The global magazine for pump users and suppliers

PUMP engineer

COVER REPORT:

Tycon Alloy celebrates 20 years of casting engineering solutions

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In this issue of Pump Engineer magazine:

Volume 7, August 2015

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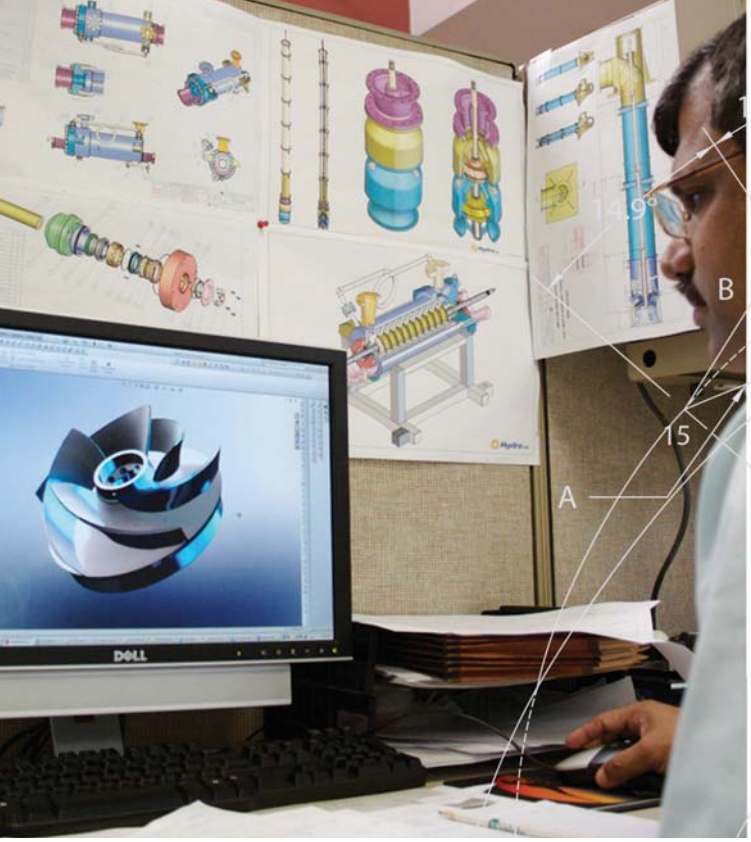

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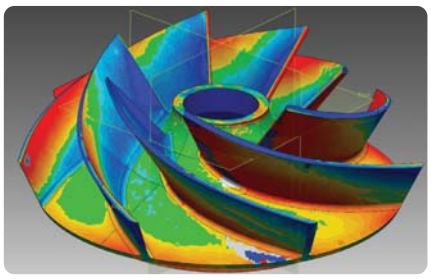

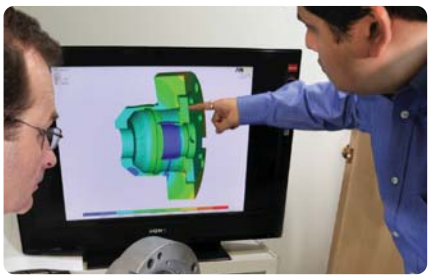

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PUMP engineer

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KCI WORLD

EVENTS CALENDAR

September 14th – 17th
44TH TURBOMACHINERY AND 31ST PUMP SYMPOSIA
Houston, Texas
http://pumpturbo.tamu.edu/

September 15th – 18th
IFAT ENVIRONMENTAL TECHNOLOGY FORUM
Johannesburg, South Africa
www.ifatforum-africa.com/index.php

September 23rd – 24th
VALVE WORLD EXPO & CONFERENCE ASIA 2015
Suzhou, China
www.valve-world.net/vw2015/showpage.aspx?pageID=2696

September 23rd – 25th
SOUTH EAST EUROPE OIL AND GAS EXHIBITION
Athens, Greece
www.oilgas-seeurope.com/home.aspx

September 26th – 30th
WEFTEC 2015
Chicago, Illinois
http://www.weftec.org/

June 13th – June 14th 2016
PUMP SUMMIT AMERICAS 2016
Houston, Texas
www.pumpsummitamericas.com

For a full list of pump-related events in the industry, please visit: *pumpengineer.net/calendar*

Dear readers,

Pump Engineer is pumped about pumps this month! With a jam-packed issue full of great end user, EPC, and consultant interviews – including one from Statoil (page fourteen) and CDI Engineering (page eighteen) – we aim to bring you the latest insider news. On page twenty-two don't miss Part One of a technical article from Flowserve's Mike Heubner on "Considerations in the selection of dual pressurized seal piping plans".

August also saw the first Steering Committee meeting take place for the new ***Pump Summit Americas*** Conference and Exhibition. With the help of the event's Chairman, Jean-Marc Fosseux from Technip, the Steering Committee assembled a top-notch Conference Program (page forty). Register as a visitor or book your exhibition stand online at: www.pumpsummitamericas.com.

Best wishes,

Sarah Schroer

Sarah Schroer
Editor, Pump Engineer
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Where Innovation Flows

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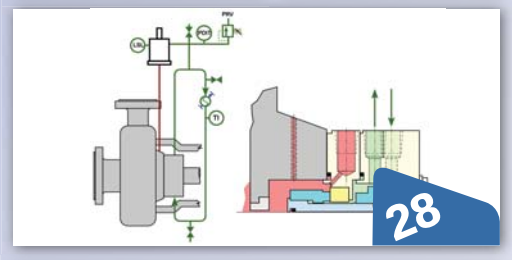
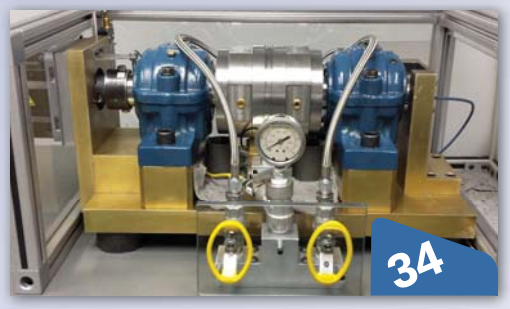
August's COVER STORY

Tycon Alloy celebrates 20 years of casting engineering solutions

Tycon Alloy Industries (Hong Kong) Co., Ltd. is celebrating their 20th anniversary. For two decades, Tycon has provided stainless steel and special alloy casting engineering solutions. Pump Engineer interviewed Tycon about their success in learning to adapt and grow in an ever-changing industry.





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PUMP engineer PRODUCT DEVELOPMENTS

UK Flowtechnik has a new Beinlich range of external gear dosing ECO.pumps.

ProMinent has released the new process pump called Orlita Evolution.

BBA Pumps announces the launch of the new BA100K 4" dewatering pump set.

A V40M-028H axial piston pump from HAWE Hydraulics is now available.

Busch Vacuum Pumps and Systems introduces rotary vane vacuum pump models R 5 RAH 200 A and R 5 RAH 300 A.

SEEPEX has introduced a new Smart Conveying Technology (SCT) for progressive cavity pumps.

Amarinth has released the API 610 VS4 Vertical Sulphur Pump.

PUMP engineer PROJECT OVERVIEWS

Torishima provides pumps for a combined cycle power plant in Algeria

Torishima received an order for eight Boiler Recirculation Pumps (CPW) for a combined cycle power plant in Djelfa, Algeria, from Nooter/Eriksen. N/E is a single source supplier of custom designed heat recovery systems. They are headquartered in St. Louis, Missouri, and are known as one of the world's leading independent suppliers of Natural Circulation Heat Recovery Steam Generators (HRSGs) combined with gas turbines. HRSGs are used to capture exhaust heat from the gas turbine that would otherwise escape through the exhaust stack of combustion gas turbines.

Name of Pump	Boiler recirculation pump
Size / Type	CPW 150-315
Quantity	8 units
Capacity	402m³/h
Total Head	113m
Motor Rating	160kW

Alfa Laval wins offshore pumping systems order from Statoil

Alfa Laval has won an order to supply its Framo pumping systems to several oil platforms in the North Sea. The order, booked in the Marine & Offshore Pumping Systems segment, has a value of approximately SEK 200 million, with delivery scheduled for 2016. The order comprises of the delivery of fire-water pumping systems to four oil platforms operated by Statoil in the Johan Sverdrup oil field in the North Sea.

Apollo Pumps secures large order for Neste Oil in Finland

Apollo secured a large order for five process pump skids for a new construction of an SDA-Unit (Solvent de-asphalting) in Porvoo/ Finland. The order consists of different single-stage heavy duty process pumps as well as the main pump units of this system. These are two large BB5-pump units of Apollo type TLB of size 350 and with a power consumption of approximately 2MW per pump. These units will be applied for pumping solvent at a high temperature of +265°C, with a flow of 1528m³/h against a differential head of 515m.

Mono pumping equipment replaced at wastewater treatment plant in England

Mono macerating and pumping equipment provided by NOV, that has operated for over 40 years, has been replaced with new equipment from the same company at a wastewater treatment plant in North Yorkshire, England. Mono Munchpump packaged systems have been supplied to replace the original equipment. The Munchpump systems are used in a duty and standby configuration, and each includes a Mono EZstrip transfer pump and a Mono SB Muncher.

PUMP engineer

PEOPLE: PROMOTIONS

Xylem Inc. names Senior VP and Chief Human Resources Officer

KAIRUS TARAPORE is Xylem's new Senior Vice President and Chief Human Resources Officer, as of July 27th, 2015. Tarapore will oversee the areas of leadership and talent development, talent acquisition, performance management, HR technology strategy, along with global compensation and rewards.

Kairus Tarapore, Xylem

New Regional Sales Manager at Pioneer Pump

Shawn Kelly, Pioneer Pump

SHAWN KELLY has joined Pioneer Pump as the Regional Sales Manager for the South Central Region. Effective immediately, Kelly will assume responsibility for the region, including managing distribution and increasing the regions sales in all markets, such as industrial, municipal, oil & gas, and rental.

Xodus appoints Global Subsurface Lead

ANDREW SEWELL from Xodus Group has been promoted to the role of Global Subsurface Lead. Sewell has more than 24 years' experience working in the oil and gas industry, initially as a Geophysicist and joined Xodus in 2012 as Subsurface Manager.

Andrew Sewell, Xodus

Grundfos Pumps appoints new Managing Director for CBS

Jonathan Hamp-Adams, Grundfos

JONATHAN HAMP-ADAMS has been promoted by Grundfos Pumps Corporation to the newly created position of Managing Director for the company's Commercial Building Systems (CBS) unit. Hamp-Adam's responsibilities will include leading the sales and production activities of Grundfos' PACO brand, which is based in Brookshire, Texas.

Tycon Alloy celebrates 20 years

From left to right: Anthony Chan, David Millward, Brian Palmer, Michael Lo, and Ryan Cole.

Tycon Alloy Industries (Hong Kong) Co., Ltd. is celebrating their 20th anniversary. For two decades, Tycon has provided stainless steel and special alloy casting engineering solutions. Pump Engineer interviewed Tycon about their success in learning to adapt and grow in an ever-changing industry.

By Sarah Schroer & Yuzhong Shen

Tycon Alloy has changed the face of Hong Kong-based engineering with their high-valued and high-quality products. Tycon was first established in 1995 and has since grown into a 1,200 employee company, with a production facility of 35,500 square meters. Their current plant, located in Shenzhen, China, has a 700-tonne capacity per month, including sand casting and investment casting. Tycon has plans to move to a new plant called the Zhongshan Plant in the near future.

Along with the move to the new plant, the facility will see several upgrades taking place, including an increase in automatic equipment and sand casting machinery. They also have plans to invest in casting technology in order to do automatic shell-making. Head of Operations, Michael Lo, discusses Tycon's desire to also introduce semi-automation in their facilities. "We foresee labour costs doubling in the next five to ten years," adds Lo, "For equipment we are buying now, we must consider future costs, starting from the basics."

Lo adds in how it is of utmost importance to Tycon to facilitate an increased optimization of their resources. "We are no longer just an OEM company," says Lo. "Instead, we have the strategic business units to align other resources to better serve our customers. It's not about the quantity, but the quality. In the past five years, we have sent our staff to learn abroad and then adapted this into our technology and processing for casting in order to increase our proficiency and our capabilities in this area. How to facilitate the better optimization of the resources is our prime objective."

# of casting engineering solutions

Customized solutions for unique product ranges

"Approximately 50% of our casting products are valves, while pumps account for about 30-35% of the production," shares Lo. "These valves and pumps are used in the chemical industry, petrochemical, or oil & gas – especially for the natural gas."

