

# Face to Face

THE SEALING TECHNOLOGY MAGAZINE

## ABOVE THE REST

Flowsolve rises to the challenge with unrivaled experience and service to help optimize your flow control operations.

**Uniquely Engineered  
Solution** Surpasses  
Expectations **P. 4**

Rethinking **Seal  
Technology** Brings  
Multiple Benefits **P. 6**



# Oil & Gas Platform Gets More Reliable Seals

Flowserve designs specific dual-pressurized seal for a hot-oil pump seal and support system upgrade, meeting stringent specifications and handling harsh seawater conditions.

The oil and gas exploration and production industry is increasingly reliant on floating production, storage, and offloading (FPSO) vessels. FPSO vessels provide greater flexibility than traditional fixed-production platforms because they rotate freely in response to the wind and waves, and can be moved or redeployed as conditions warrant.

In early 2014, a major international oil and gas customer set its sights on a new FPSO platform near the Southwest African nation of Angola. It established stringent design and time requirements for a hot-oil pump seal and support system. Hot-oil circulation pumps are necessary to maintain oil production in cold and deep water.

The FPSO project originally was designed and specified in the United Kingdom, but the vessel ultimately would operate in South Atlantic Ocean conditions. The initial project proposal did not meet the oil and gas company's specifications for Angola, so the Flowserve Seal Engineering team in Singapore was invited to propose an alternative solution. Because of the team's quick improvements, Flowserve won the opportunity to become the seal of choice for this project, which was completed on time in March 2014.

## Constraints and Complexities had to be Managed

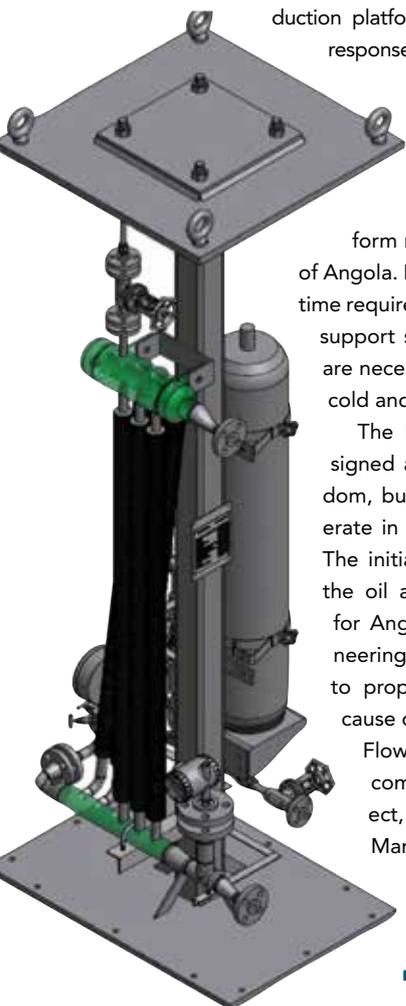
FPSO vessels are characterized by tight quarters and little room onboard for personnel and supplies. They contain equipment for both the processing and storage of hydrocarbons. Crude oil is pumped onto the FPSO platform through pipelines, gas is separated from water and sand, and the oil or gas is stored. Periodically, stored oil and gas is transferred to shuttle tankers or barges for further processing onshore.

Because the vessels typically are moored in remote offshore locations, often in deepwater or ultra-deepwater fields, they are subject to an extremely corrosive saltwater environment and potentially harsh weather conditions. In addition, any equipment or component failure and associated maintenance on an offshore vessel is a particularly costly endeavor because of their remote locations and inaccessibility to service personnel and parts.

Consequently, self-reliance, sustainability, and efficiency are essential characteristics of FPSO platform equipment and components, and were sought for the Angola-bound vessel.

To upgrade the original hot-oil pump seal and support system design, the oil and gas company turned to the Flowserve office in Singapore, through an engineering contractor also located in Singapore. The Flowserve Seal & System Engineering Group assumed responsibility for making the necessary alterations.

