number of water utilities are considering some form of public/private partnership to get the needed funding, and Decker recommended those in the market keep an eye on private money.

While current funding is not nearly enough to cover the needs, there is

some money available for water and wastewater projects across the country, Decker said. For example, in the summer of 2014 the "Water Resources Development Act" was passed with a subset on water infrastructure financing that gives a green light to 34 water infrastructure projects across the country.

Additional opportunities exist both domestically and internationally, Decker said. For example, EPA is increasingly looking to ensure that municipalities are creating separate storm water systems. Also, desalination is growing, although slower in the U.S. than other countries, and wastewater disposal for hydraulic fracturing continues to be an issue. Globally, world markets, including the Middle East, Southeast Asia and China, are growing in water/wastewater. There is some growth in India, but it is slower because the economy is not moving as fast as other world markets. In a positive move for the industry, the World Bank recently announced it is expanding infrastructure spending, Decker pointed out.

FORECAST: *While the last few years have been a challenge, 2014 will claw back to flat from a first quarter that saw some rough winter conditions. Very modest growth will occur in 2015 for the first time in four years.* **VM**

ON THE WEB

Simona Mokuta of IHS compared the post-recession progress of countries around the world with what's happening in the U.S. She reported that countries recovering well from the 2008 recession include Australia, which is now at nearly 120% of pre-2008 levels; Canada, which is at 110%; and the U.S., which is at about 108%. Historically, advanced countries have grown about 5% slower than emerging markets, but emerging economies are now growing only about 3% faster than established countries, and the pace of globalization has slowed.

Learn what Mokuta had to say about each country and what she thinks is driving the developments in the U.S., in an article on www.valvemagazine.com. Also on the website is an article ("Mining for Value") based on a presentation by Glen Ives of Deloitte Canada, who discussed the state of the mining industry and the trends affecting its profitability and future.



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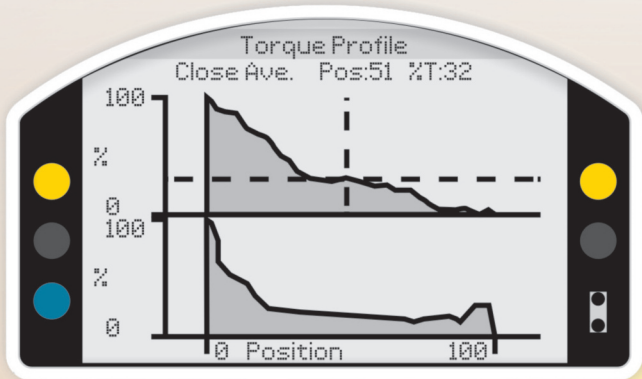
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DUKE ENERGY

From Coal to Combined Cycle

BY STEVE BROWN

In the United States and around the world, industrial processors are striving to do more with less—to maximize efficiency, minimize costs and remain compliant with increasingly stringent regulations governing operations and output. The need for higher production at lower cost is especially pronounced within the power market. Producers must balance the growing demand for energy with the changing regulatory environment, while the traditional methods of power production, such as coal-fired power, face challenges that threaten their future viability.

To keep pace with market trends, power providers must remain ahead of legislation, anticipate the evolution of the industry and implement the necessary adaptations. One significant illustration of this reality is the increasing trend to construct new power plants that use alternative fossil fuels. This article explores the cause for the conversion and explains how this change and the demand for increased efficiency has influenced the selection of valve equipment used in power generation.

Executive Summary

SUBJECT: Because of increasing regulatory restrictions and other factors, power generation is evolving in the United States from coal-fueled platforms to alternative fuels and renewable types of plants. The tougher regulatory environment, as well as stiff competition in the industry, have created an increased need to balance cost savings with greater efficiency.

KEY CONCEPTS:

- The transition of new build power plants from coal to combined cycle
- Changing fuel sources and plant types
- What these changes could mean for valve selection
- Forged versus cast products

TAKE-AWAY: Both cast and forged valves are important for the power industry with forged valves becoming more preferred in the most demanding applications and cast valves still comprising the balance of power plant valve installations.

THE ORIGINS OF COAL

Coal use in the U.S. has a history that predates the nation itself. Coal was used as early as the 1300s by the Hopi Indians for cooking, heating and pottery production, then rediscovered as a good source of energy by explorers in 1673. During the first half of the 1800s, the Industrial Revolution was instrumental in expanding coal's use, and the various applications used then became the basis for the modern proliferation of coal as an energy source in the United States.¹

Because of its applicability for a number of private, commercial and industrial processes, the consumption of coal is also driven by the fact that we simply have a good supply in this nation—we know where and how it can be readily mined. As a result, coal, which has nearly tripled in use since 1960, provides roughly half the nation's electricity today—far more than any other source of power. While proponents of coal maintain it is a low-cost energy source, both the mining and power generation processes can be costly and damaging to the environment.

Almost all coal plants operating today use pulverized coal technology, which involves grinding the coal, burning it to make steam and channeling the steam through a turbine to

generate electricity. A relatively newer technology known as Integrated Gasification Combined Cycle converts coal into gas that powers a combustion turbine to generate electricity. The method then uses the excess heat from the process to generate additional electricity via a steam turbine.²

The challenge, even with this technology, is that, when it burns, pulverized coal emits enormous quantities of carbon dioxide (CO₂) and other pollutants such as sulfur dioxide, nitrogen oxide, mercury and microscopic particulate matter, making coal-fired power plants the largest single source of CO₂ emissions in the U.S.

As a consequence, anticipated CO₂ regulations and other policy and market changes have already made an impact on the long-term viability of coal-burning electricity. Power companies are starting to integrate the future price of carbon emissions into their cost estimates for new plants, which may greatly compromise how practical investing in new coal projects will be. Although coal continues to be a significant domestic energy source and economic driver, producers are seeking cleaner, more viable solutions with a less-expensive regulatory footprint.

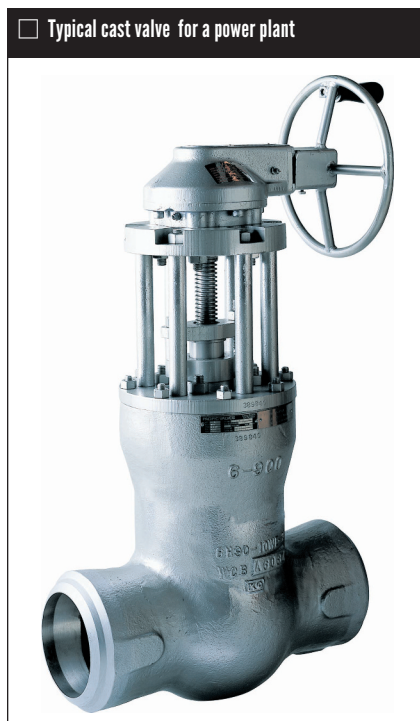
THE RISE OF COMBINED-CYCLE

According to the U.S. Energy Information Administration, many coal-fired generators in the United States are at risk for retirement from the impact of lower natural gas prices, higher coal prices, slower economic growth and intensification of environmental regulations. The Annual Energy Outlook 2014 Report states that, "of the total installed 310 gigawatts (GW) of coal-fired generating capacity available at the end of 2012, 50 GW, or 16%, is projected to be retired by 2020."³

As coal-fired power plants gradually become less sustainable, combined-



□ Typical forged valve for a power plant



□ Typical cast valve for a power plant

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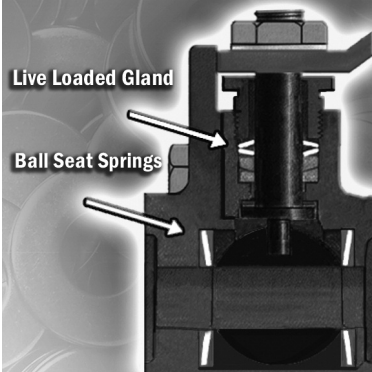
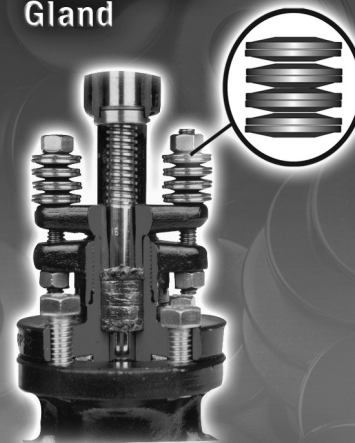
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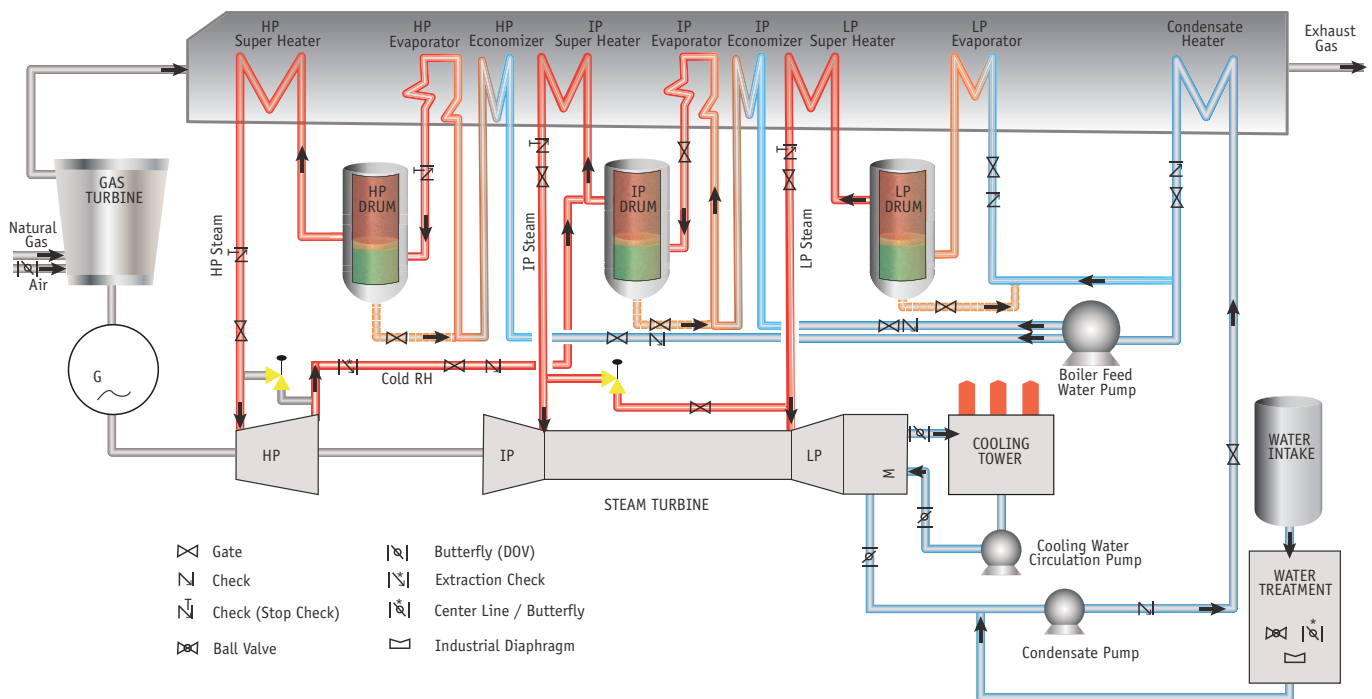
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cycle power plants offer an alternative for domestic power generation that is both cleaner and more efficient. Advances in hydraulic fracturing technology and the resulting shale gas boom have made natural gas the fuel of choice for an increasing number of private investors and consumers. Natural gas is more versatile than coal or oil, and can be used in 90% of energy applications. Also, power plants fueled by natural gas run at higher efficiencies than coal-fired power plants, operating with an average gain of nearly 10% when compared to coal.⁴

With these higher efficiencies, however, higher demands are placed on process equipment that must withstand increasing temperatures and pressures throughout the power cycle. The primary process steps in combined-cycle power plants are:

- **Air Inlet:** Air is drawn through the large air inlet section to be cleaned, cooled and controlled in order to reduce noise.
- **Gas Turbines:** The air then enters the gas turbine, where it is compressed, mixed with natural gas and ignited, causing it to expand. The resulting pressure spins turbine blades attached to a shaft and a generator to create electricity.