In addition to pumps and valves, Tycon also offers product solutions for filters, mechanical seals, and other equipment components. Aside from the natural gas industry, Tycon is also active in the chemical, offshore, power, food & pharmaceutical, ship building, and instrumentation industries. "A lot of oil and gas today is from offshore," expands Lo. "Companies are pumping the oil from the ground and from the seabed while the gas is coming out. Today, they have the techniques to collect all the gas. It needs to be pressurized so it becomes liquid and then can be transferred by ship from offshore to onshore. This is why all ships have to be built for LNG and these applications use stainless steel casting pieces by Tycon."

A pledge to ensure the highest product quality

Lo explains that they aim to be not only a producer, but also a strategic partner with their clients in order to make high-quality products, as opposed to only focusing on low prices. They have a stringent quality control process. "Most of the industry knows Tycon's name," says Lo. "With Tycon, the integrated procurement risk is low which makes it worth the investment, but our customers agree they get a very good product value because of the time saved when it comes to checking incoming materials. Tycon takes pride in being able to supply top quality products to our customers who are themselves market leaders in their own fields. Customers can take Tycon's sophisticated casting products and install them on their production immediately."

Tycon's internal management runs a continuous improvement program where they are always working on ways in which Tycon can improve their processes in order to save their customers money while maintaining a high-quality standard. "Tycon is on par with any European foundry that I have worked in, if not better," shares Consultant, Brian Palmer. "We are in a position where we can compete on a level playing field with Europe, America, and the rest of the world."

Palmer began working in the sand foundry on quality concerns to improve the process controls, to improve the quality of the finished product, to look at new ways of manufacturing including new materials and new developments in process techniques, and also to revise all the existing techniques. "Many people have a bias towards Chinese foundries – which was my perception too initially – that it is sub-standard," says Palmer. "However, that is not the case with Tycon.

Wide range of casting applications

Major applications of casting include the following related industries:

- Chemical
- Liquefied Natural Gas (LNG)
- Offshore, Oil & Petroleum
- Power Plants
- Food & Pharmaceutical
- Ship Building
- Instrumentation

Applications of castings also include the following product ranges and solutions:

- Valves
- Pumps
- Filters
- Mechanical Seals
- Equipment Components

Tycon's standards are international standards and must meet the demands of a clients that are both high-caliber and global."

Tycon has been accredited international standards and full third party certification, including ISO9001:2008, TÜV PED97/23/EC, and Marine Society Approvals: LRS, GL, DNV, BV, ABS, CCS, NK, and KR. Palmer shares that Tycon is currently striving for the NORSOK control on the off-shore projects. "It is a procedural thing to demonstrate that you have control over the business and you can maintain the standards that they are imposing on us. Now, ISO are restructuring their requirements which will be exactly the same as the NORSOK standard. In the future, all foundries that are supplying off-shore projects will essentially be using a NORSOK standard."

Utilizing the latest technologies

"We are aiming to have a stronger background on the technical side in order to support our customers and to provide them with all-around solutions to their design and casting engineering challenges," explains Anthony Chan, Marketing Manager. Tycon's customers include both equipment manufacturers and pump manufacturers. Some of Tycon's big-name customers include Sulzer, ITT, and Wärtsilä.

"When we develop a project we have a team of engineers prepare the drawings, discuss with customers, and involve them in the design of the new pump because the customers know how they want the pump to function," shares Chan. "We help them with the manufacturing. We consider ourselves to be a casting engineering solution that provides much more than just casting alone."

Castings technologies

David Millward has worked in investment castings in the UK for over 30 years. He was begun working at Tycon so he could look at their processes and practices in order to make improvements. "A major part of my job here is to look at the future of Tycon, including putting in more automation and putting in more environmentally friendly equipment because China and rest of the world has to look at the environmental emissions," says Millward, who is a Consultant for Tycon. "We are looking at more efficient equipment that will give us a better product. We'll always need labour, we'll always need that intervention of people, but we don't always necessarily need so many pairs of hands. We are looking to have a foundry that will be producing for the 21st century."

Magma software for accurate casting simulations

Tycon is pioneering the industry with their state-of-the-art equipment and use of Magma, a German software that can precisely simulate the casting procedure. "When the engineer finishes the design, they provide

us with a 3D model that we can put into the software to identify what locations might have problems with shrinkage or other issues," says Lo.

Advanced technology and software allows Tycon to reduce development times significantly. "When you are doing a 1000-kilogram product, you cannot just cut it and find the problem," says Lo. "We want to know what will happen when designing a gating system before we cast the material. This is especially cost-effective when creating large-sized castings."

Ceramic core technologies

Tycon Alloy uses a technique they have developed over the years called Ceramic Core. The technique has been used in production for several years now, but over the years they have been able to improve it. "Pump manufacturing has more requirements for this ceramic core because sometimes the impellers for high performance pumps need a very small gap on the impeller, so that ceramic core can help us to do some complicated items," explains Lo. "We will communicate with the supplier because they have a different solution for the ceramic core. In China, Tycon is the first company that is sending employees overseas to learn and buy the materials for this technique."

Plans for future growth

While the European market makes up about 50% of their business, Tycon has plans in the upcoming few years to increase their American customer base, which encompasses about 25% of their business. "We are expanding our workforce for the US market at the moment," explains Lo, "but we also see the Chinese market as another growth area. More and more companies, not only the overseas companies, are building factories in China. Also, some local domestic companies are upgrading their products to meet a higher standard in order to compete with overseas companies."

Tycon is an international company. Their management team comes from Hong Kong. Tycon's consultants are from the UK and help on the technical side with new products and design of new plants. This gives Tycon a peek into what other countries are doing and gives direction on how Tycon can upgrade themselves.

"Over the next five years, Tycon is committed to capitalizing on our sustainable competitiveness and lean manufacturing via foundry removal and resources re-engineering," says Lo, "and also to keep our sales targets above or at least pertaining to the industry growth. To do this, Tycon has to put more value-added products into our production, including engineering and machining solutions for our customers. We emphasize the need to provide integrated and highly-valued solutions to our customers through our well-trained professionals. If we finish the pilot order, then the customer will continue with us. If we don't have new products coming in, we cannot make growth, so that's why we emphasize how quick we can make samples and deliver them to our customers."

Tycon has plans to build a new 100,000 m² foundry in Zhongshan, China.

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Getting it right: Going further and deep

Pump Engineer recently had the privilege of speaking with Rune Ramberg, Statoil's Chief Engineer of Subsea Technology and Operations. In his current position, Ramberg leads a network of 400 subsea engineers and professionals.

By Richard Heyl, Contributor

Statoil's Rune Ramberg is responsible for the staffing and technology competence development of the department, as well as the hardware and software controls of subsea equipment. Ramberg's role is largely advisory, helping engineers around the world realize and overcome the technical limitations of their projects. One of his many challenges is managing his time between his personal work and the many other projects on which he acts as an advisor. He has a real passion for working with others on the many challenges the subsea environment provides.

Selecting the right subsea installation

When we asked Ramberg how Statoil goes about selecting the right pump or compressor for a project, he begins by saying, "It all starts with the asset. As reservoirs age, the natural pressure becomes too low at some point to maintain productive flow of gas and condensate. In order to extend the life of that asset, we'll increase the pressure with the use of a pump or a compressor."

There are a lot of variables that must be considered before deciding what technology is right for the job. The good news is the reservoir and its wells will tell you what they need. First, you need to know how many wells you'll be providing added pressure to. Then, you'll need to account for how much increased pressure is needed to get the volumetric flow for each well to a productive rate. Finding out the amount of increased pressure needed can be challenging. It is dependent on a few factors, one being the distance the liquid and condensate must travel from the well to a platform, an on-shore facility, or a ship.

Ramberg explains another factor that is important to consider: The production stream composition. "This is the percent of gas and

er subsea with Statoil

liquid, and we also can't forget that there will be some sand mixed in. We need to know the flow assurance, viscosity, and the temperature of what we are pumping or compressing. Lastly, we will take into account how efficient we need the machine to be, the power requirements, and the motor size."

Ground-breaking technology at Gullfaks and Asgard

When we asked Ramberg to tell us if he had any exciting projects going on, he said, "Oh yes, let me tell you about our state-of-the-art compressors at the Gullfaks and Asgard fields. Located at Gullfaks, the Brent reservoir has lost the natural pressure needed to maintain a productive flow rate. We have installed two wet gas compressors there. These are helico-axial machines with two counter-rotating shafts and impellors that will increase the pressure of both condensate and gas together."

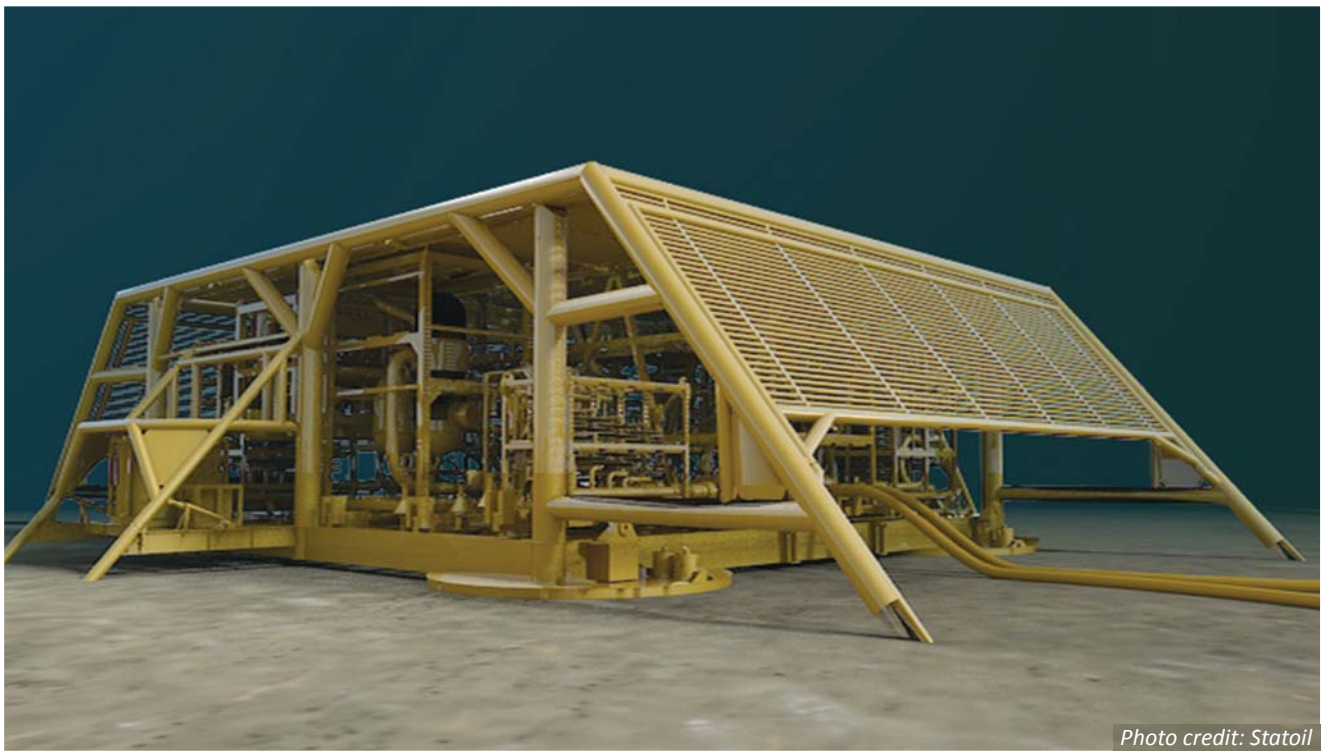
Similar to the Gullfaks situation, the Mikkel & Midgard reservoirs, located at Asgard, are the two main reservoirs whose natural pressure has been dropping. "In order to increase the pressure of those reservoirs, Statoil is placing two gas compressors, a separator, and a pump directly on the seabed floor," Ramberg explains. "By getting closer to the wellhead we can maximize the amount of pressure driving the gas and condensate to the platform. This technology will be vital in recovering assets, as we go deeper and further from the Norwegian coast."

When asked what accounted for the choice in the different

ABOUT THE INTERVIEWEE: *Rune Ramberg*

Ramberg holds a PhD in Mechanical Engineering from The Norwegian University of Science and Technology, with his thesis concentrated on multiphase pumping. In 1997, he began his career for Statoil in Stavanger, Norway, as Principle Engineer of Rotating Equipment. There he became a Subject Matter Expert (SME) on subsea processing. In 2007, he began working as their U.S. Technology Manager on the Jack St. Malo asset, a collaboration project with Chevron, located in the Gulf of Mexico. Today, he spends most of his time developing Statoil's portfolio of assets around the world as their Chief Engineer of Subsea Technology and Operations.