Flowserve had to address the tightly constrained space, mitigation of environmental emissions, and po-



◀ Construction materials included 316 stainless steel for the air fin coolers on the Plan 53B seal support system, shown here, for an international oil and gas customer's new floating production, storage, and offloading platform.



tential for equipment reliability issues within the new design in order to maximize the seal configuration and support system.

“Not only did the stringent specifications have to be met, but the project had a limited budget for seals, and the opportunity for on-site fabrication was constrained because of limited physical space,” explains Lalith Kumar Seetharam, Manager of Seal & System Engineering at Flowserve.

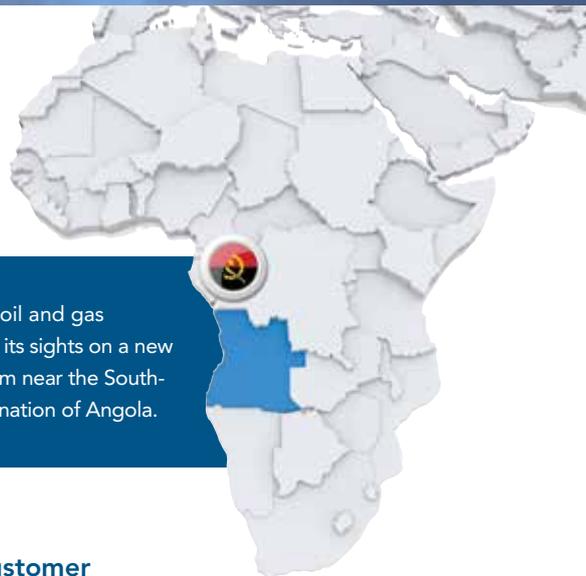
### Engineered Solution Answers the Challenge

The Seal Engineering team conceived and developed an engineered solution specific to the requirements of the FPSO owner. To meet the emissions requirement for the FPSO environment, the design included a dual-pressurized seal, which is a common seal configuration for high-vapor pressure fluids and light hydrocarbons.

To address the abundant exposure to sea water, the construction materials included 316 stainless steel for the air fin coolers on the Plan 53B seal support system. The seal flush plan support system can accommodate the arid climate location near Angola and the constant cooling breeze present at the location where the new platform resides.

“A competitive seal solution was constrained by the on-site and application conditions,” says Seetharam. “Flowserve found a solution to these challenges without having to compromise on the performance of the seal and support system. The Flowserve design wouldn’t put a strain on the platform’s limited electricity and water utilities, and it supported the vessel’s limits regarding space and on-site rework.”

Two units of the Flowserve Plan 53B System were purchased and successfully installed, along with two sets of spare units.



In 2014, the oil and gas customer set its sights on a new FPSO platform near the South-west African nation of Angola.

### Satisfied Customer Goes on the Record

The complete package has been successful in meeting the requirements of the oil and gas company. In March 2014, following the on-time commissioning of the project, the customer gladly consented to providing feedback on the services rendered by Flowserve in the completed Project Closure and Customer Satisfaction Report.

In the survey, the customer gave Flowserve Engineering/Project Management the highest rating — “very satisfied” — for Quality of Services Provided, Professionalism and Courtesy of Staff, and Technical Capability and Support. The survey acknowledged the company’s ability to meet the needs of the engineering and operational staff involved by successfully completing the FPSO project in line with the customer’s specifications and inspection requirements.

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# TECHNICAL ADVICE HELPS KEEP FDA Qualification on Track

Gas seal solution helps pharmaceutical company stay online with a new manufacturing process that depends on a blast freezer's fan design.

**W**hen a new pharmaceutical process is developed, it must be qualified by the U.S. Food and Drug Administration (FDA) prior to its implementation. In January 2013, a global pharmaceutical company initiated qualification efforts for a new manufacturing process for taking vaccines from their production vessels and putting them into the vials in which they would be sold.