- **Heat Recovery Steam Generator (HRSG):** The hot exhaust gas exits the turbine at about 1,100°F (593°C) and passes through the HRSG, where layers of tall tube bundles are filled with high-purity water. The hot exhaust gas coming from the turbines passes through these tube bundles, which act as heat exchangers to boil the water inside the tubes and convert it to steam. The gas then exits the power plant through the exhaust stack at a much cooler 180°F (82°C), after having used most of its heat during the steam process. The steam is sent to the steam turbine through overhead piping.
- **Steam Turbine:** Steam enters the turbine with temperatures as high as 1,000°F (538°C) and pressure as high as 2,200 psi. The pressure of the steam spins turbine blades attached to a rotor and a generator, producing additional electricity (about 100 megawatts per HRSG unit). This is the origin of the term “combined cycle” power plant.
- **Cooling Tower and Boiler Feed Water Pumps:** After the steam is consumed in the turbine process, the residual steam leaves the turbine at low pressure and low heat at about 100°F (38°C). The exhaust

steam passes into a condenser, where it is cooled back into water and pumped back to the system using feed water pumps.

VALVE SELECTION CONSIDERATIONS

The transition of the power industry from coal-fired power plants to combined-cycle power plants has compelled, in part, a conversion from cast-steel valves to forged equipment. Combined-cycle power plants seek higher efficiencies to maximize returns; as a result, operating temperatures and pressures have increased, necessitating superior valve solutions that can withstand the conditions without suffering the impact of the harsher environment.

Market conditions also demand faster start-up times, increasing the severity of gas turbine starts. This in turn increases the thermal transients, with higher gas turbine acceleration and higher gas flows at increased temperatures, feeding the HRSG. Every time the plant is turned on, then turned off (cycling), the gas turbine, HRSG unit, steam lines, steam turbines and auxiliary components undergo drastic thermal and pressure stress. This can quickly damage the equipment and dramatically accelerate the wear and tear on valves. As a result,

non-cast valve solutions are becoming increasingly sought by both supercritical coal and combined-cycle power producers.

Because process equipment in these conditions is subject to a lifetime of thermal cycling (hot, warm and cold start), load changes and trip scenarios, valves can become susceptible to material creep and fatigue damage, which may dramatically limit service life. By being inherently free of the internal discontinuities typically found in cast products, forged valves are less prone to defects like blow holes and shrinkage. As a result, they are becoming increasingly popular in some power generation applications.

Despite the growing popularity of large forged valves, there are still hundreds of applications throughout a power plant where castings are also well suited, including high-pressure steam. Cast technology is proven and has been used in the majority of power projects for over a century. Without the additional expense of forging dies and machining, cast valves are generally more cost-effective than their forged counterparts. They are successfully used in continuously-run modern plants, where many of the problems originally attributed to cast valves have been eliminated. Furthermore, cast valves are often easier and more practical in terms of design modification, fabrication and upgrade.

While both types of valves have distinct advantages in the proper applications, neither is completely impervious to the potential for defects. Forged valves are susceptible to laps, seams, poor grain structure and bursts—internal tears that can result in valve cracking. Castings are vulnerable to surface discontinuity, sand inclusions, porosity, hot tears and shrinkage cavities.⁵ Despite these possibilities, however, good forging and casting processes can eliminate the risk of defects, which underscores the importance of selecting a reliable valve supplier.

Castings remain appropriate for a wide range of applications, especially in cases where a unique metal composition is required, the part is relatively large or complex, or weight and cost are prohibitive factors. However, the inherent ability of forgings to provide

longer life in today's demanding applications is attractive for the volatile environment of a frequently cycling, combined-cycle power plant. To truly understand the best valve solution for a particular application, valve users and manufacturers must work together to evaluate product design, quality and cost, and select the most appropriate product for their needs.

CONCLUSION

With coal use facing gradual reduction in the U.S. and natural gas fueling the next generation of power production, valves and other process equipment must be designed to address specific conditions of the changing environment.

Power professionals worldwide seek to assure their operations are increasingly efficient. But productivity gains come at a cost because increases in plant cycling, temperatures and pressures place additional burdens and stress on the equipment. Consequently, valve users seek solutions that are reliable, safe and, above all, efficient to meet the energy needs of an increasingly-demanding nation.

RESOURCES

1. A Brief History of Coal Use, U.S. Department of Energy, Fossil Energy Office of Communications, Feb 12, 2013. Accessed Aug. 1, 2014
2. U.S. Energy Information Administration; Annual Energy Outlook 2014; May 7, 2014. Accessed July 28, 2014.
3. "Natural Gas Reserves." BP. Retrieved Aug. 1, 2014.
4. U.S. Energy Information Administration, Form EIA-923, "Power Plant Operations Report," and predecessor form(s) including U.S. Energy Information Administration, Form EIA-906, "Power Plant Report;" Form EIA-920, "Combined Heat and Power Plant Report;" and Form EIA-860, "Annual Electric Generator Report."
5. "Castings or Forgings? A Realistic Evaluation." Malcolm Blair and Raymond W. Monroe. Steel Founders' Society of America. Crystal Lake, Illinois. Retrieved Sept. 2, 2014.

Forged and cast valve solutions alike meet this need in the harsh environment, while offering users the quality and dependability commanded by the ever-dynamic industry. ❧

STEVE BROWN is the global business line manager for Crane ChemPharma & Energy's line of Pacific GGC valves (www.cranechempharma.com). In addition to his technical knowledge, Brown has a background in product management and new product development. Reach him at sbrown@cranechempharma.com.

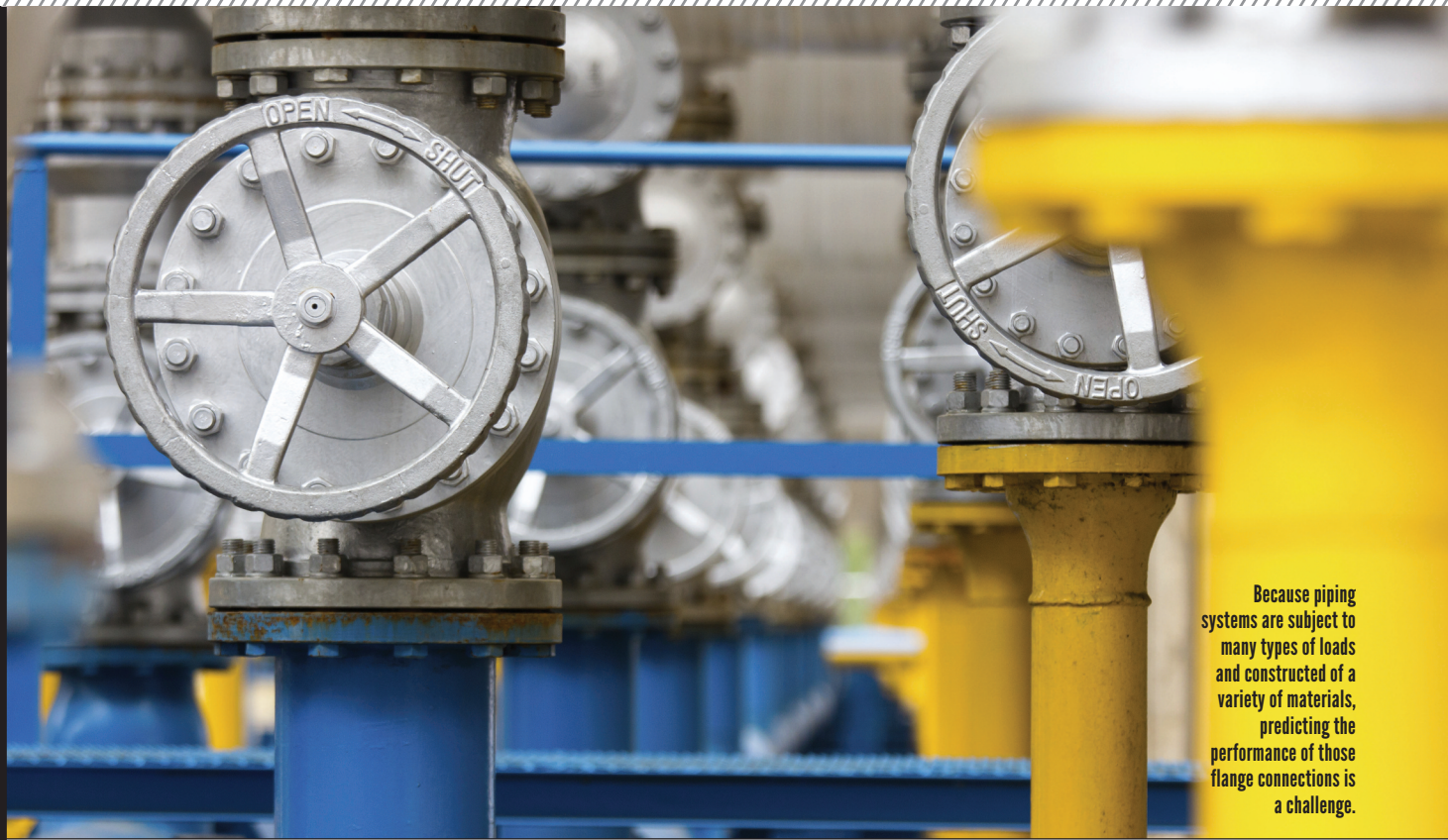
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Because piping systems are subject to many types of loads and constructed of a variety of materials, predicting the performance of those flange connections is a challenge.

Understanding and Selecting Valve Flanges

PART ONE: Design and Standards

BY JOHN V. BALLUN, P.E.

Because flanges allow the assembly and maintenance of system components without the need for cutting and welding pipe, they play an important role in piping systems. However, the structural integrity and leak tightness of waterworks piping systems are only as strong as the weakest element, which often is the flange connection between various valves and fittings. Yet because piping systems are subject to many types of loads and are constructed of a variety of materials, understanding and predicting the rating and performance of those flange connections is difficult. This is further complicated by the fact that different sealing mechanisms such as gaskets, O-rings and mechanical seals can significantly affect the performance of the connections. As far as ratings, ASME B16.1 lists pressure ratings for Class 125 flanges from 50 to 200 psig depending on size, material and temperature.

This two-part article explains in detail the variables that affect flange ratings, then describes how flanges are produced and the accepted methods for use and installation. We've included part one here in the print version. Part two is on VALVEmagazine.com.

Executive Summary

SUBJECT: Flanges are a critical component in piping systems. They can also be the weakest link in the flow channel if the people who put them in place do not understand what goes into specifying the right ones.

KEY CONCEPTS:

- What goes into flanges
- Standards for flanges
- Classes and sizes

TAKE-AWAY: To get the best flange in place requires a thorough understanding of the various challenges they face, what materials are used and how those materials interact, and which classes and types are appropriate for which challenges.

THE GEOMETRY OF FLANGES

A basic flange found on most waterworks valves and fittings is shown in Figure 1. The connection consists of a circular ring or flange welded to or cast integrally with the valve body and pipe. The basic dimensions of a flange consist of the outside diameter (OD), bolt circle diameter (BC), thickness (T) and the number and size of the bolt holes. The bolt pattern in valves and fittings typically straddles the vertical centerline. The flanges of two fittings mate together and are sealed with a resilient gasket, which is tightly compressed by the bolts located in a circle concentric with the pipe OD. To obtain a tight seal, the bolts must withstand the hydrostatic end force of the pipe and compress the gasket to a multiple of the maximum pressure of the system.

Because of the body shape of some valves, valve flanges often contain tapped holes instead of through holes, which affects the selection of bolting. The 24 nominal pipe size (NPS) eccentric plug valve shown in Figure 2 requires four tapped holes on the top and four tapped holes on the bottom of the flange because the nuts behind the flange would interfere with the main part of the valve body.