Rune Ramberg, Statoil



Åsgard subsea gas compression will be realised in 2015 as the world's first project of its kind. This technology is one of our most important measures for delivering volumes from existing fields on the NCS.

types of compressors used in the two fields, Ramberg said, "It's based on the amount of pressure needed." At Gullfaks we're compressing from a reservoir that's 15 kilometers from its platform, and at Asgard we're compressing from reservoirs 50 to 70 kilometers away. "Asgard is in need of much larger compressors to provide a bigger boost because the capacity is much higher and the distance is much further than at Gullfaks." In order to be more efficient, we first cool and separate the gases and fluids. Next, the gases are compressed, and the fluids are pumped. The gas is then cooled again, mixed back with the fluids, and together they are sent to the platform. Efficiency wasn't a problem on the smaller, closer reservoir at Gullfaks.

Current oil & gas market providing a challenge

When we asked him if the current low price of oil and gas keeps him up at night, Ramberg laughs saying, "It certainly is providing a challenge, but I enjoy that, and there are a lot of great engineers working together to decrease costs. We're constantly reviewing and reworking projects to see if there's a more economically viable way of doing things."

In order to obtain such a goal, Ramberg's focus is on creating an efficient and reliable subsea system. "The cost of repairs in a subsea environment can be enormous," commented Ramberg. Repairs often require a whole operation to be shut down while the crew waits on a repair ship to reach the platform location. The cost of a repair ship alone can be substantial, not to mention the loss in asset recovery time as each hour goes by. "That makes reliable equipment vital," adds Ramberg. "You might think that cutting costs means going in with cheaper, less expensive equipment or materials, but it's quite the contrary. If there's an exotic material that's going to make a pump, compressor, or seal more robust and reliable, then subsea engineers are probably considering using it."

Ramberg also shared his thoughts on using an ESP pump subsea. "Well, It's not really designed for subsea." He explained that, while they are inexpensive, they are not the type of reliable pump they are looking to use subsea. "There are many parts on an ESP that wear out fast, and require frequent repairs or replacements. That's ok when you can readily access the pump on land, but stopping to replace one out at sea is costly." Topside and subsea just have different limitations, and OEMs of ESPs for whatever reason have been slow to appreciate the differences.

Ramberg went on to say, "The problem can be compounded when several ESP's are required to provide the boost needed to bring the oil to the surface. Typically, the more components the system requires the more unreliable it's going to be." It's all about extending the life of the assets as long as possible, while reducing maintenance costs. So, while the subsea equipment may be more robust and costly in our initial outlay, we'll be able to recoup those costs by installing the

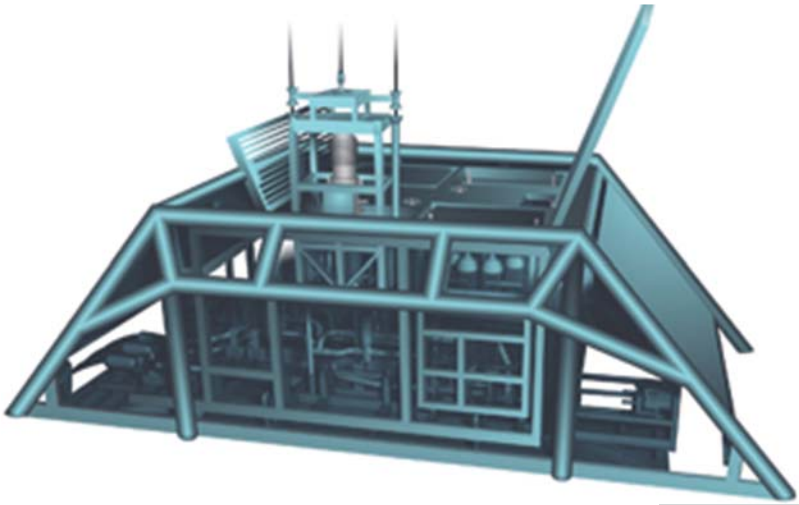


Photo credit: Statoil

Subsea gas compression at Gullfaks is an important technology leap for increasing the recovery rate and the lifetime of the gas field.

proper pumps or compressors, and extending the life of the respective oil or gas field. This of course requires us to install equipment that is reliable, efficient, and environmentally sound. Once this technology is proven, the whole future subsea environment can reduce costs further by standardizing this asset specific, tailor made technology.''

Future outlook on subsea

When Ramberg's asked to describe his outlook for subsea he replies, ''I'm not an analyst, but I think the markets will reach a healthy balance.'' The world's energy demands are increasing, and subsea is where a great bit of it lies. Ramberg optimistically concludes, ''We're gaining confidence and continuing to cut costs out of the system.''

ABOUT THE COMPANY: *Statoil*

Statoil is an international energy company present in more than 30 countries around the world. Statoil's largest activities are located in Norway. They are headquartered in Stavanger with corporate functions in both Stavanger and Oslo. They are the largest operator on the Norweigian continental shelf, and a license holder in numerous other oil and gas fields. Their on-shore facilities in Norway are active in the areas of gas treatment, crude oil reception, refinement, and methanol production. Statoil refines oil and gas at a number of plants both in and outside Norway. They're also a technical operator for reception facilities, pipelines, and infrastructure of gas.

Picking pumps for Houston's oil & gas industry

"Every day is different at CDI," says Mechanical Lead Engineer Jaime Arredondo. "Our meetings with clients and vendors often feel more like passionate discussions – we are striving together to identify creative solutions to challenges."

Pump Engineer sat down with Jaime Arredondo, a Mechanical Lead Engineer at CDI Corporation, to discuss how the engineering and staffing company selects pumps for Houston's oil and gas industry.

By Sarah Schroer, Editor, Pump Engineer

As a Mechanical Lead Engineer for CDI Corporation, Jaime Arredondo leads a team in Houston, Texas that is part of the company's Global Engineering and Technology Solutions (GETS) business. The GETS business serves a wide range of clients across multiple industries: oil & gas, chemicals, aerospace and industrial equipment, infrastructure, and government services.

Arredondo is responsible for executing the mechanical scope of work for multiple refinery and chemical projects, specifically working with rotating and static equipment.

"We provide a complete range of solutions, beginning with the development phase of a project, conducting estimates, securing quotes, and assembling and installing engineering design packages," Arredondo says. "We work closely with our clients throughout the entire life cycle of a project to understand their requirements and specifications. We also work closely with the equipment vendors. Our role, as we see it, is to pull together all the necessary people and resources to deliver a design that meets the client requirements, and that is safe, on time, and on budget."

Arredondo describes CDI as a constant and dynamic learning environment.

"I believe a large part of our success is because of our culture of performance," he says. "We are a company of people who know what it takes to go above and beyond to deliver solutions to our clients. Whoever the client, whatever the project, we strive for excellence, leverage teamwork, operate with a sense of urgency, and act with integrity. We learn from every project and bring that experience to the next one. Our goal is to create value for our clients, and, in turn, for our shareholders.

"Every day is different at CDI," Arredondo continues. "Our meetings with clients and vendors often feel more like passionate discussions – we are striving together to identify creative solutions to challenges. It's funny, you might think that many of the issues we discuss are typical issues that are common to any project. But we often come across projects that are truly unique and that require entirely new approaches and solutions not seen even by people who have worked in the industry for many years."

Keeping busy with Houston's oil & gas projects

Currently, Arredondo is working with several major oil companies to expand refinery facilities and to add or update equipment. A good deal of Arredondo's work involves issues with pumps in facilities, such as dealing with pump bearings or seals that have a history of high maintenance. "We analyze the applications to determine if the original pump is an adequate design for the actual process condition," he says. "Over the years, facilities tweak and shift their process conditions to meet their current demand, so what worked before, may not work now. We investigate those situations, along with available new technologies, and then we work hand-in-hand with the equipment vendor to identify the appropriate solution for the challenge. An example would be to incorporate a VFD (variable frequency drive) into a pump to run at all process conditions at optimal efficiency. This approach would save energy and ensure longer mean time between failures."

Another one of the challenges that Arredondo faces is to retrofit equipment at existing facilities. "The challenge with existing facilities is spacing," he says. "Retrofitting new pumps in existing locations adds another level of complexity because with greater flow and total discharge head you typically need a bigger pump. But a bigger pump may not fit, so you have to explore other options such as vertical pumps or re-routing the piping. We always are working with vendors to explore solutions and identify new technologies that suit the latest applications, project schedules, maintenance requirements, and overall costs."

Picking pumps from client-approved vendor lists

CDI works closely with their clients to identify their specifications and design requirements. "Our work is client-driven and every client is different," Arredondo says. "We primarily use API style pumps in high criticality services and ANSI for low criticality services."

Often, CDI chooses equipment based on their clients' pre-approved manufacturers' lists. But, Arredondo explains that in certain cases, clients will work from recommendations provided by CDI. "We sometimes encounter

special applications where your typical project-approved manufacturers cannot meet the pump's requirement. So, we have to deviate from the list and go out to other specialty pump vendors to meet the design requirements."

Arredondo provides an example of a water service application from a client's project. The client had a particular process condition that required a very low net positive suction head (NPSH). The listed pump manufacturers were not able to meet that NPSH. So, CDI went to the Roth Pump Company, which has a pump model that only requires one foot of NPSH. Internally, CDI maintains their own catalogue of vendors, the applications they offer, and whether they are the right fit for a project.

Complying with industry standards

Sometimes, CDI's clients have requirements above and beyond the norms of industry standards. CDI always aims to make the best pump selections that incorporate all client specifications, industry standard design requirements, and professional experience at the design stage. CDI evaluates the complete system and selects the pump for the design point and the operating point. "We want to avoid layering safety margins on top of safety margins – that could result in having an oversized pump with an oversized motor – that will drive up your energy cost," explains Arredondo. API and ANSI provide critical design guidance. "If it doesn't meet API or ANSI, then the pumps simply will not meet the clients' and our standards," he says.

The Process Department at CDI is responsible for selecting materials of construction for the equipment. Arredondo's team studies the process conditions and conducts rigorous checks to confirm that all standards are met. For example, if there is H2S in the fluid, then CDI would confirm that the pump vendor is compliant with the appropriate NACE specification.

On the lookout for industry innovations

To keep abreast of the latest industry news and technologies, Arredondo and other CDI engineers attend the annual Pump Symposia event in Houston and other industry conferences throughout the year. They also keep up to date with the latest API publications. CDI also participates in lunch-and-learns with equipment vendors. "We really look forward to the presentation of case studies by a company's sales rep or technical leader," says Arrendondo. "It's great to hear how a particular challenge was solved and the important roles that many people played in the success of a project, whether it's the engineers, the procurement people, the technology group, the delivery team, or the installation team. We learn a lot at these meetings about the latest technologies, but also how to keep costs low and how those cost savings can be passed on to the client."

> *"We want to eliminate as much maintenance as possible. Frankly, we want to avoid anything that's unnecessary to the success of the project. It has to add value."*

Arredondo says that new technologies can often take several years to make it to the marketplace. "And it can take even longer to implement the new technologies," he adds. "Clients need to consider if they want to justify the risk of introducing a new technology into their process. Introducing new technologies works well on small projects, where they can help build confidence in the new design. But, we have to break out of the old ways of thinking and approach each application with an open mind. Clients may have a process that has worked and is still working, but there are always new technologies that can make a project go smoother and avoid maintenance and reliability issues. When we find a good application, we really push to get that technology installed and working. It takes a lot of effort on the vendor side to work with us too, so it's really a team effort."

Pump industry trends

Arredondo has noticed a recent trend toward installing canned motor pumps that eliminate the need for mechanical seals and reduce maintenance. "We want to eliminate as much maintenance as possible," he says. "Frankly, we want to avoid anything that's unnecessary to the success of the project. It has to add value. At CDI, we are always striving for continuous improvement," Arredondo added. "We are always looking for new and better ways to do everything. If you do great work and you are always getting better, that's how you get repeat business."

ABOUT THE COMPANY: *CDI Corporation*

CDI Corporation provides client-focused engineering, information technology and staffing solutions. Our customers operate in a variety of industries, ranging from oil, gas & chemicals to aerospace & industrial equipment, and high technology, and include corporate, federal, state and municipal entities. We serve customers through offices and delivery centers in the United States, Canada and the United Kingdom. We also provide staffing services through our global MRINetwork® of franchisees.