Not only was the application new to the pharmaceutical manufacturer, but it was new to the original equipment manufacturer (OEM) of the key component: a blast freezer. The fan contained within the freezer had to be properly sealed. However, in June 2013, equipment issues put the extremely tight qualification timetable at risk. Problems with the seal-maintaining vacuum arose during the commissioning period.

Recurring installation failures were followed by equipment disassembly and root cause analysis of the problem. Flowserve assisted in determining that the problem was not with the fan's Flowserve GX-200 noncontacting dual gas seal. Instead, axial movement of the shaft was a key contributor to the premature failures. A fan design recommendation by Flowserve helped to correct the condition, and the problem was resolved by May 2014.

## Seal Choice Comes Into Question

The pharmaceutical company is a long-time Flowserve customer that uses many Flowserve seals at its production facilities. Four GX-200 dual gas seals were purchased for the two plant locations where the new process was targeted; each location would have one installed and one spare.

The blast freezer's fan is a 45.7-centimeter (18-inch) electropolished rotor that operates between 800 and 3,600 rpm, and its function is to circulate the air within the freezer. In this application, the seal would be subject to challenges including extremely cold operating temperatures, variable speeds, intermittent operation, steam-in-place cleaning, and vacuum vessel pressure.

Unexpectedly, the seal failed four times during operation in a short period of time. Seal reinstallations were performed by the plant's technician under the guidance of Bob Leach, Flowserve sales engineer supporting the pharmaceutical company.

"After the second seal failure, I was asked to be on-site for the removal of the fan from the equipment," says Leach. "The initial indication during post-operational analysis of the seal was that the inboard seal faces had excessive wear,

and the outboard seal faces were in 'like new' condition."

Leach felt strongly that the seal was not causing the problem. In fact, he believed the Flowserve GX-200 noncontacting gas seal was the ideal solution for this type of application. The GX-200 can operate at the required temperatures, as low as -120°C (-184°F) and as high as 130°C (266°F), and it can tolerate a very low vacuum. Flowserve lent test equipment, provided seal expertise and expedited rebuilds.

### Analysis Leads to Equipment Design Change

Following the fourth failed installation, Leach joined the plant's process engineer on a trip to visit the blast freezer OEM facility, bringing along with the entire fan, to resolve the problem. "After dismantling the fan, a root cause analysis of the failed seal components was conducted. It was determined that we had axial movement issues," Leach notes. The analysis indicated an under-supported shaft in the bearing housing with 3 millime-

ters (0.118 inch) of axial movement.

"The most evident indicator of axial shaft movement was that the seal-setting clips were unable to be reinstalled to the mechanical seal," explains Leach. "Upon further disassembly of the equipment, the theory of axial shaft movement was proven: When there was a gap between the thrust bearing and the shaft step, the bearing should be in contact with during operation."

Following a review of the OEM's fan design, the team determined that the thrust bearing arrangement was not made according to best practices, and was held only by a shrink fit. "This was not ideal, especially due to the extreme temperature and pressure changes and the vertical configuration of the equipment," says Leach.

He recommended the inclusion of a snap ring to the bearing housing design to positively retain the thrust bearing. "The snap ring arrangement holds the inner race of the bearing from sliding down the shaft," he explains.

After working with the OEM's engineering department to address the issue, the recommended positive retention of the thrust bearing was implemented.