A flange is a structural element of the piping system that must withstand the pressure and pipe loads related to that system since the element is a rigid or restrained joint. The flange connection will not slip or pivot, and it must withstand the internal pressure forces without any external restraint. Certain push-on and mechanical joint connections often used below ground are not restrained. This is an important distinction that affects the supports, anchors and thrust blocks needed for many systems. The flange must be strong enough to transfer pipe loads, pressure forces and gasket loads from the bolts to the connecting pipe, fitting or valve. When a pipe is pressurized internally, the hydrostatic forces tend to stretch the pipe and pull the flanges apart. The bolts must maintain contact between the mating flanges and gaskets without excessive stretching.

To absorb these loads, a designer has several types of flange shapes available as shown in Figure 3. The

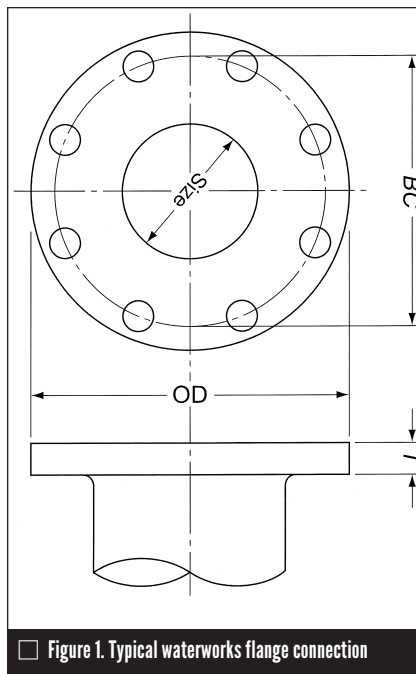


Figure 1. Typical waterworks flange connection

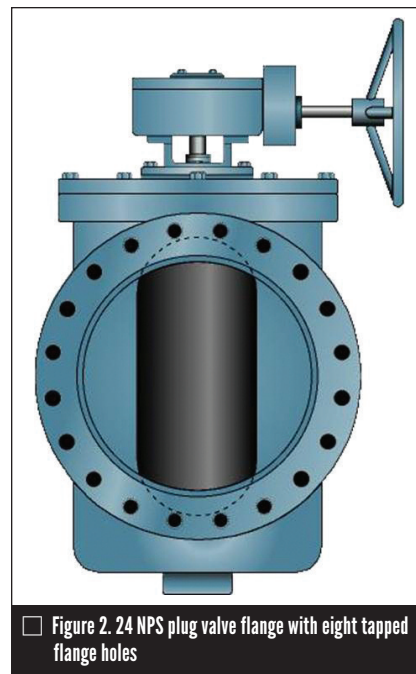


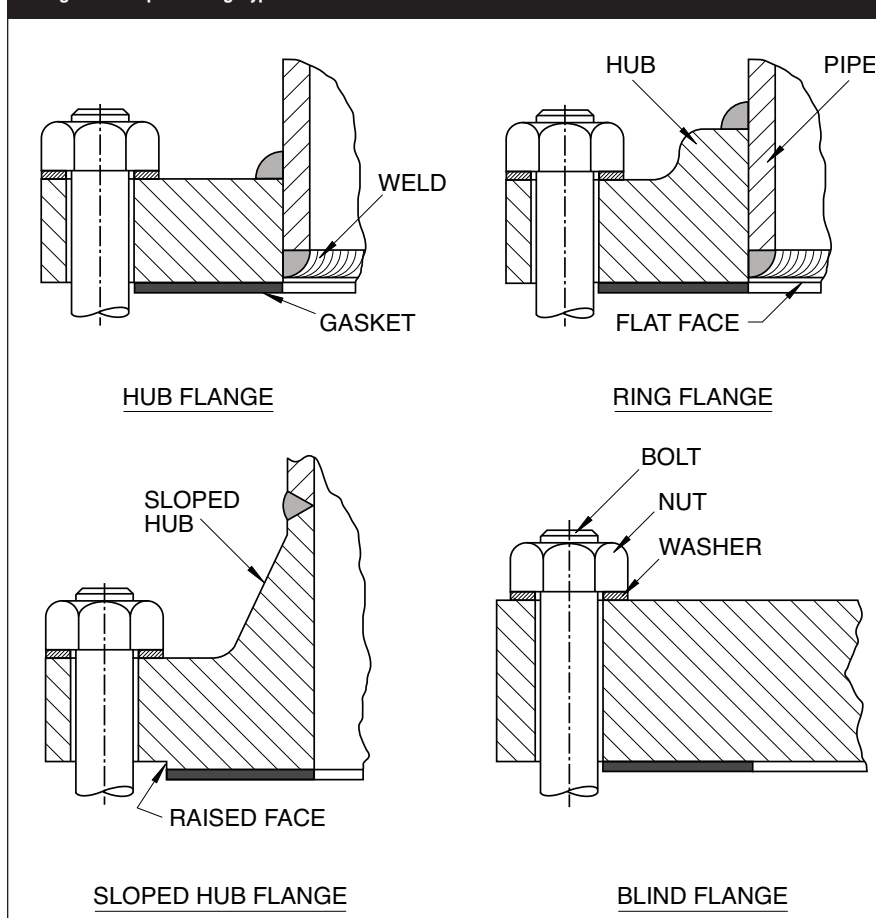
Figure 2. 24 NPS plug valve flange with eight tapped flange holes

simplest is the ring flange, which consists of a flat plate of uniform thickness.

The hub flange is similar to the ring flange but has additional material at the base of the flange so loads are dis-

tributed more uniformly to the pipe or fitting. Ring and hub flanges can be attached to the pipe by welding or threading (companion flange). High-pressure steel flanges often have a raised face and sloped hub that opti-

Figure 3. Examples of flange types



mizes the strength-to-weight ratio of the flange. These are attached to the pipe with a butt weld. The raised portion of the flange focuses the bolt load over a smaller gasket area, which improves the gasket's performance. Finally, when the purpose of the flange is to block off the end of the pipe, a blind flange is used, which consists of a solid flat plate. A flat plate is an inefficient shape to withstand pressure (as opposed to dished heads, which are better), so blind flanges tend to be thicker than pipe flanges.

FLANGE MATERIALS

Pressure ratings of flanges are based on their material of construction. This makes sense because steel can be twice as strong as gray iron. However, to understand how material strength affects flange ratings, it is important to understand fundamental mechanical properties of metals.

For example, the mechanical properties of gray iron and ductile iron differ greatly despite the fact they are both iron alloys. To produce a cast flanged

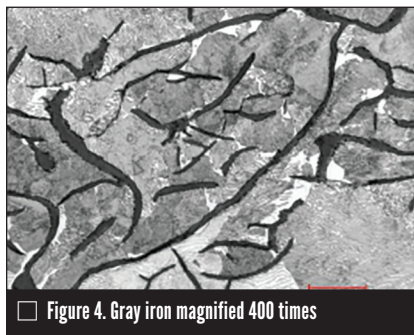


Figure 4. Gray iron magnified 400 times

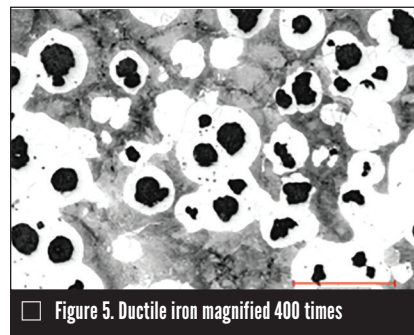


Figure 5. Ductile iron magnified 400 times

fitting, pig or scrap iron is melted down and combined with other elements such as carbon and silicon to produce unique properties. Figure 4 shows that when gray iron solidifies, its grain structure includes graphite (carbon) in the form of flakes, which appear as jagged lines in this illustration. These flakes give gray iron its strength and hardness, but at the same time, make this metal brittle. Nevertheless, gray iron is used extensively in fittings and many other products including engine blocks because the graphite structure absorbs noise and exhibits favorable resistance to wear.

Conversely, when ductile iron is

cast, the molten metal is treated with magnesium, which causes the graphite to solidify into the nodules seen in Figure 5. The nodule shape gives ductile iron greater strength and less brittleness than gray iron. Materials such as ductile iron tend to deflect significantly before they fracture. This tendency, which is similar to what happens with a rubber band, is called ductility. Granted, that rubber band may deflect five to 10 times its length before it breaks, but ductile iron can deflect as much as 18% before breaking. Since ductile iron can bend like steel, it also has the ability to absorb shocks, which helps reduce line breaks in water main

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applications. This shows how knowledge of materials and their mechanical properties allows engineers to establish safe and predictable flange designs for use in various industries.

FLANGE STANDARDS

To allow components within an industry to be interchangeable, engineers have developed standard dimensions over many decades for bolts and flanges for a variety of pipe sizes and pressure ranges. The first such effort was undertaken by the American Society of Mechanical Engineers (ASME). ASME is dedicated to ensuring the safety of the general public from the risks of pressurized systems such as boiler piping. Beginning in 1920, the ASME B16 committee assumed responsibility for developing codes and standards related to valves, pipe flanges and fittings. The committee's published body of work includes standard dimensions and pressure/temperature ratings for gray iron flanges and fittings (ASME B16.1), ductile iron (ASME B16.42) and steel (ASME B16.5). ASME also recently produced a

standard for large steel flanges (ASME B16.47), but it is mainly used by the petroleum industry. Compliance with these standards is voluntary, but their application ensures safety at stated pressures and temperatures as well as uniformity so that flanged valves and fittings from different manufacturers can be interchanged.

Similarly, the American Water Works Association (AWWA) A21 Committee publishes flange and fitting standards that mate with some of the ASME flanges, but are designed for cold water service. Most notably, AWWA C110 ductile iron and gray iron fittings describes 3- to 48-inch fittings and flanged joints with Class 125 dimensions for waterworks service. These fittings and their ratings are based on extensive burst testing and provide a safety factor of at least three times the rated cold working pressure (AWWA C110). Because the products are intended for cold water, the ratings of AWWA fittings and flanges are higher than a similar ASME fitting. Keep in mind, however, that the ASME fittings are

also used for steam service, which is far more hazardous than waterworks service.

It is also important to realize that while valves incorporate these flanges, their pressure ratings may differ based on different valve standards. For example, some butterfly valves with Class 125 flanges have flanges capable of 250 psig, but AWWA C504 rubber-seated butterfly valves limits the maximum working pressure of gray iron valves to 150 psig.

FLANGE CLASSES

ASME and AWWA standards provide dimensions for various classes of flanges. Given those dimensions, the standards development organizations establish pressure ratings for flanges and fittings based on the materials from which they're made and the temperatures at which they're used. These pressure classes of 125, 250, 300, etc. cause considerable confusion in the industry. This is because the classes often are interpreted as rated pressures for the flange; but nothing could be further from the truth.



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Instead, these classes are “designations” that generally represent a pressure and temperature for saturated steam. For example, an ASME B16.1 Class 125 flange is rated for 125 psig at 353°F (178°C), which is the boiling temperature for water at that pressure. As temperature increases, the pressure rating of the flange decreases. For example, a Class 150 flange is rated about 270 psig at ambient conditions (i.e. 100°F or 38°C), 180 psig at 400°F

(204°C), 150 psig at 600°F (316°C), and 75 psig at 800°F (427°C). At ambient temperatures, it makes sense that the pressure ratings are higher than the saturated steam pressure. When the temperature rises, the rated pressure goes down and vice versa. Pressure and temperature tables in the applicable standards must be consulted to apply them to a piping system.

A general summary of flange pressure ratings versus temperatures is

shown in Figure 6. The ASME pressures represent nonshock pressure ratings, as in steady pressures, not pressure spikes or cyclic water hammers. Conversely, AWWA fittings are adequate for the rated pressure plus a surge allowance of 100 psi or half the rated working pressure, whichever is less (AWWA C110). The table brings to light some important observations.