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OUT & ABOUT *with* PUMP engineer

The Pump Engineer Team has been busy visiting industry events across the world to stay up to date on all the pumping trends

By Kyra van den Beek & Candace Allison

The VWAM Conference consisted of plenary sessions and panel workshops developed by a Steering Committee of industry experts.

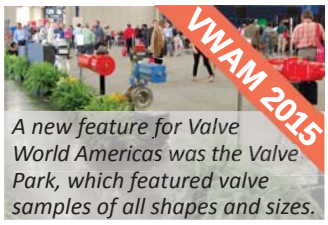
It has been another busy couple of months for Pump Engineer! On June 8th – 10th we attended the Pipeline Technology Conference (ptc) in Berlin, Germany. The ptc had 49 different nations with over 480 participants, including staff and management of 53 international pipeline operators, 47 exhibitors, 10 sponsors, 70 speakers, and 12 poster sessions.

Pump Engineer also made sure not to miss this year's ACHEMA event that saw 3,800 exhibitors from all around the world that presented their products, solutions, and services. The three day event took place on June 15th through 19th in Frankfurt, Germany.

July 15th and 16th celebrated the third staging of Valve World Americas Expo & Conference, recently held by KCI Publishing Corporation and Messe Düsseldorf North America in Houston, Texas at the George R. Brown Convention Center. Products and innovations were presented by 192 exhibitors from the United States, Asia, Europe, India, and Mexico on 38,900 net square feet of exhibit space. The next Valve World Americas Expo & Conference will be held from June 20th – 21st in 2017.

AW Chesterton stood out at the Valve World Americas 2015 Exhibition in Houston, Texas.

Netzsch showcased many of their products during this year's ACHEMA event in Frankfurt, Germany.



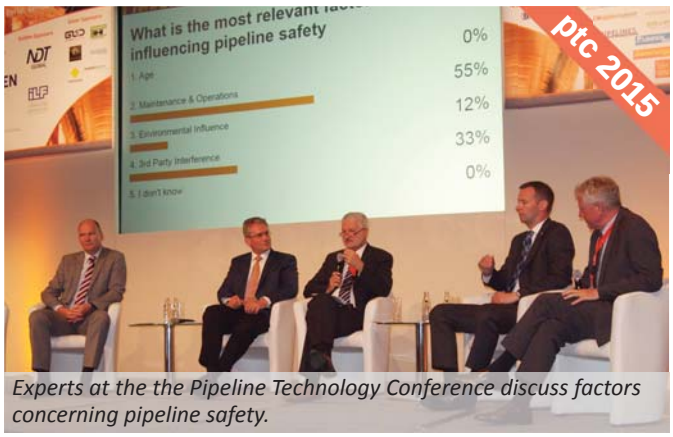
A new feature for Valve World Americas was the Valve Park, which featured valve samples of all shapes and sizes.

The Metso staff pose infront of their exhibition booth at this year's ACHEMA event.

Pentair's booth at the ACHEMA 2015 event, which saw 166,000 participants this year.

GOTTSBERG Leak Detection's booth at the ptc event in Berlin, Germany.

A total of 3,718 visitors and delegates attended Valve World Americas this July in Houston, Texas.



Experts at the the Pipeline Technology Conference discuss factors concerning pipeline safety.

CONSULTANT'S CORNER: An interview with Julien Le Bleu Jr. – Part 1

Julien Le Bleu Jr. has over 35 years of experience with pumps in the chemical industry. Pump Engineer spoke to him about his history in the pump industry, along with his new consulting business.

By Sarah Schroer, Editor, Pump Engineer

Pump Engineer: *Tell us a bit about your history in the industry, what your experiences are, and what you are doing now.*

Julien Le Bleu: I graduated from the University of Florida and I have been working as a Mechanical Engineer for most of my 35 year career. I have worked for Schlumberger logging oil wells and, I worked for General Electric company where I installed several 500 plus megawatt turbine generator sets in coal fired utility facilities. I went to work in the chemical industry in Lake Charles for Olin Chemicals. I worked there for about 25 years. My responsibilities were the rotating equipment and equipment in general, such as valves and piping, towers and heat exchangers. In that time, I worked on relatively large machines for the chemical industry, such as 15,000 HP steam turbines, as well as barrel compressors with pressures as high as 2500 pounds per square inch, split case compressors and reciprocating compressors. I worked with all types of lube systems, couplings, bearings and seals. I also worked with many chemicals both toxic and benign. Some of the more toxic were chlorine, Phosgene, sulphuric acid, and nitric acid. I have written articles for numerous professional magazines and was on the board for the pump advisory committee of the International Pump Symposium sponsored by Texas A&M University. I presently have a book published titled *Operators Guide to Rotating Equipment.* I continue to teach operator classes in the plant environment relating to rotating equipment. I teach how the equipment operates and inspection techniques, which I have done for several years.

Pump Engineer: *How do you find the industry has changed in terms of knowledge transfer?*

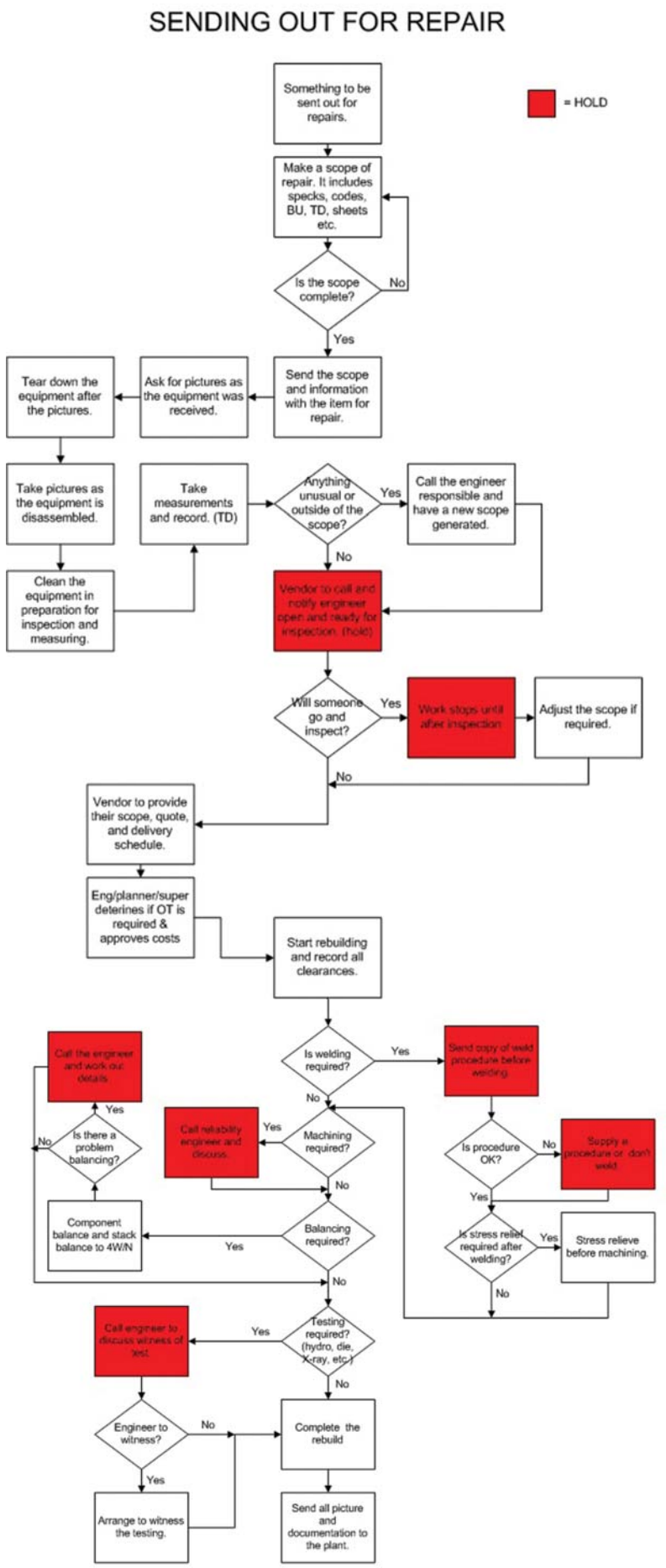


Figure 1: *An example of a typical logic diagram that could be provided to operators in order to help them with the decision-making process.*

Julien Le Bleu: There is a definite loss of expertise with all the retirements that are taking place. I find that when companies hire engineers a lot of the people doing the hiring really don't understand the engineering role. So they hire people with great grade point averages and when those people go out into the plant they may not have actual practical experience. Early in my career, I was allowed to make mistakes because no one knew any better. A smart person was one who didn't keep making the same mistake, not necessarily someone who did not make mistakes. Our knowledge grew, but now with the industry and cost and everything being what they are, people only want "correct" answers. "*I am paying you a big salary; you come as a graduate from a big university, with great grades, so I expect nothing but correct answers.*" But, in the real world that's not possible. The next question is, how do you get them the experience? The best way to bring lesser trained individuals to a better understanding of their job and the equipment they operate is to have them work with an individual that excels at the job. The high achiever got his experience at a time when he could make mistakes and learn as well as apply him/her self.

Pump Engineer: *What is your recommendation?*

Julien Le Bleu:

- Allow people to make mistakes, including the operators and the craftsmen – as long as they have a reasonable reason for making the decisions that they made and don't keep making the same incorrect decision. I had a young engineer work for me that had graduated with very good grades from a University in Mechanical Engineering. When he came to work with me as his mentor, I gave him a book to read. He read it, and then I gave him another, and another. They were simple

books on equipment. He would say *"Well hey, I am a graduate engineer, how come I have to do this stuff? I want to be out in the plant solving problems."* I told him that when he graduated from the University, they gave him a tool box, and what I was doing, with these books, was putting tools in his tool box.

- Make use of retired individuals to either work in the plant part time or at least mentor some of the younger, less experienced people.

- Do more training on a practical level (hands-on) for the people in the plant. The returns can be significant, but you must implement those things that are taught. That means some of management must attend the classes. The students must be held accountable for the material presented.

An additional method of capturing the knowledge of more experienced operators or engineers is to make and require the use of applicable decision trees to aid in making better decisions. This can be very beneficial to ensure proper actions are taken when a problem occurs and a decision is required. It makes knowing what the best decision is available, and also what to do about the problem identified.

Pump Engineer: *Tell me about your consulting company, Sage Technologies.*

Julien Le Bleu: I recently started a company named Sage Technologies LLC. I do consulting for problems in the plant I also teach operators troubleshooting in their plant environment. I have been doing operator training for the last eight or nine years. It is done in their plant on their equipment. One of the things that I hear from a lot of the operators in my class is *"I don't know why I have to have this training. I have 28 years of experience."* I ask them if that means that every day they come to work they run into something new that they have never seen before and then have to solve the problem? Or does it mean that today is just like yesterday, doing the same thing, taking readings, and then going home? I tell them that if they have run into something new every day, then they have 28 years of experience. If you are doing the same thing you did yesterday, it is not experience, it is just repeating what you did yesterday.

Pump Engineer: *Is your new company going to have a certain focus?*

Julien Le Bleu: The main focus of my company is operator training. The operators are resources in the plant that really haven't been used to their fullest potential. The operators are in the plant 24 hours a day. Management thinks that the operators are doing troubleshooting when they identify a problem. It is assumed they know how to do what I call a look, listen, and feel inspection – which is monitoring the equipment the old-fashioned way – but many don't. My class teaches not only how to do a proper inspection, but also how to do a little troubleshooting at the same time.

Pump curves for centrifugal pumps are considered the realm of the engineer. The operator, however, also needs to understand relationships between discharge pressure and flow, net positive suction head and cavitation, and flow and horsepower requirements. It is not possible to troubleshoot a piece of equipment without understanding how it is supposed to work. It is important for the operator to be able to identify cavitation and what they can do to prevent it.

Everything I teach is geared toward the operator and the way they look at equipment. Another thing that the operators can do that no one else can do is to identify the conditions around the problem they have just identified. For example, let's say they have a pump and every three months or so the bearings are failing. The mechanic will likely get the credit (blame) for putting in crummy bearings or not doing it correctly. Of course, that doesn't endear the mechanics to the operators nor the operators to the mechanics. But, if someone is really paying attention, what the operator might find is that those bearings always fail two weeks after they do a wash down, or two weeks after they do a process change or they have a process upset – meaning an excursion in either viscosity, load, or temperature. It might be some other thing that is going on in the process that might actually be causing the bearings to fail. If that information never gets to the mechanic or the engineer, then that problem is never going to be solved.