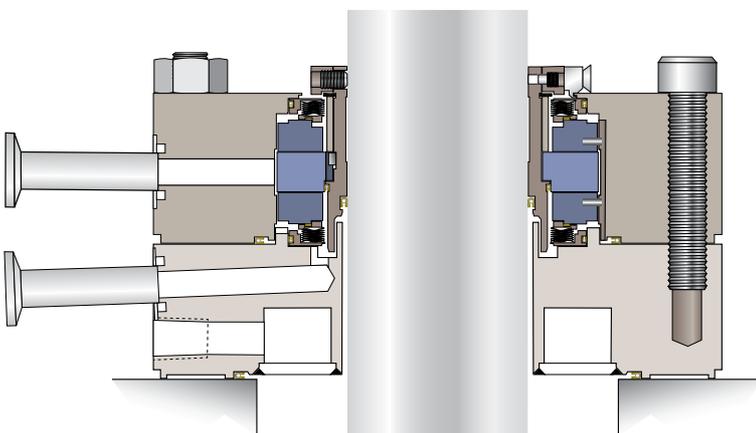
### Process is Qualified and Seal Reliability is Proven

Since the completion of the OEM fan redesign, the blast freezer has been running successfully for months. The shaft now has axial movement that is acceptable to the mechanical seal, and the new manufacturing process is supported by properly functioning, reliable equipment.

There was no negative impact to the pharmaceutical manufacturer's FDA qualification schedule during the recurring failures, thanks to the responsiveness of the Flowserve sales engineering, customer service, and repair teams.

The pharmaceutical company was impressed with the technical support provided by Flowserve on-site and during multiple conference calls involving Matthew Fox, senior engineer at Flowserve Applied Technical Solutions. Fox conducted tests on the failed seals and provided technical expertise on the ability of the Flowserve GX-200 seal to handle the axial movement under vacuum.

In May 2014, in a letter to Dave Siek, Flowserve Regional General Manager responsible for this account, the pharmaceutical company's process engineer acknowledged and commended the efforts of Bob Leach and the Flowserve Seal team, and expressed optimism that the problem has been solved after six weeks of successful fan and seal operation. As of August 2014, the seals are still in operation.



**Bob Leach from Flowserve recommended the inclusion of a snap ring to the bearing housing design to positively retain the thrust bearing on a blast freezer's fan.**

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# New Sewage Pump Cartridge Seal Surpasses All Expectations

Innovative technology using diamond-coated seals remain leak-free for a wastewater plant and have slashed seal maintenance costs.

**W**astewater treatment plants cannot hide from pump failures. The telltale mess and pungent odor are strong drivers for ensuring maximum process performance, equipment reliability, and positive community relations.

Years of recurring seal failures experienced at a Southern California regional treatment plant were inflating its maintenance costs and heightening the risk of failure for a recessed impeller slurry pump. The sludge treatment facility, which has a liquid-handling capacity of 45 million liters (12 million gallons) per day and a solids handling capacity of more than 76 million liters (20 million gallons) per day, had multiple hurdles to overcome: entrained solids in the process water, a lack of consistent water flow, and a notoriously abrasive slurry environment.

Because the plant's long-standing seal provider was unable to provide a solution that successfully prevented excessive leakage from the recessed impeller slurry pumps, plant leadership asked Pacific Mechanical Supply ([www.pacmech.com](http://www.pacmech.com)), its authorized Flowserve Distributor, to identify a more reliable cartridge seal solution.

## Difficult Conditions Placed Seals at Risk

The recessed impeller slurry pump operated in a slurry application with 3% to 4% solids. The competitor's split seal and then its single-cartridge general industry seal were unable to last longer than two months under these conditions. In fact, they often failed within weeks.

"In 2013, we took apart the recessed impeller slurry pump to determine the root cause of the failures and found heat checking on the faces. There was a lot of exposed heat and a lot of wear on the faces," says Mark Neamtu, product development manager at Pacific Mechanical Supply.

"I have found from years of experience that recessed impeller slurry pumps can have heat issues. A lot of faces use tungsten carbide against tungsten carbide on cartridge seals, but I've seen compression setting of the O-rings or checking on the faces," explains Neamtu.

"It has been a problem particularly when you try to run flushless. The smaller cavity with these faces can result in heavy heat generation in the faces, and a small amount of flush is needed to keep the faces cool," he adds.