- In all cases, as the maximum temperature increases, the pres-

Figure 6. Nonshock pressure ratings of gray and ductile iron flanges in psig

Max-Temp	ASME STANDARDS (ASME B16.1 and ASME B16.42)								AWWA STANDARDS (AWWA C110)			
	Gray Iron ASTM A126				Ductile Iron ASTM A 395				Gray Iron		Ductile Iron	
	Class B				Gr 60-40-18				Class 25 or 30		Gr 70-50-05	
	CLASS 125		CLASS 250		CLASS 150		CLASS 300		CLASS 125		CLASS 125	
	NPS 1-12	NPS 14-24	NPS 1-12	NPS 14-24	NPS 1-12	NPS 14-24	NPS 1-12	NPS 14-24	NPS 3-12	NPS 14-24	NPS 3-12	NPS 14-24
100°F	200	150	500	300	250	250	640	640	250	250	350*	350*
200°F	190	135	460	280	235	235	600	600				
300°F	165	110	375	240	215	215	565	565				

*With special gasket containing molded annular sealing elements.



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The Manufacturers Standardization Society held its first meeting just as Calvin Coolidge was being inaugurated back in 1924. Since that time the organization has developed nearly 150 standards relating to the valve, fitting and actuator industry. Many former MSS standards have been adopted by ASME and API and have become backbone documents for the industry. Today nearly 100 companies participate in MSS activities, creating new standards that will stand the test of time.

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sure rating of the flange goes down. Metals are weaker at high temperatures.

- Most of the time, the pressure ratings do not match the class designation at 100°F (38°C).
- As the class designation increases, the pressure rating increases.
- Ductile iron flanges are rated higher than gray iron flanges.
- AWWA C110 only specifies Class 125 drilling.
- The AWWA fittings are not rated for high temperatures.

The ASME standards contain many other standard pressure classes. But in the waterworks industry, Class 125 and Class 250 apply to gray iron flanges, while Class 150 and Class 300 apply to ductile iron, steel and stainless steel (ASME B16.1, ASME B16.42). The bolting patterns of Class 125 and Class 150 match, as do Class 250 and Class 300. It is important not to mix the rating of the fitting with the drilling of the flange. Most AWWA fittings have Class 125 drilling, but a 250 psi rating even when made of gray iron (AWWA C110).

Figure 7. Flange size relationship

U.S. Customary Sizes	International Sizes
NPS 1	DN 25
NPS 1-1/2	DN 40
NPS 2	DN 50
NPS 2-1/2	DN 65
NPS 3	DN 80
NPS 4	DN 100
For NPS > 4, the DN is NPS x 25	

In the waterworks industry, AWWA publishes standards for flanged fittings and valves that are related to the ASME standards. Because AWWA fittings and valves are used with water, which is considered a safer medium, the general safety factor may be lower than with the more hazardous high-temperature steam applications. AWWA also allows several alternate grades of gray iron and ductile iron.

FLANGE SIZES

Even though every flange size and pressure class has an exact OD, flange sizes are denoted by the size of the pipe, which is expressed as NPS. It is

often assumed that NPS stands for the size in inches of a pipe; but technically, the NPS value is a dimensionless number related to the reference nominal diameter (DN) used in international standards. Similarly, the DN sizes are dimensionless and not millimeters. The general relationship is shown in Figure 7 (ASME B16.5). Each flange standard has limited size ranges and pressure classes. Figure 8 presents the scopes of the various standards. In addition to those listed, flange standards exist for stainless steel, copper and international (metric) drilling. Still, these standards are the most common in this industry.

Some general facts should be understood when using these standards.

First, Class 125, Class 150 and AWWA Classes B, D and E flanges have the same bolt pattern and can be joined together (AWWA C207). The same goes for Class 250, 300 and AWWA Class F.

The steel flanges given in ASME B16.5 only go up to NPS 24; so that standard is of little use for large flanges. Because of this, AWWA C207 is used for large steel flanges in the

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Flanges are a vital part of the piping system and come in many different configurations.

waterworks industry. C207 is a relatively new standard for which dimensions for sizes up to NPS 144 in 1978 (AWWA C207) were just released. Therefore, many valves and fittings in the field have special flange drilling. Caution should be exercised when fabricating replacement equipment for existing piping systems.

Class 125/150 drilling is the most common flange in the waterworks industry. In fact, it is so common some projects specify iron valves with 250/300 flanges drilled specially to mate with a Class 125/150 bolt pattern. This is done so that the valve can carry the same pressure rating as the steel mating flange. However, doing so is not practical since it adds unnecessary weight to the valve and is unsightly when the flange diameters do not match in the

pipeline. A better practice is to specify a Class 125/150 valve flange in ductile iron, which will carry a pressure rating similar to the steel mounting flange.

Finally, Class 250/300 drilling is common, but only available up to size NPS 48. Above that size, flanges will have the 125/150 drilling with the pressure rating dependent on the material (ASME B16.1).

CONCLUSION

Flanges are an important component of piping systems and are provided by both valve and pipe manufacturers in many configurations. Complete knowledge of their design and applicable standards is essential for a piping system to be successful. In the waterworks industry, valve and pipe flanges are provided in many alternate materi-

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als and conflicting pressure class designations. To avoid serious construction problems and unneeded costs requires thorough knowledge of flange ratings and specification of flange systems that meet the required pressure and temperature requirements of the piping system. **WM**

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Figure 8. Applicable waterworks flange standards

FLANGE STANDARD	MATERIALS	CLASSES	SIZE RANGE
ASME B16.1	Gray and Ductile Iron	25, 125, 250	NPS 1 to 96
ASME B16.5	Steel, Stainless Steel	150, 300, 400, 600, 900, 1500, 2500	NPS ½ to 24
ASME B16.42	Ductile Iron	150, 300	NPS 1 to 24
ASME B16.47*	Steel, Stainless steel	75A, 150A, 300A, 400A, 600A, 900A, 75B, 150B, 300B, 400B, 600B, 900B	NPS 26 to 60
AWWA C110	Gray and Ductile Iron	125	NPS 3 to 48
AWWA C207	Steel	B (86 psi), D (175 psi), E (275 psi), F (300 psi)	NPS 4 to 144
MSS SP-44*	Steel	150, 300, 400, 600, 900	NPS 12 to 60

*CAUTION, These standards apply to steel petroleum pipelines and do not match B16.1 drilling in large sizes. The "A" designation indicates MSS SP-44 compatibility; the "B" designation indicates API-605 compatibility (ASME B16.47).



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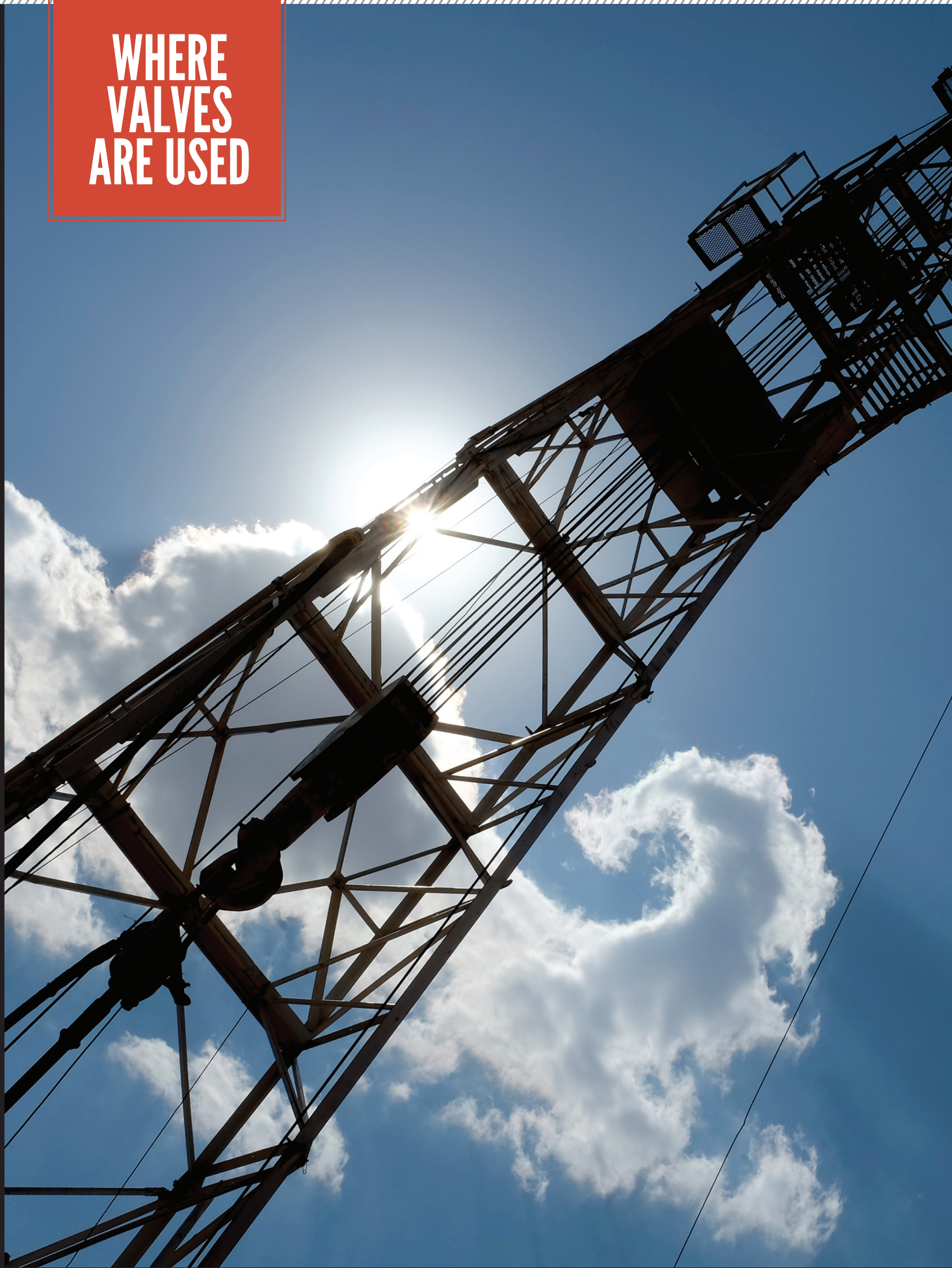
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Recovering More Oil Through CO₂ Flooding

BY GREG JOHNSON

Not so long ago, some experts were declaring that the oil boom was dead. The energy-charged oilfields in many areas of the U.S. had seen better days and short-lived plentiful production from water-injection-fueled secondary recovery efforts were just a highlight in the rearview mirror.

The experts were wrong. American ingenuity had not abandoned the oil industry; new ideas were simmering.

The world now knows about the sometimes-controversial fracking process and how it has caused the gas industry in North America to figuratively explode in the last few years. But other processes, including a type of oil recovery that injects carbon dioxide (CO₂) into the process, are contributing to a rebounded oil industry as well, and these processes require many specialized valves.

HOW WE GOT HERE

Since the initial oil boom of the early 1900s, tens of thousands of wells have been pierced into the crust of our North American continent, concentrated in many diverse oil fields and producing billions of barrels of oil. During that process, the initial hydraulic pressure that brought the oil to the surface of these fields slowly played out. Oil still lies beneath the ground in these spots; it just would require energy and new methods to get it out.

The vision of an oil well “gusher” is outmoded: We rarely see such events today. The physics behind that gusher involved huge amounts of hydrocar-

bons held under extreme pressure deep in the ground. This high-pressure oil was located in pools of highly porous rock and only required the piercing of a pipe open to the surface a few thousand feet up to release fluid to the surface “with great prejudice,” which made for great visuals of spouting wells. But this is only a small part of the oil picture.

Oil exists in the pore spaces of rock formations, defined as the open area between the solid grains of material that make up the rock. The more porous the rock and the more interconnected the pore spaces, the easier the oil flows. This interactivity in the rock formation is called permeability, and different types of rock have different degrees of permeability. For example, sandstone is a very porous rock that easily holds hydrocarbons, while granite essentially has zero permeability.

The different levels of permeability mean oil and gas in porous rock formations can be trapped underground, surrounded by impermeable rock formations.

Within a matter of weeks or months after a well is completed and flowing, the “reservoir pressure” dissipates to zero, and the oil has to be brought to the surface with the aid of the rock and roll motion of the iconic pumping units. These pumps continually and easily pull the oil to the surface for a good while; but at some point, the suction of a pump ceases to be effective in pulling the oil from the porous rock.

Executive Summary

SUBJECT:

One of the tools this nation has in working toward energy independence is maximizing what an oil well can produce. An effective way to do this is through a method that alternates water and CO₂ flooding.