ABOUT THE EXPERT: *Julien Le Bleu Jr.*

Julien Le Bleu Jr. was the principal rotating equipment engineer for Lyondell Chemicals. He retired in January 2006 after 25 years with Olin / Arco / Lyondell, and is presently teaching operator best practices. He worked for General Electric's large steam division and has installed three large steam turbines of more than 500 megawatts. Le Bleu graduated from the University of Florida with a Bachelor's degree. He has written articles and lectured for the Texas A&M International Pump Symposium, where he was an advisory member for eight years. He worked in industry for more than 35 years prior to his retirement. In 2014, he published "Operator's Guide to Rotating Equipment: An Introduction to Rotating Equipment Construction, Operating Principles, Troubleshooting, and Best Practices". In 2015, he founded his consulting and instruction business, Sage Technologies LLC. He can be reached at www.sonnylebleu@hotmail.com or 337-660-8659 with additional questions.

Julien Le Bleu Jr.

MOMENT WITH PAUL KEARNEY: Howden Roots on troubleshooting, oil selection, and energy efficiency

Pump Engineer recently had the pleasure of speaking with Paul Kearney, the Global Senior Sales Leader of Aftermarket and Key Accounts at Howden Roots, about his experience with pumps and what the future has in store for him and his company.

By Sarah Schroer & Lindsay Jackson

Pump Engineer: *What is your role within Howden Roots?*
Paul Kearney: My current role with Howden Roots is Global Leader for Aftermarket Sales, as well as some key accounts. I specialize in the vacuum truck market, the mobile products market, and process gases. In total, I have 25 years' experience in various roles within the industry.

Pump Engineer: *What you do on a day-to-day basis?*
Paul Kearney: A typical day would involve troubleshooting our pumps and blowers as they relate to maintenance concerns, vibration issues, bearing life expectancy and system related failures. All of my team members are either former application engineers or field service engineers with an average of 20 years' experience.

Pump Engineer: *What are some of the most common issues you see?*
Paul Kearney: By far the top two are lubrication and vibration complaints. We have vibration emanating from the pump itself, from poor base design, or from poor installation techniques. Improper service, specifically with regards to use of the wrong lubrication for the applications, which can cause premature bearing failures.

Pump Engineer: *I realize each situation is unique, but in general, what do you suggest to correct these problems?*
Paul Kearney: Well, for proper installation of a pump, you need to ensure you have a level and true base to start. It must be properly grouted and anchored to the floor. Read and follow the instructions provided by the manufacturer. If you do not have the proper equipment, hire a professional, it is less costly in the long run. Of course, selecting the right oil viscosity for the ambient and the operational temperature of the machine is important. At different temperatures oil will degrade faster, so you need to pay close attention to the oil temperature in your operations. Synthetic oil is fantastic, but it still degrades over time and temperature. Sample it periodically.

Pump Engineer: *Could you give an example of a type of oil in a specific application?*
Paul Kearney: We go by an ISO rating. For example, in a particular application, ISO 320 has better characteristics at certain temperatures than ISO 100. However, each engineer should refer to the manufacturers' table for a proper ISO rating for their specific application.

Pump Engineer: *Could you tell our readers about your system evaluation process?*
Paul Kearney: It's a very thorough evaluation. For example, if it is a wastewater treatment plant, we assess the dissolved oxygen – which is ultimately what we are trying to deliver into the process – and we look at all the piping, all the controls and the machine for efficiency. The whole delivery system as well as the blowers and the motors need to provide the most energy efficient solution to the customer.

Pump Engineer: *It seems that the whole industry is talking about energy efficiency right now. Have you found that?*
Paul Kearney: Well, people need to consider the fact that it is the entire system's total energy efficiency that is more important than any one individual component in the system.

Pump Engineer: *What projects are you currently working on?*
Paul Kearney: There will be a paper coming out for Weftec on a Lemay wastewater treatment plant where we did a total plant evaluation. We had another project at Bird Island, in Buffalo, New York. We went through the entire plant changing valves, controls, and replacing other equipment to get the plant upgraded. This project was funded by New York Power Authority.

Pump Engineer: *What kind of valves did you switch out?*
Paul Kearney: We used the Rotork valve, which was chosen for more accurate control of the air delivery to the tanks.

Pump Engineer: *In this project, Howden Roots was asked to come in and help evaluate the energy efficiency of the system. What are the recommendations that you made?*
Paul Kearney: In the main plant, we altered the performance of the compressor and we installed the variable frequency drive so the machine could be operated in a more efficient area of performance.

Pump Engineer: *In general, what are the main industries that Howden Roots tends to deal in?*

Paul Kearney: We have a very wide footprint for our products. Clearly the water industry is huge, but it's also what we call general industrial. That can include food and beverage as well as industrial gases with companies like Praxair or Air Products, the mobile market including something as big as a hydroexcavator to as small as a carpet-cleaning van, etc. Essentially anywhere there is air movement can be included in what we call general industrial - petrochemical, chemical plants, refineries, and power plants. Anything that needs air or gas moved at high volume and medium pressure. Howden Roots has been in business 167 years and is one of the leaders in the oil and gas business, the coal business, and the water business for any kind of process equipment.

Pump Engineer: *Are there any big milestones that Howden Roots has recently reached?*

Paul Kearney: Howden Roots is driving a family of new high-efficient machines. We're still in the development stage, but there is a lot of excitement as we continue to innovate. There will be several new products coming out within the next 12 months. Howden Roots also makes the largest rotary lobe blowers in the world for process gas. That's a claim to innovation we will always be proud of and is just one more way we revolve around our customers.

ABOUT THE COMPANY: *Howden Roots*

ABOUT HOWDEN ROOTS

Now known as Howden Roots, this key business unit of Howden's Compressors Division is a well known manufacturer of blower and compressor technologies - including the world renowned rotary positive displacement blower known commonly as "Roots Blowers." Howden Roots serves industries such as chemical production, waste water treatment, power generation and general industrial. The new business unit has a 279,000 square foot manufacturing facility in Connersville, Indiana, as well as its headquarters in Houston, Texas and various sales and support sites around the world including the UK, China and Australia among others. More information on Howden Roots can be found at howdenroots.com.

Paul Kearney, Howden Roots

Considerations in the selection of dual pressurized seal piping plans – Part 1

Mechanical seals continue to be the most effective and efficient method for sealing most centrifugal and rotary pump applications. In recent times, the selection of seal designs has migrated towards dual pressurized seals primary due to the need for improved reliability and an increased focus on emission reductions. There are however several options for creating the pressurized environment for these seals. The selection of the appropriate piping plan is a critical consideration in the specifications for new or upgraded seal applications.

By Michael Huebner, Principal Engineer, Flowserve Corporation

Benefits of Arrangement 3 seals

API 682 defines one of the general characteristics of a seal design through the use of the term "Arrangement". A seal arrangement specifies the number of seals and the pressurized (or unpressurized) condition of the fluid between the seals. An Arrangement 3 seal contains two mechanical seals with the barrier fluid between the seals maintained at a pressure greater than the seal chamber pressure. An Arrangement 3 seal, therefore, will have both the inner and outer seal operating on the barrier fluid (See Figure 1). This makes the seal operation less dependent on the properties of the fluid in the pump. It also allows the seal to operate in a vapor space, mixed phase fluids, or flashing fluids. Finally, it minimizes or prevents the potential for process fluid from migrating to the atmosphere.

Pressurized seal support systems

Along with the benefits of a pressurized barrier fluid come the challenges of providing pressurization, conditioning, and monitoring of the barrier fluid. API 682 provides the most globally referenced specifications for piping plans for mechanical seals. The two primary options for dual pressurized liquid seals are Plan 53 and Plan 54. There are three options for Plan 53 labelled as Plans 53A, 53B, and 53C. While within the standard all Plan 53's are considered technically equivalent, the differences in design and function can be significant. Understanding these differences is critical in meeting both the requirements of the application and the end user's expectations.

Plan 53A

Plan 53A consists of an external reservoir which contains the circulated volume of barrier fluid. The top of the reservoir contains a vapor space which is pressurized from an external source such as a plant Nitrogen header. The

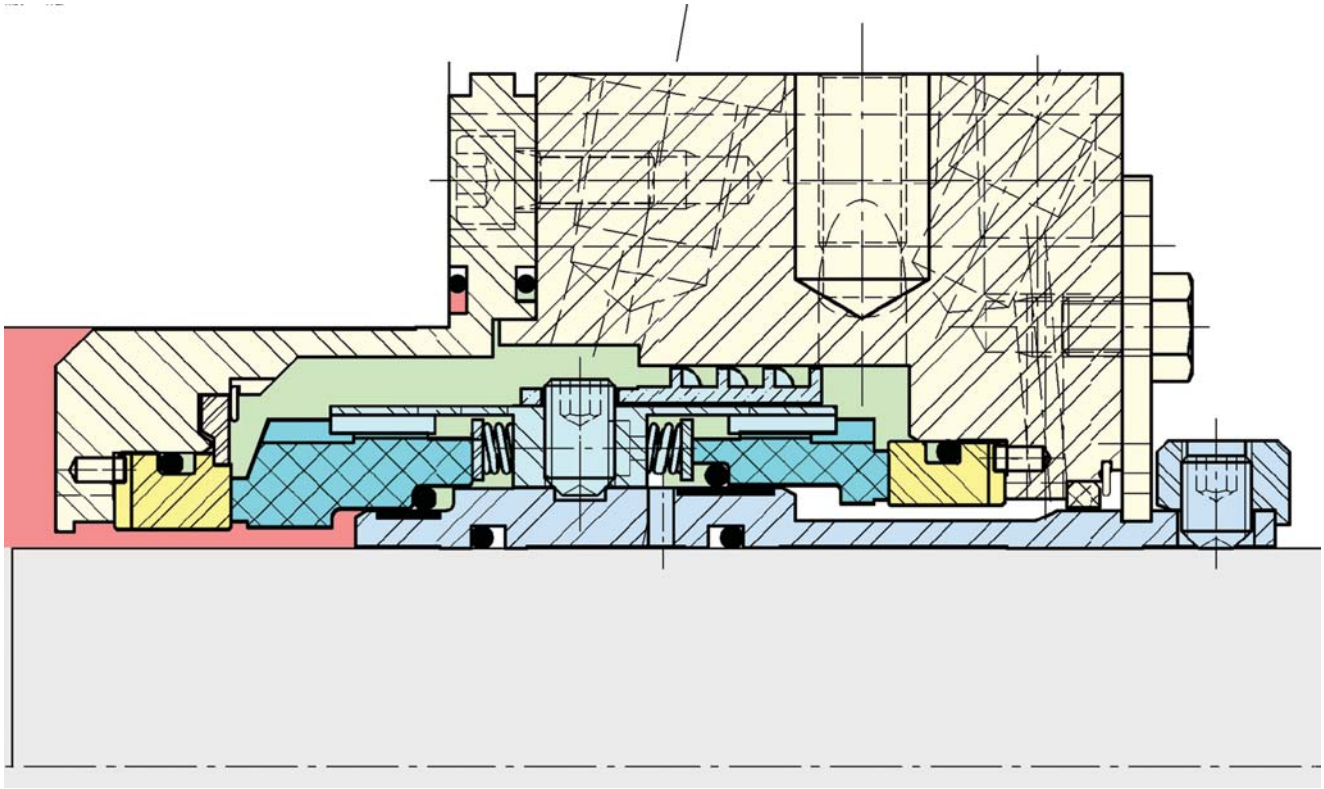


Figure 1: *A typical Arrangement 3 seal will have both the inner and outer seal operating on the barrier fluid.*

pressure of the barrier fluid is controlled by a pressure regulator in the Nitrogen supply line. The performance of the mechanical seals is monitored by the level of the barrier fluid in the sight glass and instrumentation. The volume of the reservoir can vary significantly depending upon application conditions with the most common volumes ranging between 11 – 30 liters [3 – 8 gallons]. Larger volumes of circulated fluid can allow for longer retention time in the reservoir improving heat removal and longer operating times between barrier fluid maintenance intervals.

Because the Nitrogen which pressurizes the system is in direct contact with the barrier fluid, there can be a significant absorption of Nitrogen into the fluid. As the barrier fluid migrates across the outer seal faces, this gas can come out of solution with the local reduction in pressure in the fluid film. This can result in erratic seal performance. As a result, most Plan 53A systems are limited to operating pressures less than approximately 10,3 bar (150 PSI) although many end users report successful operation up to 13,8 bar (200 PSI).