The regional treatment plant required a flushless approach for two reasons. First, anaerobic digesters typically require a minimum of 14 days of retention time in the tank for the microorganisms to properly break down the organic solids, although 21 days is considered ideal. At the same time, sewage is regularly added to and drawn from the tank. If excessive flush water is added to the pump, it displaces too much sludge in the digester and dilutes the process, thus reducing its efficiency.

The second reason the pump is running flushless is because thermophilic wastewater processes must maintain a sludge temperature of 69°C to 74°C (156°F to 165°F) for

maximum efficiency. Flushing cool water into the system generates cold spots in the vessel, which creates a need for heating and reduces the digester's overall efficiency.

### Innovative Approach to an Effective Solution

Neamtu coordinated development of an effective cartridge seal solution with Jack Vasko, Flowserve product manager for the ultrananocrystalline diamond (UNCD) coatings for seal faces, through the Flowserve Quick Response Center in Southern California. The faces had to be strong against abrasion, and it was necessary to find a suitable seal to fit the pump without requiring pump modifications.

Neamtu suggested a UNCD coating on a single pusher Flowserve Innovative Standard Cartridge mechanical seal, model ISC2, with silicon carbide faces. "The ISC2 is a very rugged seal, and diamond-coated faces are better because of the reduction in heat gener-

ation," says Neamtu. "We ran diamond against silicon in this application because it runs so much cooler than any other face combination."

In October 2013, after years of chronic seal failures and associated costs, the sewage treatment plant placed an order for the ISC2 with diamond-coated faces. It was installed on the digester pump one month later and began successful leak-free operation.

### System Upset Taken in Stride

After just two weeks of smooth operation, a system upset occurred. A pump operator realized that the pump and seal had run dry for nearly two hours before it was noticed. A ball of rags had entered and plugged the pump's suction, starving the pump and depriving it of the fluid necessary to lubricate the seal. Fortunately, after the pump was taken off-line and the rags were removed, it was restarted without any change to the seal, and no leaks were discovered.

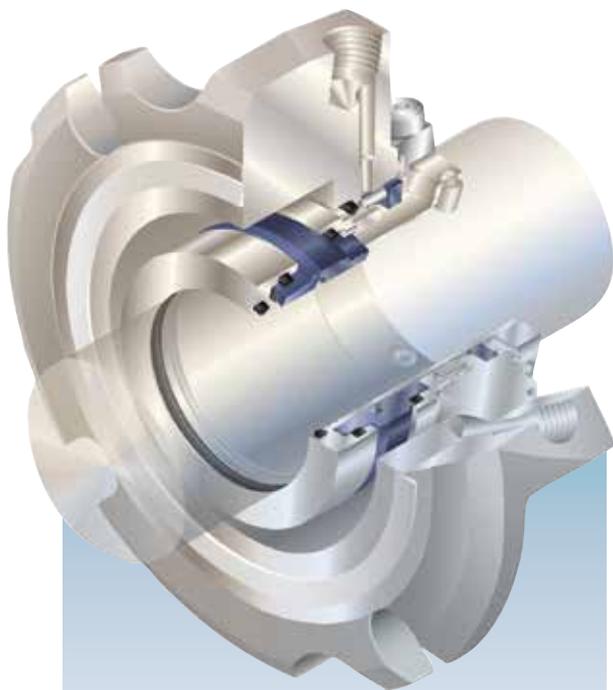
The maintenance staff believed the previous seal brand would certainly have failed under these circumstances, and they anticipated similar difficulties with the new seal. Thankfully, that proved not to be the case.

Nine months later, this same seal continues to run with no leaks, marking a dramatic improvement over the frequent and costly maintenance of the competitor's seal solutions. "The longest this pump ran on the prior brand of seal was maybe two months, but sometimes they didn't last more than three or four weeks," says Neamtu.

The maintenance supervisor and staff have been pleasantly surprised by the performance of the seal in this demanding service, and they intend to use diamond-coated faces on all mechanical seal applications. Currently, two ISC2 seals with diamond-coated faces are in operation; one for recirculating and the other for filling the recessed impeller slurry pump. A third seal was purchased and installed on the spare pump.