KEY CONCEPTS:

- How it works
- What it requires
- The valves used

TAKE-AWAY:

CO₂ recovery provides new opportunities for using valves and related equipment.

producing through the end of the 20th century.

The initial drilling and secondary recovery processes can yield up to 25-40% of the oil in a formation. But that leaves 60-75% of the oil still trapped underground.

In areas of thick oil impregnated sand (oil sands), such as those found in Canada, steam injection is very effective in unlocking and releasing some of the remaining oil. However, the steam injection process does not work well with many "sweet crude" formations found in the lower 48 states of this nation, particularly some of the fields in West Texas and the Gulf Coast.

In 1972, a new method of EOR was tried in the Permian Basin of West Texas called CO₂ flooding. From a production standpoint, this process has been a huge success with the added bonus that it makes use of a byproduct of energy that has been classified by the U.S. government as a cause of greenhouse gas.

HOW IT WORKS

To retrieve the tightly-held sweet crude that remains after the initial extraction processes, the physical characteristics of the fluid itself must be changed. CO₂ is a great choice for doing that because the CO₂ and the oil are miscible, meaning they are capable of becoming one homogeneous fluid. CO₂ readily dissolves in some crudes and can offer a 10-fold viscosity reduction for heavy crudes. By contrast, oil and water are immiscible and hard to combine.

For CO₂ and crude to become one, the CO₂ must be raised to a "supercritical" state through pressure and temperature increases. When this supercritical state is achieved, the two substances combine completely. This unique marriage results in a fluid that moves more readily through porous rock.

Although the CO₂ in this process is the primary injected ingredient, water usually plays an important part. Water is usually alternated with CO₂ in a process called water-alternating-gas (WAG) injection. In practice, water is injected into the formation for a period of days or weeks, then the CO₂ fol-



□ A typical Permian Basin injection manifold found just upstream of the wellhead is where incoming, very-high-pressure CO₂ and water are alternately fed into the Christmas tree and down into the oil-bearing formation.

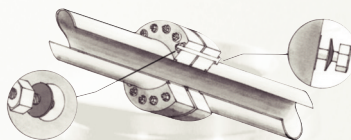
A secondary oil recovery technique is often employed at this point; it adds pressure to the whole formation to release more of the oil imbedded in the soft rock surrounding the now-depleted pool. These

secondary techniques use water or brine flooding to add pressure to the reservoir and squeeze out more trapped oil. This initial round of secondary enhanced oil recovery (EOR) kept some older fields

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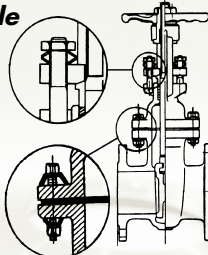
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□ The CO₂ injection wellhead channels CO₂ and water about 3,000 feet down into the oil-bearing West Texas rock formations.

lows. Next, the water and CO₂ are alternated.

The U.S. Department of Energy is very bullish on the CO₂ injection process. In 2012, the department projected potential oil reserves recoverable by CO₂ EOR at over 150 million barrels. This threefold increase in proven reserves translates into billions of dollars of new investment into the industry, and the potential for nearly 5 million barrels of crude a day for the next 50 years from existing fields.

Because the process begins with CO₂, the source for obtaining it is important to the picture. Currently, most of the CO₂ is piped in via high-pressure pipelines from sources of naturally occurring CO₂ or from gas separation plants. However, plans are well underway to use byproduct CO₂ from power plants and other industrial sources.

Currently a network of CO₂ pipelines carries that product to Texas CO₂ injection fields from naturally-occurring sources in New Mexico, Colorado and Mississippi.

PIPELINES AND VALVES

The CO₂ pipelines vary in diameter, depending upon the length of the run. Pressures in pure CO₂ lines are generally high, in the 2,000–2,300 psi range, which

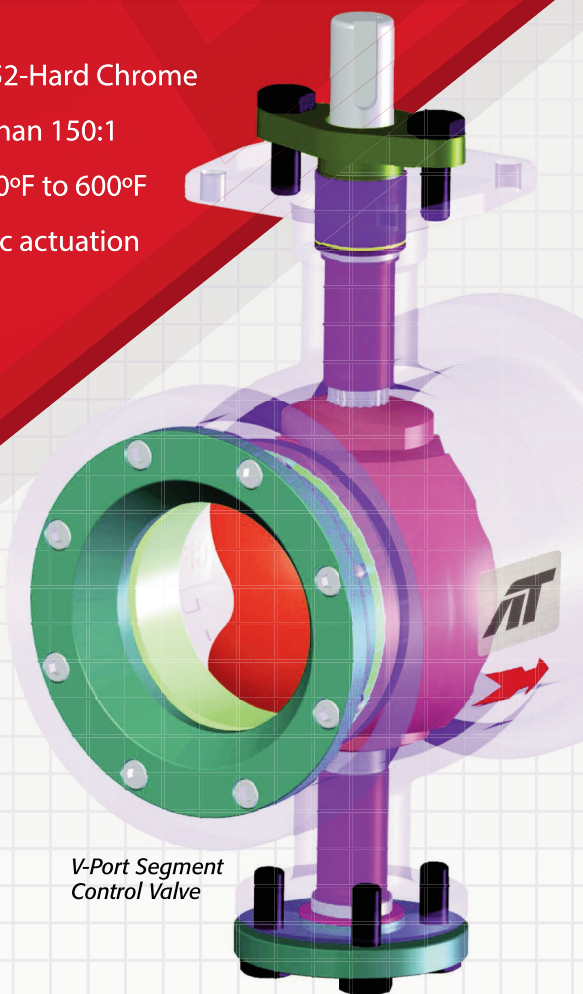
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□ This is the termination point for the incoming pipeline from New Mexico that brings CO₂ to the field at a pressure of around 3,000 psi. The check valve and redundant pressure relief valves are critical for protecting the piping system from backflow and overpressure.

means Class 600 piping and valves are needed. Some lines operate under even higher pressures (about 3,000 psi), which requires use of Class 1500 rated valves and piping components.

The design of these pipelines, including valve requirements, is covered by the American Society of Mechanical Engineers (ASME) B131.4,

Pipeline Transportation Systems for Liquids and Slurries, and B31.8m Gas Transmission and Distribution Piping Systems. CO₂ pipeline valves are usually built to American Petroleum Institute (API) specification 6D, Pipeline Valves design standards. Once the CO₂ reaches the oilfield site, it is concentrated into a pre-battery distribution

system that contains a variety of gate, ball, check, pressure-relief and control valves. CO₂ from these facilities is then distributed under high pressure to batteries of piping, tanks and valves that provide water and CO₂ to the injection wells.

Up to this point, the dry CO₂ is relatively benign as far as corrosion. Standard, low-carbon steel materials are the primary body materials of valves used here while the biggest material concern is the lowest ambient temperature of the field itself. Turbulence often is a critical factor in the corrosion rate of a CO₂ line. Excessive turbulence can prevent the formation or retention of the iron carbonate film that protects low-carbon steels. If excessive turbulence cannot be avoided, then more corrosion-resistant materials or coatings are recommended.

In the Permian Basin and on the Gulf Coast, ASTM A216 grades WCB and WCC are used for castings, while forgings are commonly ASTM A105 material. However if the CO₂ is throttled down in the piping run, velocity increases and operating temperatures can drop below the -20°F (-28°C) lower temperature range of the WCB, WCC and A105 materials. If this situation is anticipated, lower-temperature-rated base materials such as LCC, LCB, LF2 or 300 series stainless steels may be used.

When the pure CO₂ reaches the battery site, it is combined with CO₂ that has already been forced underground, separated and captured after it reached the surface. For the separation process, oil, brine and CO₂ are parted from each other in large plants built specifically for the purpose. These plants can be the size of a small oil refinery, using hundreds of valves of all types and materials.

THE NEXT STEP

The new and processed CO₂ is now ready for the injection process. The actual mixing is performed either at a manifold that feeds into each individual injection well or on the Christmas tree itself. The manifolds are usually NPT 2-inch size. Most of the piping from this point on through the injection process calls for Class 1500 valves.

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Because of the physics of the fluids involved and the differing permeability of various rock types in the oil-bearing formation, CO₂ by itself is not as effective in pushing the oil to the production well as alternating it with water.

The WAG process requires much water but what's used is often recycled. The water must be pressurized to a level higher than the CO₂ pressure in the well, or the water can't be injected. To gain pressure for the water injection cycle, high-pressure pumps are used to bring the system up to about 3,000 psi, or slightly above the CO₂ injection supercritical pressure. The injected water may also contain salt, so proper trim material selection is important: 300 series stainless steel is often the material of choice for valves used here.

The battery contains a series of non-pressurized tanks to store the water and provide a slight head pressure for input into the high-pressure water pumps. For control of low-pressure water flow, standard rubber-lined butterfly valves are often selected.

Once the water is combined with the CO₂, either in a mixing manifold or on the Christmas tree itself, the corrosion requirements for the valving change drastically. When the two compounds finally mix, carbonic acid is created. Like most other acids, this compound requires special valve materials and trim. If a mixing manifold is employed, Class 1500 austenitic stainless-steel ball valves are a popular choice.

After the feed line reaches the Christmas tree atop the injection well, the design standard for valves changes from API 6D, Specification for Pipeline Valves or other general commercial valve standards, to API 6A, Specification for Wellhead and Christmas Tree Equipment.

These wellhead master valves are critical fluid control features of the CO₂ flooding process. In the Permian Basin, the most popular valves for this service are Class 1500 aluminum-bronze-bodied, stainless-steel-trimmed API 6A, gate valves in sizes 2-3/8 inches and 2-7/8 inches. These valves have a good record of reliability after many years of tough service.

Because many of these valves contain elastomers, selection of O-ring or seal material is critical. In high-pressure gas service, elastomers can easily fail from a phenomenon called explosive decompression, which in this case is caused by CO₂ diffusing into the elastomeric compounds under the right combination of pressure and temperature, such as supercritical CO₂. This situation can cause elastomers to crack, blister, and fracture or catastrophically fail. The most common way to alleviate the possibility of explosive decompression is to increase the hardness of the elastomer. For O-rings in CO₂ service, Buna or Nitrile

O-rings of a hardness of at least 90 durameters or higher is preferred. The Buna and Nitrile products are relatively inexpensive; however, costlier EPDM and Kalrez elastomers also work well.

Once the CO₂ WAG process has been instituted, the underground oil is forced to strategic production well sites. These wellheads regulate the oil on the surface and direct it to facilities where additional oil, water and gas separation occurs. Although the production wells do not see the very high pressures that injection wells obtain, wellhead and distribution system valve selection is still critical. The oil from these wells can contain a corrosive



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□ The secondary oil recovery-led West Texas oil boom is providing jobs of all types. These pipe fitters are working on a low-pressure segment of a CO₂ battery.

cocktail of oil, brine, water, CO₂, natural gas and hydrogen sulfide (H₂S) in varying velocities and fluid phases.

The presence of H₂S requires piping and valves designed for this fluid in accordance with NACE International specification MR0175, Petroleum and Natural Gas Industries—Materials for Use in H₂S-containing Environments in Oil and Gas Production. The MR0175 specification recommends specific materials and materials processing steps for components for valves in this highly corrosive and potentially lethal service.

After exiting the production well, the fluid is channeled through separation facilities and sent back to the mixing battery for re-use. One of the future plans for CO₂ injection is to use the procedure for permanent storage of CO₂. This process, called carbon capture, utilization and storage (CCUS) holds great promise as a way to safely sequester industrially produced CO₂ for an unlimited period in the same underground locations that once held oil and natural gas.

Check valves also are a key component in all the CO₂ EOR piping systems. The nature of mixing non-corrosive fluids with corrosive fluids and their specific piping materials calls for reliable check valves. One example why this is necessary is: if H₂S-contaminated fluid is allowed to backflow into piping and valves not designed for H₂S service, catastrophic failure can occur.