Advantages:

- Simple system
- Constant pressure
- Inexpensive pressurization source

Disadvantages:

- Absorption of gas into barrier fluid
- Limited to lower pressure applications
- Requires constant external pressurization source

Plan 53B

The Plan 53B was developed to address some of the shortcomings of the Plan 53A. This piping plan uses a bladder accumulator to pressurize the barrier fluid thereby removing the live interface between the pressurization gas and the barrier fluid. This removes all the complications of gas absorption and allows the system to be operated at very high pressures.

The basic principles of a Plan 53B are simple. The bladder in the accumulator is pre-charged with Nitrogen. Barrier fluid is added to the system and all air is vented from the barrier fluid piping. As barrier fluid continues to be added to the system, the Nitrogen in the bladder is compressed raising the pressure in the system. Barrier fluid is added until the system pressure reaches a high pressure set point (high level). During operation, barrier fluid which leaks past the seal faces will reduce the fluid

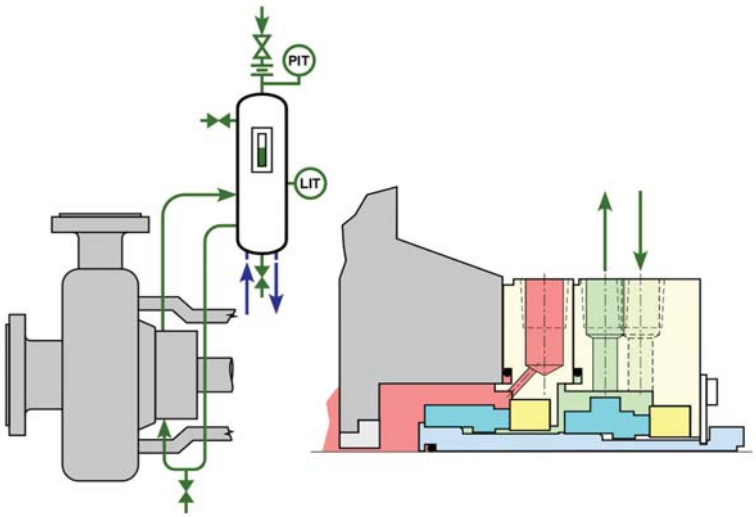


Figure 2: *Illustration of Plan 53A, which consists of an external reservoir which contains the circulated volume of barrier fluid.*

volume causing the Nitrogen in the bladder to expand with a corresponding reduction in system pressure. When the barrier fluid pressure reaches a maintenance set point (low level), the user will add barrier fluid to increase the system pressure back to the high pressure set point. The maintenance intervals for refilling will depend upon the size of the accumulator, seal leakage rate, and allowable pressure variation.

The most common Plan 53B designs also eliminate the seal reservoir and favor a small circulated volume of barrier fluid. This also leads to the use of a dedicated seal cooler for managing the temperature of the barrier fluid. While water-cooled seal coolers are often used, many end users favor air-cooled seal coolers since this eliminates the need for external cooling water and can allow the Plan 53B to be used in remote locations. This system, however, will be impacted by ambient temperatures which will affect the pressure of the Nitrogen in the bladder. Large variations in ambient temperature (particularly with direct sunlight on the accumulator) can result in pressure swings in the system which are independent of seal performance.

Advantages:

- Can be used at all pressures (including very high pressures)
- Does not require connection to a pressurization source
- Can be used in remote locations with limited utilities

Disadvantages:

- Variable pressure of barrier fluid
- Changes in system pressure due to changes in ambient temperature

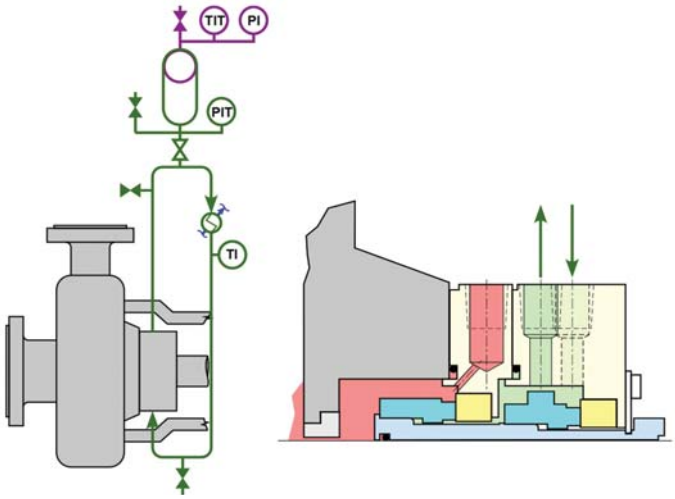


Figure 3: *Plan 53B uses a bladder accumulator to pressurize the barrier fluid which removes the live interface between the pressurization gas and the barrier fluid.*

	Plan 53A	Plan 53B	Plan 53C
Barrier pressure	Constant	Varies with leakage and temperature	Varies with seal chamber pressure
Pressurization source	External N_2 supply	Pre-charged accumulator	Reference line to seal chamber
Monitoring seal leakage	Level in reservoir	Pressure of barrier fluid	Position of piston
Maximum barrier fluid pressure	10,3 - 13,8 bar [150 - 200 PSI]	Limited only by system components	Limited only by system components
Suitable for remote location	No	Yes	Yes
Affected by ambient temperature	No	Yes	No
Ability to track seal chamber pressure	No	No	Yes
System components isolated from process fluid	Yes	Yes	No
Suitable for dirty process fluids	Yes	Yes	No

Table 1*: Comparison of features on Plan 53A, 53B, and 53C.*

Plan 53C

The Plan 53C utilizes a piston accumulator to pressurize the barrier fluid system. Rather than using an external pressure source, this plan uses a reference pressure from the pump itself (normally the seal chamber). As the pump is pressurized, the reference line pressurizes the accumulator and creates a correspondingly higher pressure in the barrier fluid. The pressurization occurs due to the different hydraulically loaded areas on the two sides of the piston. This system is therefore self-energizing and tracks both normal and upset pressures in the seal chamber. The piston itself slides to compensate for a loss in barrier fluid. The position of the exposed piston rod is used to monitor seal leakage and determine the volume of barrier fluid remaining in the accumulator.

There is one severe limitation to this design; the piston itself is exposed to the process fluid from the pump. This requires that the piston accumulator itself is compatible with process fluid in the pump. In addition, the sliding nature of the piston requires that the process fluid does not become viscous, solidify, plate-out or leave deposits in the accumulator. Piston accumulators are available in a fixed number of pressure ratios which may vary between manufacturers. The ratio is also fixed which means that the end user cannot alter the barrier fluid pressure from the pressure naturally created by the design ratio and the seal chamber pressure.

Advantages:

- Automatically pressurizes barrier fluid system
- Automatically tracks pressure changes in pump
- Can be used in remote locations with limited utilities

Disadvantages:

- Exposes piston accumulator directly to process fluid
- Not usable in dirty process fluids or fluid which will plate out or leave deposits
- Available in a fixed number of pressure ratios

Conclusions

End users are specifying more Arrangement 3 seals in an effort to improve reliability and reduce emissions. The available piping plans for supporting this arrangement provide the end users with options to meet their unique application requirements. Selecting the correct piping plan is a critical step in ensuring successful seal performance.

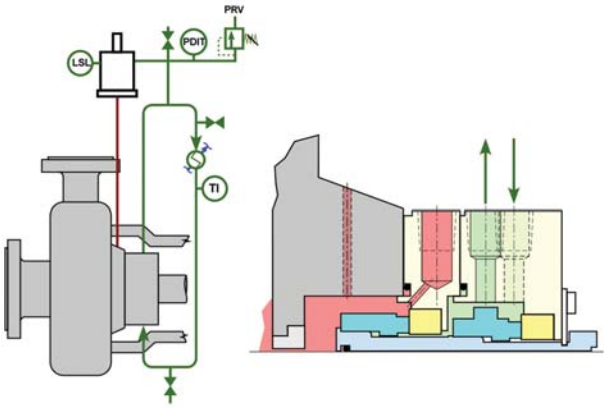


Figure 4: *Plan 53C utilizes a piston accumulator to pressurize the barrier fluid system.*

Be sure to check out the October 2015 issue of Pump Engineer to read Part 2 of Michael Huebner's article series!

ABOUT THE AUTHOR: *Michael Huebner*

Michael Huebner is a Principal Engineer at Flowserve Corporation in Pasadena, Texas. He has over 30 years of experience in the design, testing, and application of mechanical seals both in the USA and Europe. He has authored numerous articles and lectured extensively around the world. Mr. Huebner is a member of the API 682 Task Force on Mechanical Seals, the ASME B73 Committee on centrifugal pumps, the Advisory Committee for the Texas A&M Pump Symposium, and the ASME. He has a BS in Engineering Technology from Texas A&M.

Michael Huebner, Flowserve

Effective sealing in flowline breakaway connectors

Deep sea locations prevent the use of conventional freestanding working platforms, as construction at great depths is simply unachievable. As a consequence, many of today's deep water exploration rigs and extraction vessels now float in close proximity to the well site in order for engineers to access the valuable resources below. These floating working vessels are connected to the wellhead on the ocean floor via flowlines, umbilicals or cables, allowing raw hydrocarbon materials to be pumped onto the ship and transported to the shore for processing.

By Steve Jagels, Global Market Manager Oil & Gas, Precision Polymer Engineering (PPE) Limited

As anchorage is not achievable in such situations, Dynamic Positioning (DP) systems have been developed and deployed, allowing ships to use satellite positioning to maintain a fixed position on the ocean surface. With a modern DP computer-controlled monitoring system, these devices can include GPS, wind, and motion sensors which deliver information to the on-board computer that controls the angle and output for each thruster. DP systems offer excellent manoeuvrability and fast set-up as they can be positioned quickly and without costly construction.

However, while this system can have many advantages, one sizeable disadvantage is that the system can fail and blackouts can occur in the event of GPS connection failure, often caused by issues such as harsh weather patterns or loss of connection to communication systems. In this event, there is a real risk that oil and gas extraction vessels may drift off course, damaging flowlines and pumping equipment, potentially leading to catastrophic leakages.

To address this challenge, some companies have been working to develop a patented pressure balanced emergency breakaway system, where airtight connectors provide ship drift/drive off protection for vessels in case of DP loss. Positioned subsea and/or topside; the connector would breakaway in a drive off scenario while under full working pressure, leaving a dry seal on either side of the valve. This ensures safety for crew, equipment, and the environment as well as cutting operational downtime due to ease of connection and disconnection.

To meet pressure and chemical resistance requirements, the breakaway connectors would need to be manufactured from high grade nickel alloys and super duplex steels, and developed as a risk management and safety measure. In the occurrence of axial tension, the two connectors break apart and upon separation, each connector would seal itself completely at full working pressure without spillage into the surrounding water. The connectors can be operated remotely or manually with the capability of connecting and disconnecting under high pressure conditions and operate effectively whether positioned subsea, mid-level, or mounted on the extraction vessel. The system means that the environment is protected against oil leakage, but also that the oil within the flowline remains unpolluted by seawater.

Applications such as these pressure balanced disconnector cuffs require a high performance made-to-order sealing solution to meet the high pressure challenge, which would also work in conjunction with other conditions such as low temperature and even harsh chemical exposure common to the oil and gas operating environment.

In deep waters, extraction equipment is exposed to high pressures while enduring low temperatures. In these environments, elastomer compounds will become brittle below a certain temperature, in turn losing a degree of elasticity and the capability to create an effective seal. If an elastomer begins to exhibit brittle characteristics, it will no longer provide an efficient solution, risking failure and leakage. Hence, it is important that critical equipment intended for offshore exploration is meticulously tested to perform at pressures upwards of 15,000psi and at temperatures ranging between -18°C and +121°C.

Elastomer Family	NBR	Low Temp HNBR	HNBR	FEPM (TFE/P)	Low Temp FKM	FKM	Low Temp FFKM	FFKM
Sour Gas Performance 1=best or non-reactive 3=most reactive	3	3	2	1	2	3	1	1
Glass Transition, °C	-30	-40	-30	5	-40	-17	-30	0
Upper Service Temperature, °C	120	160	180	250	225	225	240	260

Table 1: *Demonstrating the relative sour gas resistance of elastomer types and their respective glass transitions with approximate low and high temperature performance. A rating of 1 on the Sour Gas Performance scale indicates the elastomer does not react to hydrogen sulphide.*

It is also essential to consider the possibility that pumping equipment may come into contact with extremely corrosive or aggressive media. When pumping both onshore and offshore, exploration companies can often encounter highly toxic chemicals, including hydrogen sulphide, otherwise known as 'sour gas'. Hydrogen sulphide is intensely corrosive and can cause widespread damage to equipment and sealing materials, as well as being extremely dangerous to personnel and the environment. This has led to stringent regulations such as API 6A, 17D, PSL3G, and PR2, along with a strict testing regime to ensure that safety criteria is met.