"I think the ISC2 with diamond-coated faces is a good fix for this pump. We intend to try UNCD technology on a split seal at another sewage plant, and look forward to proving whether the diamond coating will work equally well in the split seal sewage pump application," adds Neamtu.

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Two ISC2 cartridge seals with diamond-coated faces now are in operation at the wastewater plant, one for recirculating and the other for filling the recessed impeller slurry pump.

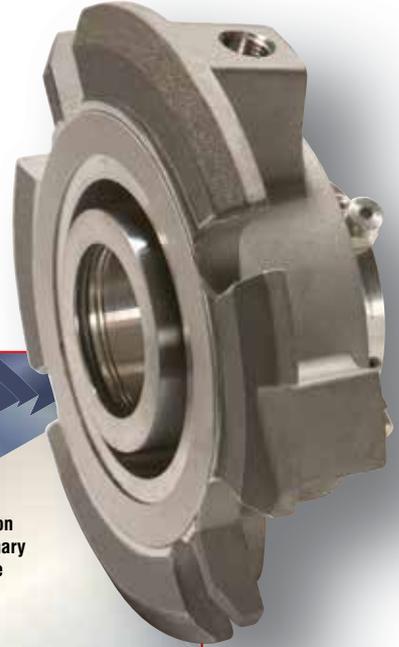
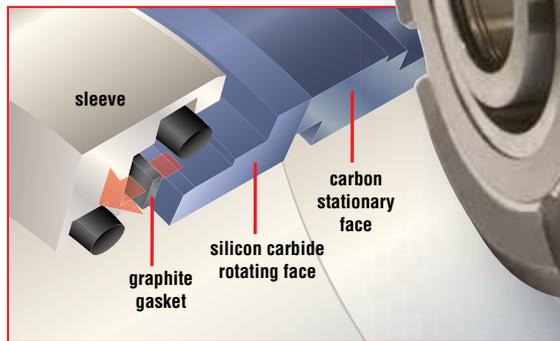


# ISC2 Mechanical Seals and Ultrananocrystalline Diamond Coated Seal Faces

*A winning combination for dependable service in challenging applications*

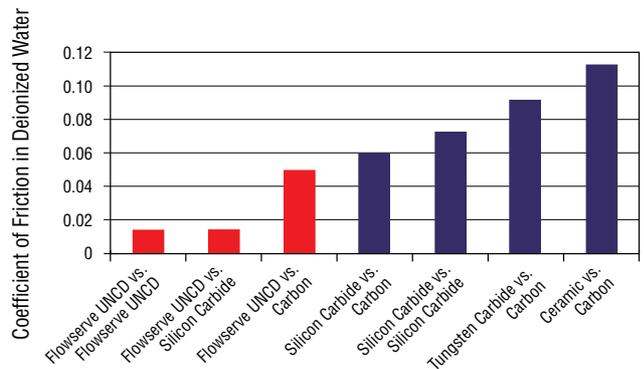
## ISC2 seals tolerate dry running events with exclusive thermal management technology

- Thermally conductive and mechanically compliant graphite material dramatically improves heat transfer between the silicon carbide rotating seal face and the sleeve
- The sleeve acts as a heat sink, lowering seal face operating temperatures and transforming cavitating and dry running bad actors into highly reliable installations



## Flowserve diamond coated silicon carbide offers the lowest coefficient of friction for cool operation

- The lowest friction of any seal face material provides cool running seal faces in poor lubricity fluids such as hot water
- Maximum resistance to abrasive particle damage
- The highest chemical resistance of all seal face materials enables its use in aggressive acids, alkalines, and caustics
- High wear resistance brings forgiveness for off-design operation such as intermittent dry running



To learn more, visit [www.flowserve.com/UNCD](http://www.flowserve.com/UNCD)



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