CONCLUSION

The CO₂ flooding, enhanced oil recovery process is another tool U.S. energy producers are employing to increase the output of domestic energy and hopefully reach the ultimate goal of energy independence. The operating conditions in a CO₂ flood EOR system can vary from field-to-field and region-to-region. The number and types of valves and valve materials is equally diverse, providing a multitude of opportunities for valve manufacturers and suppliers to offer many choices to end users. VM

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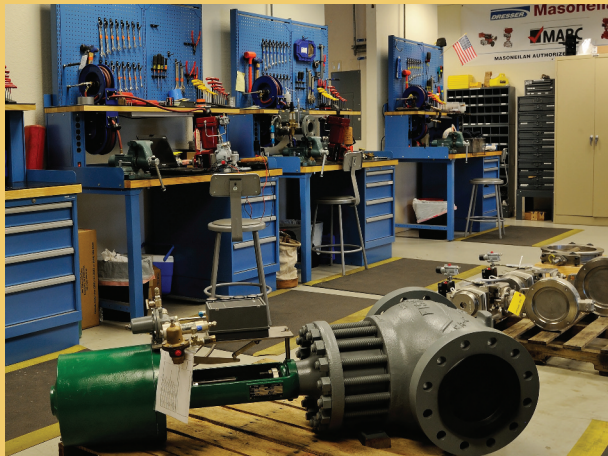
VMA's Founding Distributors

BY GENILEE PARENTE

Since the Valve Manufacturers Association added its newest category of membership—distributors/channel partners—early this year, the association has received an enthusiastic response adding 10 new members in the first half of the year.

Bill Walton of RES Energy Solutions explains the source of that enthusiasm. Walton says that in his particular case, he was already familiar with the association because he was employed at one time with a major manufacturer that remains active in VMA. When he first switched from the manufacturing business to his first distributor employer, “I inquired about becoming a VMA member,” not knowing distributors weren’t yet members. That changed last year when the new category was approved.

“Since learning that VMA was allowing channel



Many of today's distributors are also authorized repair shops for major manufacturers. Pictured here is Classic Control's shop.

partners to join, and since I recently moved to RES, I thought it was the right thing for us to get exposure to both manufacturers and end users,” he explains.

Shawn Warren, Classic Controls, thinks the same way.

“VMA is the gold standard in the valve industry in terms of associations and publications,” he says. “It is well known throughout our organization, and we jumped at the opportu-

nity” to join, he adds.

John Nicholas, Edgen Murray, says his company joined “for the opportunity to network among leaders” and “to take full advantage of all the quality market information and research VMA provides.”

To get a feel for VMA's new members, VALVE Magazine offers these snapshots of each company to give readers a glimpse at the distributors that make up this important part of the valve chain.

AIV

Established in 1991, AIV is an international master distributor of hard-to-find, exotic alloy valves for the chemical, oilfield, petrochemical, pulp and paper, refining, power and water treatment industries. The company services distribution only and represents more than 20 major valve manufacturers. Its sales force of more than 30 professionals worldwide offers over 250 years of combined industry experience. The company's 130,000-square-foot, state-of-the-art Houston headquarters currently houses over \$50 million in inventory, offering dedicated facilities for custom modification and actuation. Additional stocking locations include Chicago, Philadelphia, Edmonton (Canada) and the United Kingdom. AIV's concept of around-the-clock, around-the-world service has helped the company become a world leader in valve distribution.

www.aivinc.com

CLASSIC CONTROLS

Classic Controls, Inc. was founded in 1991 with four employees; 23 years later, it has grown into one of the most respected representative firms in its territory with 28 employees and a full offering of products and the services to support those products. The company serves industrial customers in Florida, southern Georgia and the entire Caribbean in the process markets of power generation, chemical, petrochemical, natural gas T&D, phosphate, food, pulp and paper, and water/wastewater. Classic Controls is an instrumentation, valve and controls representative with full service capabilities including instrument calibration & repair, control system integration and control valve repair. The company represents several valve manufacturers and is also an authorized repair center for a major valve company.

www.classiccontrols.com

DISTRIBUTIONNOW

DistributionNOW is a worldwide distributor serving the energy and industrial sectors. The company stocks and sells a variety of products and provides first-class customer service to the upstream, midstream, downstream and industrial market segments. Its offerings are extensive and include: pipe and tubing, manual and actuated valves, fittings, flanges, gaskets, fasteners, instrumentation, power transmission products, mill and janitorial supplies, hand and power tools, machine cutting tools, safety products, personal protective equipment, electrical products, artificial lift equipment, pumps, drilling and production products, and industrial paint and coatings. It also offers a wide range of supply chain solutions to reduce customer costs and increase efficiency.

www.distributionnow.com

EDGEN MURRAY CORPORATION

With over 35 global locations, Edgen Murray is a leading provider of specialty steel products and services to the energy sector and select industrial markets. The company manages procurement, value-added services and delivery of high-performance pipe, fittings, flanges, valves, high-yield heavy plate and related components through a global distribution platform across the Americas, Europe, Middle East and Asia Pacific regions. It serves customers in the following end-user markets: upstream, midstream, downstream, power, civil and mining. Edgen Murray's valve team works across all market segments to provide a wide array of valves and valve packages for an extensive range of projects.

www.edgenmurray.com

FCX PERFORMANCE

FCX Performance is a leading provider of process flow control solutions and products to a variety of process industries. Based in Columbus, OH, it has 25 locations covering 30 states and over 400 employees. FCX sources, stocks, manages, maintains and delivers custom solutions. From a single valve to a fully integrated process control loop, FCX has more than \$20 million of inventory available in regional operations centers. The company's application expertise is extensive, and it serves a broad end-user customer base that includes alternative energy; pulp and paper; power; food and beverage; pharmaceutical and biopharmaceutical; chemical and petrochemical; steel; phosphorous; and sugar.

www.fcxperformance.com

MRC GLOBAL

In business since 1921, MRC Global is the largest distributor of pipe, valve and fitting products and services to the energy and industrial markets. Its customers' businesses are capital intensive and their operating processes and operating environments are often extreme. The company's products include an extensive line of PVF, oilfield supplies, specialty products and related supplies for upstream oil and gas; an extensive inventory of equipment for pipeline transmission, gathering and storage and gas utilities and dis-

tribution; a broad range of carbon steel, stainless-steel and corrosion-resistant PVF automation products for chemical, refining and other downstream sectors and more. The company focuses on putting service-oriented people in locations near customer operations.

www.mrcglobal.com

RES ENERGY SOLUTIONS

RES Energy Solutions, Production Products, provides the upstream and midstream oil and gas industry a comprehensive offering of valves, including safety relief valves, actuation and chemical injection pumps. The company also offers the accessories needed for its product portfolio. With two valve actuation centers in Texas, technical expertise and a commitment to customer service, RES Energy Solutions is positioned to meet a wide range of valve, actuation and chemical injection requirements. The company has more than 50 service technicians involved in wellhead and valve, maintenance and re-certifications. Its technical service solutions improve process inefficiencies and provide a lower total cost of ownership through reduced operation, installation and maintenance costs. The company provides customers a single source for the products it sells along with quality service.

www.res-co.com

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www.setpointis.com

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Headquartered in Houston, Sunbelt Supply maintains one of the largest inventories of valves, actuators and accessories in North America comprising over 50 major manufacturers of manual and automated valve products and accessories. The company provides in-house valve automation services, including assembly and testing, machining, fabrication and CAD design and drawings. It is also an authorized automation service center for several major valve manufacturers.

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www.wolseleyindustrialgroup.com

Actuation in the Wind

BY KATE KUNKEL

On June 2, 2014, the Obama administration announced a proposed clean air rule aimed at cutting carbon-dioxide (CO₂) emissions from the nation's power plants to roughly 30% below 2005 levels by 2030. Despite concerns over job losses in the power sector and increased electricity rates, this rule can be put into place without congressional approval. Meanwhile, the Environmental Protection Agency (EPA) has a mandate to regulate CO₂ under the existing Clean Air Act as long as evidence supports the fact that the gas endangers public health. In 2009, the EPA issued an endangerment finding to that effect.

As part of the new Obama rule, EPA will be requiring every state to cut the amount of CO₂ emitted by their power generation plants. Different states will have different emissions-cutting goals depending on their specific energy mixes. The individual states will have the authority to figure out the best way to accomplish those goals.

One result of all this will be that wind turbines likely will play a larger role in the power generation mix for many states. While valves don't play a significant role in the wind energy field, actuators are an important component in operating wind turbines.

BLADE CONTROL

Many areas in a turbine operation use actuation. However, Henrik Stiesdal, chief technology officer at Siemens Wind Power, says the main use is for pitch regulation systems of the turbines.

The pitch regulation system is the system that adjusts the rotor blades on the turbine hub attached to the main shaft. Stiesdal says the blades can be pitched (adjusted) within a 90-degree range. A pitch angle of 0 degrees is the setting where the blade is in the operating position, with the chord (the long axis) of the blade tip profile parallel to the rotor plane.

In normal operation at wind speeds that yield power output below rated



Most wind turbines are located in remote areas so they are hard to repair.

power (maximum power capacity as rated by a manufacturer), the blade is adjusted within a few degrees of zero to provide maximum output. When wind speeds are above the speed at which the turbine reaches rated power, the blades are adjusted up to 20-30 degrees to maintain power output at rated power.

In a shut-down situation, the blades are moved close to a 90-degree position, with the chord of the blade tip roughly parallel to the rotor axis. This causes the rotor to stop or just idle slowly.

Active blade control systems typi-

cally involve micro-actuators moving flaps or other aerodynamic devices to change the lift of the blade, Stiesdal explains. For active blade control systems, piezoelectric actuators, linear electrical actuators or pneumatic actuators are used.

"The most common pitch actuation systems use electric motors which engage with a ring gear," Stiesdal says. "Backup power for power loss situations is provided by batteries or ultracaps. However, some major turbine manufacturers, including Siemens and Vestas, use hydraulic pitch systems," where backup is provided by hydraulic accumulators, he says.

SECONDARY FUNCTIONS

While some actuator operations are labeled "secondary functions," their use in wind turbines is essential. These secondary functions include:

- **Ventilation:** An actuator, usually electric, controls the angle of the ventilation louvers in the nacelles (the place where the generating components—generator, gearbox, drive train, etc.—are housed). Louvers are used to regulate the temperature inside the nacelle, protecting against extreme heat or cold. But the louvers in some cases are

Wind turbines catch ocean breezes to generate energy.



also adjusted like sound baffles to reduce the amount of noise emitted by the generator. Actuation is also used to adjust ventilation in the transformer unit, which is located at the base of the turbine.

- **Access gates and service hatches:** Actuators open the gates and hatches to give access to all areas of the wind turbine.
- **Rotor brake and lock:** An actuator can be used to stop the rotor for servicing, in very high winds or when there is not enough wind for operation. Actuators lock the rotor after braking as well, preventing it from rotating during service.
- **Emergency lubricating system:** If the main lubricating system fails, the actuator opens the emergency lubricating system.

Whether electric, pneumatic or hydraulic actuation is used is a matter of choice, according to Stiesdal. "Opinions differ on which is the most efficient and reliable," he says.

Some operators believe that an electric actuator system offers lower weight and easier control while taking up less space in the nacelle. Stiesdal points out, however, that actuators do not contribute significantly to the overall weight of a wind turbine, and weight is typically a secondary parameter. "Cost and reliability are much more important parameters," he says.

MAINTENANCE

Since wind turbines are generally in isolated areas difficult to access, the biggest concern when choosing a product for wind turbine operations is reliability.

"The main challenge is the high number of operating hours without the presence of technicians," Stiesdal explains. "Turbines typically operate for 3,500 hours between inspections and 7,000 hours between maintenance visits," he adds.

For active blade control systems, the interval can be 35,000 hours between maintenance visits, he says. "These numbers of hours are highly unusual for industrial actuators, and they are one of the key challenges of maintaining actuators in wind turbines," he explains.

Also, active blade control actuators often are located in positions that are only accessible by rappelling on the outside.

All of this means reliability and low maintenance are key considerations when purchasing actuators that control the flaps, which control aerodynamics.