The elastomer types used as seals in pumps and valves for the oil and gas industry typically include NBR (nitrile butadiene rubber), HNBR (hydrogenated NBR), FKM (fluoroelastomer), FEPM (tetrafluoroethylene/propylene), and FFKM (perfluoroelastomer).

Of these individual types, there are general properties that are fundamental to that group such as temperature range, chemical resistance and glass transition temperature. However, within each of these elastomer families there are also variations differentiated by monomer ratios, cure chemistries, and other factors. Each of these materials will have trade-offs in performance in sour gas and low temperature resilience as shown in Table 1.

FFKMs provide more resistance to aggressive and corrosive substances such as oil, aromatic hydrocarbons, water, amine based corrosion inhibitors, sour gas, and methanol. Although traditional FFKM materials have this ability, they are unable to perform at low temperatures and are only rated to around -15°C. New FFKM materials are specially developed to cope with lower temperatures down to -46°C. These FFKMs are a more suitable choice for low temperatures faced in subsea operations.

The development of breakaway connectors for suspended flowlines provides a solution that ensures the prevention of environmental contamination and the pureness of extracted materials in case of a DP loss situation. To ensure the effectiveness of the connector system, specialist elastomer sealing materials should be employed in the connector cuffs that have been tested and proven to perform far beyond the anticipated extremities of the operating environment.

Steve Jagels, PPE

CASE STUDY: Hose pumps used in winery filter press system

Verderflex provides hose pumps to a standard filter press system that is used at a winery for processing yeast slurries.

By Sarah Schroer, Editor, Pump Engineer

The yeast removal process produces a clumpy, yeast slurry that gets pumped through a filter press. In this case, a Verderflex VF25 industrial hose pump is used as part of a standard filter press system produced by a German manufacturing company.

From the yeast slurry storage vessel, the slurry is fed into the peristaltic pump through a 32mm suction line made from flexible Verderflex hose to reduce pulsation. The peristaltic Verderflex pump is fitted with DIN 11851, type SC stainless steel sanitary connections of 32mm, with reducing inserts to suit the 25mm tubing. The drive of the pump is a 1.1 kW gear reducer giving a pump speed of 48 rpm, delivering 800 l/hr of product to the filter press.

On the discharge side of the filter press pump, a 32mm flexible hose is used to feed the filter press. In addition to the flexible hose, an air dome is installed which has a volume of approximately 20 liters, allowing it to absorb pulsation, but also to act as a pressurized storage tank for the filter.

The chamber filters are evenly filled with wine/yeast slurry mixture, to a pressure of 10 bar that is maintained and not exceeded for effective operation. A pressure sensor is installed on top of the air dome and is set to stop the Verderflex pump running when 10 bar pressure is registered. At least one pressing shoe of the pump is always positioned to be fully compressing the hose, acting as a valve, thus maintaining the pressure in the air dome and chamber filter.

Verderflex peristaltic hose pumps are also commonly used for transferring yeast in the brewery industry.

As the wine slowly flows through the filter the pressure inside the air dome reduces, until the sensor registers a pressure of 7 bar, at which point it is set to start the Verderflex pump again. At the end of a batch, when the yeast slurry feed vessel is empty, the peristaltic Verderflex pump can run dry without damage.

Accelerated testing of composite bearings for rotary pumps

Composite polymer bearings are used in a variety of pumping applications. The benefits of composite bearings include low running friction, low wear on associated pump shafts and ease of replacement. However, the wear properties of these bearing materials are often a characteristic of concern for engineers. The development of new materials requires controlled wear testing to validate the effectiveness of candidate material formulation.

By Kurt Hayden, PhD & Ashley Raines, EGC Critical Components

While standard tests such as ASTM D3702 may be used to screen candidate materials, end users prefer the validation of field testing. Testing in actual pumps can be prohibitive due to the amount of fluid which must be managed during the test and the management of heat generated during the pumping operation. The Journal Bearing Test Rig (JBTR) discussed here has been designed to simulate pump bearing conditions in conjunction with accelerated testing methods.

Test method

The journal bearing specimen of the candidate material sits in a sealed testing chamber that fits against a stainless steel shaft, as shown in Figures 1 and 2. A force perpendicular to the shaft is applied to the testing chamber by a pneumatic cylinder. The shaft rotates against the ID of the specimen. The air supplied to the cylinder generates a side load on the specimen and is regulated by the control software.

While the test is running, a slurry of 5% silica and distilled water originates from a mixing chamber and continues its flow through a heat exchanger and afterwards, a peristaltic pump. The pump then sends the slurry mixture to the test chamber on one side of the bearing. The mixture passes to the other side of the bearing through the channels shown in Figure 3 and is returned to the mixing chamber. Together, the applied side load, the silica and the rotation of the shaft cause abrasive wear on the test specimen, which our test aims to evaluate.

Figure 1: *Photograph of the test chamber of the journal bearing test rig.*

Various data is collected by the rig during the test. These data include temperature, displacement, pressure, and speed. The slurry inlet and outlet temperatures and the temperature of the reservoir fluid are monitored by immersion thermocouples. Slurry pressure is measured via an in-line pressure transducer. For safety and consistency from test to test, temperature is also sampled from the right and left rotary bearings.

The specimen temperature is approximated by the shaft temperature at the point of bearing contact which is measured with an IR sensor, located within the ID of the shaft. A heater and a chiller are used to control the temperature of the system. The heater is immersed in the slurry mixing chamber. The system program may control either the slurry or the specimen temperature.

The side load is measured via a load cell at the bottom of the plate which applies the side load. It is also measured through calculations based on the controlled air pressure through the valves (this air pressure is measured via a pressure transducer as well). The rotary motion of the shaft is managed by a DC motor controller which is configured by the rig software. Shaft RPMs are measured with a proximity sensor that is placed over a

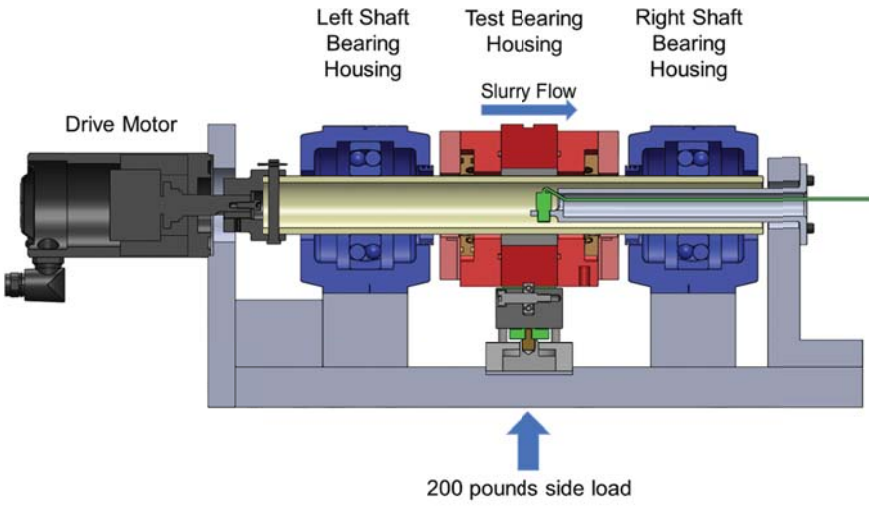


Figure 2: *Cross section illustration of the journal bearing test rig showing the location of components.*

hole in the shaft. Displacement of the sealed testing chamber is measured by a Linear Variable Differential Transformer (LVDT).

Each test of candidate material is replicated to establish a measure of variability. The data collected from before, during, and after the test are compiled and analyzed using various methods. Changes in the dimensional measurements, weight, volume, and surface finish of the bearing specimen and shaft provide an empirical indication of wear. However, the preferred method of determining wear rate utilizes a line of best fit generated from the data provided by the LVDT.

General observations

The data collected through the aforementioned methods is reviewed after each test for trends within each response as well as correlations between factors. In general, the temperature of the shaft at the point of contact with the bearing is higher throughout the test than the incoming slurry temperature, as shown in Figure 4. Additionally, the outlet slurry temperature is always greater than the inlet temperature. It is apparent that the slurry is removing some of the heat generated by friction between the shaft, the wear particles, and the bearing.

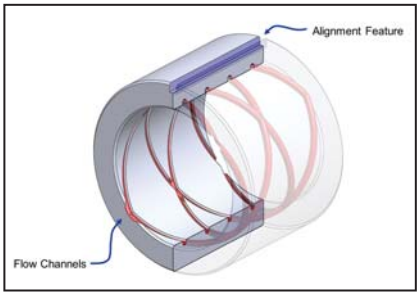


Figure 3: *Illustration of the specimen bearing showing the slurry flow channels.*

The analysis of the wear data collected by the LVTD has demonstrated that the wear exhibits three distinct phases. The first phase is the break-in period, often accompanied by an initial increase in the size of the bearing due to thermal expansion. This expansion may be observed as negative wear (displacement) shown in the graph of Figure 5. Immediately following this thermal break in period is a period of rapid wear due to the initial shearing of the sample and gradual smoothing of mating surfaces (bearing break in). The duration of this phase varies from material-to-material, but typically occurs within the first one to two hours of the test.

The second phase of typical wear curves exhibit a transition to a reduced, more stable wear rate experience in the third and final stage of "stabilized wear rate". While the transition stage exhibits a parabolic characteristic, the stabilized wear rate may be highly approximated by linear regression ($r > 0.98$). For material comparisons, it has been found that this wear rate is indicative of comparative long-term bearing performance.

Closing

The Journal Bearing Test Rig provides a platform for the comparative testing of new composite bearing materials. The test rig has shown to be a useful tool for the collection of wear data and contributing factors pertaining to the performance of composite bearings in rotating pump applications. Other factors remain to be investigated, such as the relationships between various temperatures and comparative wear rates of bearing materials. These factors will be discussed in future publications and investigated during on-going upgrades to the Journal Bearing Test Rig.

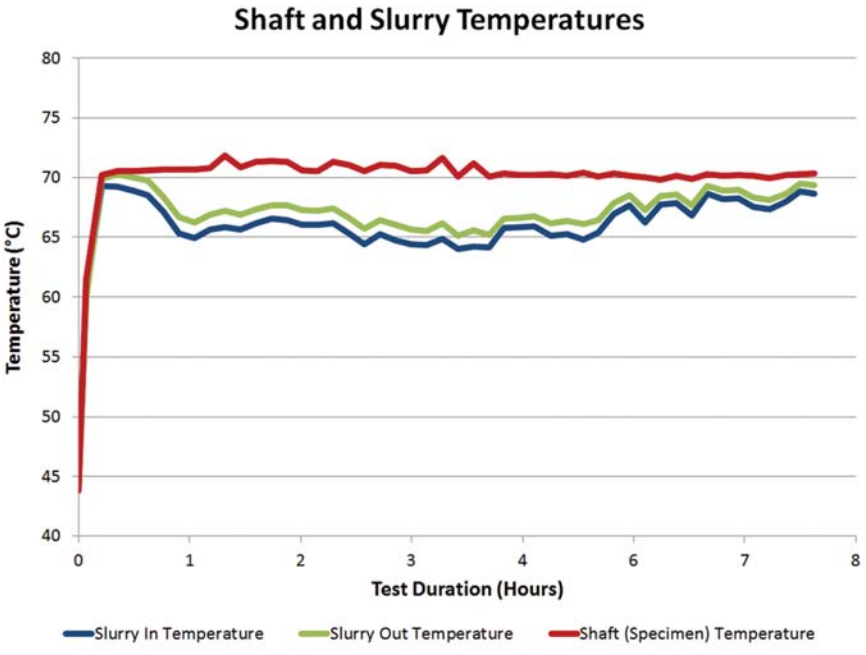


Figure 4: *Graph of typical temperature effects observed in the slurry and shaft.*