For pitch systems, the location inside the wind turbine hub means corrosion is not a major issue. Also, the environment is generally dry so a rating of C3 is fine. However, for active blade control actuators, corrosion is a major issue, and everything needs to be protected to the highest class, C5 (C3 and C5 are corrosion ratings the International Standards Organization sets for finishes based on the environmental conditions they face).

CONTROLS

Stiesdal says wind turbines are always fitted with advanced computer control systems. These systems "are necessary to achieve the degree of automation required. They are part of the standard control algorithms that make it possible for the turbines to operate independently and be fully automatic under all conditions," he says.

Power demand is low for the control and actuation systems, provided typically by uninterruptible power supply arrangements, ensuring fully functional control systems even during power outages.

"Electronic load monitoring is used for planning of preventive maintenance, and it is an integral part of all modern wind turbines," Stiesdal continues.

CONCLUSION

Stiesdal says the wind energy industry is "always looking for improvements in cost and reliability of actuators."

He says, however, that incremental improvements are generally tackled by suppliers in dialogue with the buyers.

And some actuator manufacturers are discovering that there are other demands for actuator use in wind energy, in particular with offshore wind farms.

Going forward, as the demand for quiet, more efficient wind turbines increases, ongoing innovations by actuator manufacturers will be even more critical. **VM**

KATE KUNKEL is senior editor of VALVE Magazine. Reach her at kkunkel@vma.org.

□ A crew accesses the inside of a turbine for maintenance.



Emergency Repair in Pipelines

BY JASON CHISHOLM AND JOE PIRKL

Decades of innovation and ingenuity in the pipeline valve manufacturing industry have resulted in dozens of designs incorporating multiple body parts, top and bottom entry designs and sophisticated seat sealant systems. These simple valve designs make emergency sealing and repair safer and easier for technicians.

Valve care product manufacturers and service companies continually invest in research and development to keep pace with this evolving industry. The result is that today, even if all conventional equipment fails, technology allows aggressive sealing procedures to occur.

NEW TECHNOLOGIES

Long gone are the days of unscheduled outages for replacing valves that fail to seal.

Many valve manufacturers offer designs that allow for in-line repairs. Smaller diameter, three-piece ball valves can be swung out of the line by removing all but one corresponding bolt on each body flange, making seat ring access and replacement faster and simpler. Also, top-entry and bottom-entry valves allow technicians access to the seat rings or slips without physically removing the valve body from the pipeline.

In both cases, the pipeline section under repair needs to be completely isolated and depressurized before work can commence. This is an ideal scenario for the technician because there is no risk from trapped pressure release. But it can be a costly situation for an operator when unscheduled. Not only is there lost revenue from an unplanned shutdown, but also the cost of venting large sections of pipeline between critical valves. Some designs allow for stem seal repairs while the valve is online, but this requires great care and attention when executing to prevent accidents.

The most economically efficient method of maintaining pipeline



□ A below-grade mainline valve that has failed is removed.

integrity without having to shut down for repairs and maintenance is to temporarily seal a leaking valve with a synthetic-based valve sealing product. Conventional sealing might not be temporary and can actually prevent a valve from operating because of its design intent or because of organic additives, which tend to harden and set up in the presence of dry hydrocarbons such as natural gas. Synthetic sealants, however, are specifically designed for use in extreme operating conditions such as steam injection and heavy oil extraction, sour gas and

other refined products. They won't harden inside the valve's sealant system and will remain pliable until washed away. An important note here is that, once the synthetic product is injected into the seat, it will only last for as long as the valve remains in one position. Once the valve cycles, some of the product will wash downstream and may need to be injected again.

EXTREME REPAIR

Some extreme cases require a technician to fill the valve body cavity with a heavy sealant that, because of pas-

sageway restrictions, wouldn't otherwise pass through the injection and buried check fittings. This procedure is reserved for critical mainline ball and gate valves that must seal in an emergency. The operator can have a service crew ready to perform this procedure for a scheduled shutdown, but the logistics involved make this solution difficult to pull off in an emergency. Anyone who anticipates this situation should stock the proper volume of sealant for the valve in question to mitigate the delay in manufacturing and shipping a custom order. Large-diameter, mainline block valves require hundreds and sometimes thousands of pounds of product to fill the body cavity, especially gate valves with elongated body designs. Another important note is that having this volume of product manufactured for a special order can take days or weeks, which can delay day-to-day operations further.

Very rarely is a valve damaged to the extent that these emergency sealing solutions fail. If the downstream seat ring cannot maintain a seal inside the body cavity, the temporary seal needs to be made on the upstream seat. The only way to achieve that is to use a cleaning pig to isolate a small section of pipe between that seat and the closure element. Hot tapped connections between the pig and valve allow access to the pipe section so that sealant can be injected. Once the downstream side of the pipeline is isolated and drained, a new valve can be installed. The defective valve can then be left in the open position indefinitely becoming, in essence, an idle piece of pipe.

This procedure is labor intensive and requires several trade experts who can perform hot tapping, line vent-



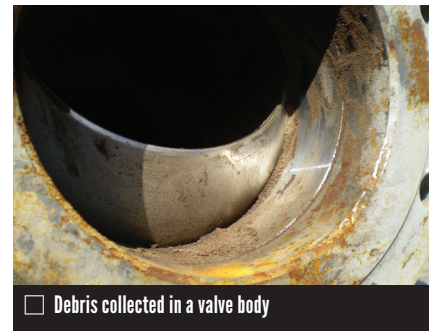
□ This top-entry ball valve has a bonnet leak.

ing/draining, pipe cutting and welding, valve sealing, operator installation and new equipment commissioning. Once the assembly is installed and the line is drained of sealant, the new valve needs to be closely monitored.

Construction debris is the top reason for new valve leakage. To help with this situation, lubricant needs to be pumped through the seat sealant system before the valve is operated to ensure leftover debris is pushed out of the seat ring grooves and washed downstream to be collected by a cleaning pig.

PLAN FOR IT

The costs associated with this solution include contracting trade personnel, procuring sealing product and a new valve assembly, and the logistics of getting all of this to the site. However, when advanced planning is done so the repair corresponds with a sched-

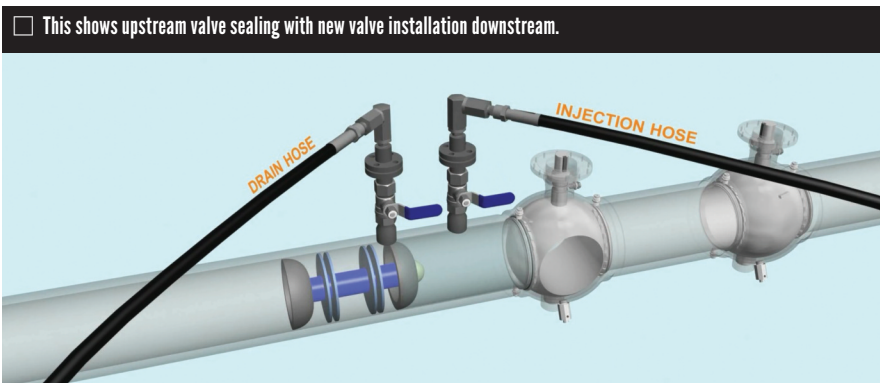


□ Debris collected in a valve body

uled outage, the solution is much more economical than risking an unplanned multi-million-dollar shutdown.

Another way to anticipate emergency scenarios is to have trained personnel on staff that can execute these types of procedures safely and efficiently. Operators and maintenance technicians that have decades of experience may still lack the knowledge of more modern valve features or emergency sealing techniques. An experienced third-party consultant who knows the proper resources to access can make the turnaround go much smoother. The best chance at avoiding a costly catastrophe, though, is to have contingencies in place to quickly deal with emergency situations and identify possible future failures. **VM**

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□ This shows upstream valve sealing with new valve installation downstream.

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A Primer on Castings

BY GREG JOHNSON

Valve components, such as bodies, bonnets and caps, are manufactured either by forging or casting. The forging process produces a homogeneous structure often needed for challenges such as specialized high-integrity applications. But it is much costlier than casting for large pieces. Because of this, although forged valve ranges go up to sizes NPS 4 and more, the vast majority of valves are comprised of cast pressure-containing components.

Virtually every metal can be cast into valve components. From small bronze valves that populate the big box store plumbing shelves to the largest iron valves found in waterworks projects, all are created from castings. Some materials, such as bronze and iron, are easier to cast than others. Iron founding is a particularly forgiving process and its use in large valve castings is legendary. Today's foundries regularly produce iron butterfly valve castings up to NPS 144 and gate valve castings up to NPS 108.

Two primary casting processes are in use today for valve components. The oldest is sand casting, where molten metal is poured into a mold of sand held together with binding compounds. The second process is called the investment or lost-wax process. Although it has been used for corrosion-resistant valve components for about 50 years, the past 25 of those years have seen use expanded tremendously for low-carbon steel valve castings. The lost-wax process is especially popular with Asian foundries and is the defacto method for casting small-to moderate-size valve components.

HOW THEY WORK

The sand casting process begins with a wood or metal pattern. This pattern is placed in a box; then specially prepared sand is packed rigidly around the pattern. When it's removed, it leaves a cavity corresponding to the shape of the pattern. The mold is baked to



□ Molten metal is the beginning of every casting process. Depending upon the material to be cast, temperatures close to 3,000° F are required to liquefy the metal.

strengthen the sand/binder surface, creating the outer surface of the part to be cast. When inner ports or voids are required, such as in valve castings, a sand core is prepared and placed inside the mold box. The usual mold box is comprised of two parts—the cope (top) and drag (bottom). If needed, tiny spacers called chaplets are used to keep the core from falling out of alignment and touching the mold wall. Molten metal is then poured into the mold and allowed to cool.

In the lost-wax or investment process, a wax pattern is created in a wood or metal mold. This pattern is then covered with several layers of refractory slurry. When the slurry is the proper thickness, the wax is melted out, leaving a smooth outside casting diameter pattern. As with the sand casting process, cores are installed in these patterns. Molten metal is then poured into the casting and allowed to cool.

The casting process is very straight-

forward; however, several factors present challenges for creating an acceptable casting free of detrimental defects. The metal must be poured at the right temperature to allow for proper solidification in the mold. The molten metal must not be poured too fast or with too much velocity because gas bubbles or pattern damage may occur. Because of the many variables in the casting process, a foundry must have experience in each different alloy it pours.

One tool at the disposal of the foundries that helps to ensure a quality casting is a virtual casting process

Table 1. Common valve casting material standards

Basic metal	ASTM standard	Material grade
Bronze	B61, B62	
Cast Iron	A126	B
Low-carbon Cast Steel	A216	WCB
Chrome-Moly (9 Cr-1 Mo)	A217	C12
Chrome Moly (1-1/4 Cr, 1/2 Mo)	A217	WC6
316L stainless steel	A351	CF3M
316 stainless steel	A351	CF8M
Monel	A494	M35

using casting simulation software to predict the soundness of the casting

during the pour and after cool-down. This software is very much like finite element analysis because it graphically creates a thermal diagram of the proposed pour. To achieve accurate results, all the parameters and variables have to be properly assessed and entered into the program. The use of casting simulation software can help the foundry develop or improve pouring practices, which if followed closely, will yield increasingly better castings.

STANDARDS AND QUALITY CONTROL

Casting standards in the United States have been developed by the American Society of Testing & Materials (ASTM). ASTM has dozens of casting standards covering virtually every metal and pouring process. Table 1 (above) shows some of the more common casting material standards used in the valve industry.

Casting quality begins with an accurate pattern and correct rigging (patterns, molds, cores and boxes). After the mold is prepared and filled with molten metal, quality processes are put into motion. The first is to create a test coupon, which is a sample of the metal cast during a pour. The mold of each casting and test coupon to be poured during the heat is embossed with a specific heat number. This heat number will allow traceability between the test coupon and the castings poured during a specific heat.

After the pour is made, the test coupon is subjected to a variety of chemical and mechanical tests. The results of these tests determine the initial acceptability of castings in the pour. Because of the differences between the geometry and size of the test coupon and the actual casting,

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slight variations will occur in the test results. The test coupon is also subjected to any subsequent heat treatments performed on the castings in the heat.

Quality assessment of the actual castings is performed a number of ways. The most widely used volumetric (evaluation of the interior of the casting) inspection method is radiography. Radiography results can assess the overall workmanship of the foundry or can detect potentially catastrophic defects in the metal. Additional non-destructive examinations (NDE) performed on valve castings include dye penetrant examination, which detects surface irregularities, and magnetic particle examination, which can detect surface and slightly subsurface irregularities.

All castings for valves built in accordance with American Petroleum Institute (API) design standards must have a surface inspection. This inspection is in accordance with the Manufacturer's Standardization Society (MSS) SP55, Quality Standard for Steel Castings for Valves, Flanges, Fittings and Other Piping Components - Visual Method for Evaluation of Surface Irreg-



□ These bronze castings have been pre-cleaned in a shot-blasting machine. The next step will be to remove the sprues and smoothly grind away any burrs or surface aberrations.

ularities. This visual inspection is performed to detect defects such as hot tears, cracks, porosity and shrinkage.

Two new casting specifications have been written over the past 24 months that will aid foundries, valve manufacturers and end users. The first is API 20A, Carbon Steel, Alloy Steel, Stainless Steel and Nickel Base Alloy Castings for Use in the Petroleum and Natural Gas Industry. The second is MSS SP-147, Quality Standard for Steel Castings Used

in Standard Class Steel Valves, Sampling Method for Evaluating Casting Quality. The availability of these standards should aid in the quest for continuous casting improvement.

Foundries worldwide have made large investments in the latest melting and NDE equipment to assure the continuing quality of their products. Items such as vacuum-degassing furnaces and linear accelerators are becoming staples in 21st century foundries. Castings are still an excellent economical choice for valve components, and it appears they will be for years to come. VM

This is part one of a two-part article. Part two, which will cover forgings in addition to castings, will appear in the Winter 2015 VALVE Magazine.

GREG JOHNSON is president of United Valve (www.unitedvalve.com) in Houston. He is a contributing editor to VALVE Magazine, a past chairman of the Valve Repair Council and a current VRC board member. He also serves as chairman of VMA's Education & Training Committee, is vice chairman of VMA's Communications Committee and is president of the Manufacturers Standardization Society. Reach him at greg1950@unitedvalve.com.

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ASCO NUMATICS has introduced its 16mm ASCO 068 Series flapper isolation solenoid valve, the first in its class that offers greater throughput, smaller sample sizes and reduced calibration requirements for clinical and analytical instruments. This solenoid valve is ideal for OEMs serving the clinical diagnostic, life science, sterilization and dental markets.



The valve is designed for use with neutral and aggressive liquids and gases. Its flapper technology allows high pressures to be achieved (up to 116 psi) at large orifice sizes while preventing the fluid contamination that can result from spikes in back pressure inherent in analytical devices. The valve has been tested to well over 10 million cycles for extended product life.



AUMA's compact SGC part-turn and SVC globe valve actuators have been considerably enhanced. An additional size for the SGC part-turn actuators, the new SGC 12.1, extends the torque range from 500 Nm to 1,000 Nm. Additionally, the two-layer powder coating standard for other products in AUMA's portfolio is now also applied to SGC and SVC actuators, providing excellent corrosion protection.

Main features include adjustable speed and an ellipto-centric gearing, which is virtually free from backlash. All components required for operation are integrated in a single housing. Once the power supply is connected, the actuators function immediately and can be operated via standard integral local controls. When installed in a

difficult location, the local controls can be mounted separately from the actuator; the local controls and actuator are connected using a cable set available from AUMA.



BERNARD CONTROLS has moved its former printed User's Guide into an interactive Web application named GPS Actuator. As suggested by its name, the GPS function of this application simply drives the user to the electric actuation solution fitting his/her needs.

This new interactive tool is available on the Bernard Controls website in a design optimized for all devices or directly on www.gpsactuator.com.

At the end of the on-line selection process, a user can fill in a form to be contacted by Bernard Controls back-offices. Sales teams then receive an e-mail with the selected criteria and can contact the user to finalize a quotation.



CRANE CHEMPHARMA & ENERGY has launched the new Pacific Forged range of gate, globe and check valves for use in power, oil and gas, and chemical markets. Crane specifically developed these valves for high-stress, high-thermal-cycling applications. The unique forging process and next-generation design reduce the total cost of ownership, assuring consistent quality and long life.

Multi-stage ultrasonic testing is standard on all forgings and finished valves, so customers can rely on con-

sistent and continuous valve quality in the most severe process conditions. A contoured shape and a proprietary hard-face overlay process make these valves resistant to cracks and delamination, reducing maintenance and plant downtime.

EMERSON PROCESS MANAGEMENT

has released the Fisher P700 rotary style actuator for use with Fisher C series internal valves in LP-Gas services. These actuators remotely operate internal valves on storage tanks, bobtail route trucks and bulk transports.



The P700 series actuators assure efficient performance of both the actuator and the Fisher C series internal valve to deliver full valve capacity. The actuator is designed to precisely actuate the company's internal valves and eliminate side-load wear. The new series minimizes actuator air consumption, while maximizing service life. The P700 series actuators are compatible with air, nitrogen or propane vapor. They include a 1/4-inch UL-approved thermal fuse plug to provide shutoff in the event of an emergency situation.



ITT ENGINEERED VALVES brand has launched a new line of hygienic diaphragm valves designed to dramatically reduce maintenance time and total cost of ownership for today's biopharm manufacturing facilities. As the latest platform to be added to the engineered valves product family, the EnviZion valve helps customers install, operate and maintain their systems more efficiently and reliably.

CONTINUED ON P. 60

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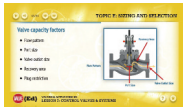
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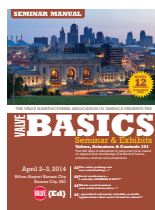
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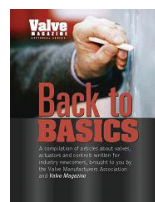
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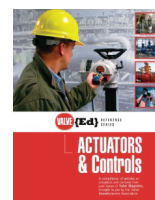
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CONTINUED FROM P. 58

The valve's embedded technologies allow a more streamlined installation and maintenance process, delivering less downtime, longer preventative maintenance cycles and greater production capacity for manufacturers.

Assembled with a simple mount and turn motion, the valve is installed in three minutes without using any special tools or difficult torquing procedures. Its 360-degree active seal protection provides leak-free operation, helping to eliminate the risk of contamination and the need to re-torque after thermal cycling.



SIEMENS INDUSTRY has extended the range of functions of the Simatic WinCC SCADA (Supervisory Control and Data Acquisition) software in its latest Version 7.3 with the addition of the Simatic WinCC/WebUX V7.3 option for mobile applications.

Designed to make engineering easier, the software now supports the central configuration of process data, messages, archiving and user management and processes texts in any language. Communication options to current Simatic S7-1500 controllers have also been extended, and it's now possible to directly transfer tags with symbolic addressing. System messages of the controllers can also be handled. The new software meets the growing demand for anytime, anywhere access to plant information using internet-based and mobile devices.

VAL-MATIC handles the demands of oil and gas production and pipelines, refining, geothermal, power, chemical, pulp and paper, cryogenic and mining/steel with the QuadroSphere trunion ball valve. Multiple flow paths through the valve and the four

recessed surfaces of the ball provide self-flushing to prevent clogging by avoiding high scale and solids build up. The self-flushing feature makes the valve stand out in industries where the media flowing through the valve collects and solidifies, which can cause failure. The special machining of the ball substantially reduces the ball-to-seat surface contact, creating less resistance during cycles, lowering the torque to operate it. The QuadroSphere comes standard as fire safe for flammable materials such as natural gas, oxygen, gasoline and oil.



VICTAULIC introduces improvements to the FireLock Series 745 Fire-Pac. The Victaulic Fire-Pac is a pre-assembled fire protection valve



and trim that is pre-wired to a fire alarm control panel or junction box and enclosed inside a metal cabinet. The improvements give customers more options and benefits for installation, maintenance and design.

The new design relocates the electrical connection box from atop the cabinet to inside the cabinet, creating a lower profile and allowing the 6-foot, 5-inch cabinet to fit through standard doorways for ease of delivery and installation.

The new valve can be used in a wider range of operating environments because of new insulation and heating components for ambient temperatures as low as 20°F (-6°C). The FireLock Series 745 is also weatherproofed to an equivalent of NEMA 4 standards to keep out moisture and dirt.

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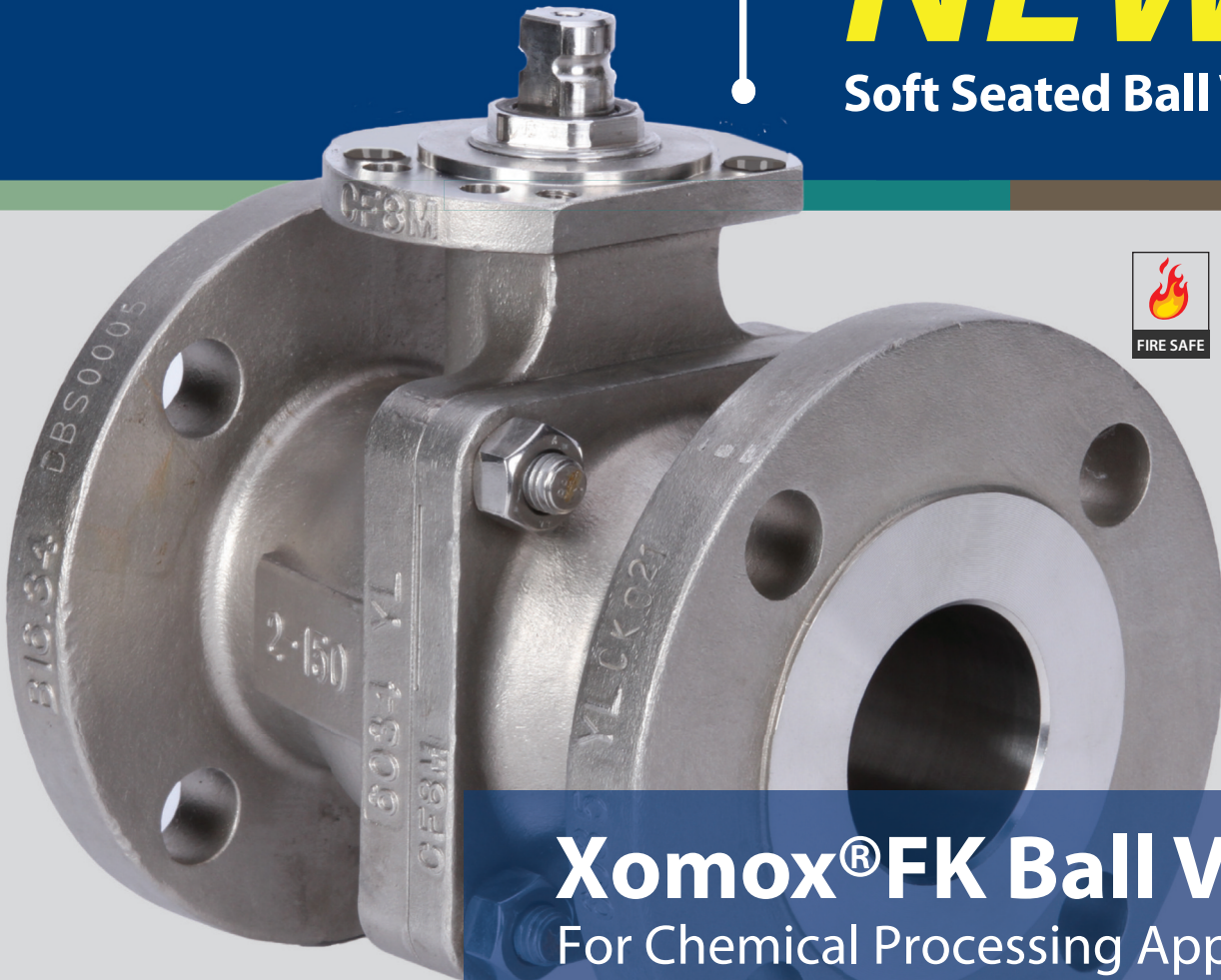
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