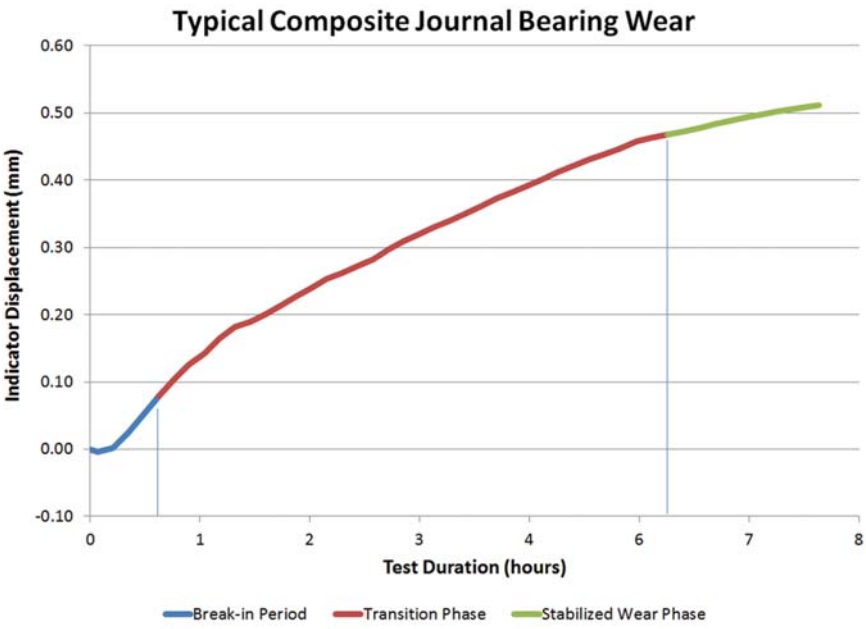


Figure 5: *Example graph of a wear curve showing the three phases of typical wear.*

ABOUT THE AUTHORS: *Ashley Raines & Kurt Hayden*

Ashley Raines, EGC

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Kurt Hayden, EGC

Kurt Hayden is the Director of Engineering and Technology Development for EGC Critical Components in Houston, Texas. Kurt received his Ph.D. in Industrial Engineering from Western Michigan University. He has 21 years of experience in polymer processing, testing, and product development.

Thermal growth considerations in pump mechanical seals

The effects of thermal and differential expansion are destructive to pump mechanical seals. The components of a pump, operating at high temperatures in particular, suffer internal differential growth.

By Mr. Adolfo Gomez & Andrea Marcela Morales

Wrongly supported piping, which expands toward the pump, might impose extremely large loads that will throw the pump out of alignment or impose high moments that might bend and even break nozzles.

For example, a 6" Schedule 40 carbon steel pipe, 10' long supported at the end opposite to the pump, will expand toward the pump. Consider the temperature of the liquid in this pipe; if it increases 320°F, it will grow as outlined in Figure 1. The calculations from Figure 1 show that if a pipe undergoes an increase in temperature and a component next to it impedes its expansion, extremely high stresses will take place.

Growth = 320 °F × 120" *0.0000065 /°F = 0.250"

Strain will be 0.250"/120 = 0.00208 in/in

Stress = E * Strain = 30,000,000 * 0.00208 = 62,400 lbs/Sq. in

The area of a 6" Schedule 40 pipe is 5.481 Sq. in

Force = Stress * Area = 62,400 * 5.581 = 348,441 lbs

Figure 1: *Calculations showing that if a pipe undergoes an increase in temperature and a component next to it impedes its expansion, extremely high stresses (forces) will take place.*

Mechanical seals could be seriously affected by differential thermal growth between the shaft and pump casing if put in operation before preheating and before they reach thermal equilibrium.

Refer to the seal in Figure 2 that shows the cartridge seal installed and its operating length held and determined by the Locking Washer or Locating Fixture. After the cartridge seal gland bolts and set screws on the shaft are tightened, the preheating process begins. The shaft will be immediately immersed in the hot liquid, while the massive pump casing and its insulation slowly begin to absolve heat. Some of this heat is lost depending on the state or lack of insulation.

Figure 3 shows the cartridge seal with its Locking Washer or Locating Fixture removed and ready to start operating. Going back to our previous example, we can assume our pump has a 5 ft. long shaft, and the operating temperature 320°F above ambient temperature, so the shaft will expand half of above calculation, that is 0.125", and the casing will just begin to expand a few thousands of an inch. This 0.125" expansion is significantly above the seal operating length tolerance that is usually plus or minus 0.030".

In multistage pumps, one end of the shaft (usually the outboard side) is axially held by two angular contact bearings, while the inboard (coupling end) is held by radial, Conrad-type bearings, free to slide horizontally.

Figure 4 shows this differential expansion between the shaft and the pump casing, in this case dimension E = 0.125". Eventually, the pump casing will reach the expansion of the shaft, and the pump will be ready to begin operation.

The pump operator should be aware of when uniform thermal growth has been attained by observing Dimension E on the inboard seal. The outboard seal will not be affected by the thermal growth since the shaft is axially held at that end.

If the pump is submitted to operation before it reaches thermal equilibrium, depending on the magnitude of the shaft thermal expansion, the inboard seal might be over-compressed beyond its operating length tolerance, and will be irremediably damaged. Observation of Dimension E during the warm up period is extremely important in high temperature pumps with long shafts, also to some extent in very low temperature operating pumps.

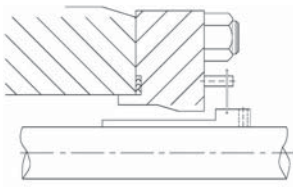


Figure 2: *Cartridge seal is installed, its operating length held and determined by the Locking Washer or Locating Fixture.*

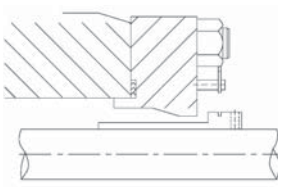


Figure 3: *Cartridge seal with its Locking Washer or Locating Fixture removed and ready to start operating.*

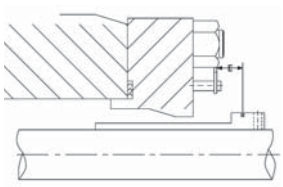


Figure 4: *Differential expansion between the shaft and pump casing caused by heating of the pump, E = 0.125".*

ABOUT THE AUTHOR: *Adolfo Gomez*

Adolfo Gomez has over 30 years of experience in mechanical seal selection, installation, and training. He holds a Bachelor of Science in Mechanical Engineering from the University of Louisiana at Lafayette.

Article edits and diagrams by: Andrea Morales, Mechanical Engineering Student, Tufts University, Class of 2016

SHOW PREVIEW: Pump Symposium 2015

Dr. Dara Childs serves on both the turbo and pump advisory committees for the Turbomachiney & Pump Symposia.

Pump Engineer connected with Dr. Dara Childs, who not only has been the Director of the Texas A&M University Turbomachinery Laboratory since 1984, but is also heavily involved in the Turbomachinery & Pump Symposia. This September will mark the 31st Pump Symposium, which will take place on September 14th through 17th in Houston, Texas.

By Sarah Schroer, Editor, Pump Engineer

***Pump Engineer:** What can attendees look forward to at the event this year?*

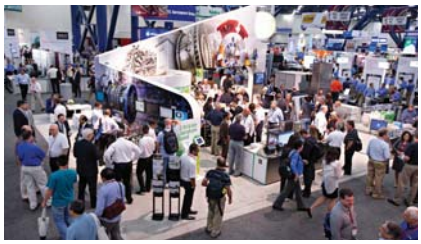
Dr. Dara Childs: Attendees can look forward to lectures, tutorials, case studies, and solving problems that regularly face engineers. Even twenty years ago, when there were perhaps only ten pump companies at our event, there were papers given by the leading research engineers in the industry. Our event always attracts the top people who work on the industry's top pumps, turbomachines, mechanical seals, and other machinery.

***Pump Engineer:** As the Director of the Turbomachinery Laboratory since 1984, how have you seen the industry evolve over the years?*

Dr. Dara Childs: I've likely observed the same evolution as others. For one thing, there continues to be an increase in industry consolidation. Today, a handful of smaller companies exist alongside ever-expanding, larger companies. Moreover, many industry challenges have been put to bed. In 1984, for example, there began a real push to meet the new EPA emissions requirements. This was taken care of by new mechanical seals and sealless pumps. The extension of pump impeller lifespan is likewise a significant, industry-level advancement, as are a number of significant developments in pump manufacturing.

***Pump Engineer:** What benefits are there to running the Pump Symposium alongside the Turbo Symposium?*

Dr. Dara Childs: A great benefit is a much wider array of exhibits in our exhibit hall. Most user companies require their rotating equipment engineers to be conversant with pumps, compressors, and turbines. Because of this, attendees are interested in the full spectrum of industry issues, and at our symposia they get exactly that.



This September Houston will host the 44th Turbomachinery & 31st Pump Symposia.

***Pump Engineer:** Is there anything else you would like to add?*

Dr. Dara Childs:

- The proceedings of the symposia are all freely downloadable at: *tps.tamu.edu.* They are a real resource for practicing engineers around the world.
- Friendships are made between engineers at the symposia. They arrive with common industry problems, work through those problems together, and continue their technical interactions all year round.
- The TPS advisory committees are the single biggest resource that the Turbo Lab has. We couldn't begin to pay them for their time put into planning and reviewing the technical program and inviting others.
- The quality of our program exceeds that of many technical societies, today.
- When I attend the ASME Turbo Expo, I note that many of the references cited in their program are to lectures given at TPS.

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BRINGING THE FOCUS BACK TO PUMPS:

The new Pump Summit Americas event will cater to pump professionals

Pumps are part of everything we do. As a professional in the process industry, pumps are often referred to as the "heart of the system". For the first time, Houston will see a pump conference and exhibition for pump professional by pump professionals. Pump Summit Americas aims to truly support relationships between young engineers and industry veterans. With the knowledge gap becoming more and more apparent, it is essential to work together as one pump community in order to prepare for a successful future.

By Sarah Schroer, Editor, Pump Engineer

Pump Summit Americas is grateful to have the support of Chairman, Jean-Marc Fosseux, and a strong Steering Committee. The group recently held their first meeting during the Valve World Americas event on July 15th at the George R. Brown Convention Center in Houston, Texas. The Steering Committee discussed the direction of the conference, picked topics, and selected moderators for each session.

A handful of the Steering Committee members for Pump Summit Americas poses for a photo during a Left to right: Baha Tanju, Bob McIlvaine, Sarah Schroer, Michael Huebner, Charli K. Matthews, Jean-M (Bob) Heyl, Henri Azibert, and Pedro Larregui.

> *"Houston's Premiere Networking Event for Pump Experts"*

Jean-Marc Fosseux from Technip is the Chairman for the first Pump Summit Americas event.

QUICK FACTS: Pump Summit Americas

Name of event: Pump Summit Americas
Date: June 13th – 14th, 2016
Location: George R. Brown Convention Center, Houston, Texas

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meeting that was held in July 2015 in Houston, Texas. arc Fosseux, Jack Creamer, Michael Michaud, Robert

New approach to a pump conference

Pump Summit Americas is planning a hands-on learning experience for the conference, with a diversity of teaching styles and conference formats:

Pump Summit Americas is planning a mix of:

1) Workshops
2) Panel Discussions
3) End-User Forum
4) Plenary Presentations
5) Speakers' Corner

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Jean-Marc Fosseux, Senior Rotating Equipment Consultant, Mechanical Engineering, Technip USA

Steering Committee Members:

Baha Tanju, PhD, Sr. Advisor Subsea Control Systems, Chevron Energy Technology Company

Charli K. Matthews, Founder & President, Empowering Pumps, LLC

Heinz P. Bloch, P.E.

Henri Azibert, Technical Director, Fluid Sealing Association

Jack Creamer, Market Segment Manager, Schneider Electric – Square D

Jay A. Zaffino, P.E., Associate Rotating Equipment Engineer, Burns & McDonnell

Kamran Z. Mirza, Director, Business Development, SEEPEX Inc.

Dr. Klaus Brun, Machinery Program Director, Southwest Research Institute

Mark Sullivan, Director of Education and Marketing, Hydraulic Institute

Michael Hotho, Chief Engineer, Rotating Equipment, Technip USA

Michael Huebner, Principal Engineer, Flowserve Corporation

Michael Michaud, Executive Director, Hydraulic Institute

Robert (Bob) Heyl, Independent Consultant

Robert McIlvaine, President, Mcilvaine Company

Steve Kura, Vice President, Teadit North Americas

Not pictured, but also on the Pump Summit Americas Steering Committee:

- Laurel Donoho, Global Research Manager, Frost & Sullivan
- Pedro Larregui, Senior Reliability Engineer, Phillips 66

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