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# Face to Face

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## Smooth Operator

Flowsolve Alliance program improves seal life nearly fivefold at Louisiana chemical plant

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# Turning your partner into a Smooth Operator

Alliance program improves seal life  
nearly fivefold at Louisiana chemical plant

**R**ubicon Inc.'s Geismar, La. facility is a large chemical plant jointly owned by Huntsman International LLC and Uniroyal Chemical Co. The plant makes isocyanates—used in producing foam products for furniture and insulation—as well as other chemicals. The 75-acre facility is divided into seven operating areas, each containing several operating units. Altogether, the plant has 650 to 700 pieces of sealed equipment.

Three years ago, Rubicon's management recognized that frequent seal replacements had become a costly problem. Mean-time-between-replacement (MTBR) was running less than six months, and according to Flowserve Sales Engineer Michael Reagan, some seals were being replaced almost weekly.

## The landscape

Part of the problem, Reagan says, lay in the nature of Rubicon's business. Chemical plants process a wide variety of materials under a wide range of conditions. No two plants are alike. "There are so many different types of applications, different chemicals and unknowns, that a lot of times, the people at the plant may not even know what they've got." A second factor, he says, is that chemical plants tend to use ANSI (American National Standards Institute) pumps, rather than the more rugged API (American Petroleum Institute) pumps Flowserve finds among its refinery customers.

ANSI pumps, Reagan explains, use smaller bearings and bearing housings, and have thinner casings than API pumps. They're a lot less expensive, however, and most of the time, they get the job done. "But at this plant—and at others—you do come across some hotter applications," he says. Lighter construction makes ANSI

pumps more prone to failure, but the cost of replacing them with heavier-duty equipment is prohibitive and, in most cases, it's overkill.

## The big picture

Rubicon needed a seal vendor that would do more than simply supply it with replacements. "We wanted to get our seal failures under control," says Rubicon Maintenance Engineer John Kennedy. "We brought in all the seal manufacturers in our area. We went through their shops and did audits. Upper management made the decision to go with the service program offered by Flowserve."

The chemicals maker signed a five-year Alliance agreement with Flowserve, one that bound the seal manufacturer to

increase MTBR from 5.1 months at its onset in January 1998 to 24 months by the end of the contract period. The agreement covers two of Rubicon's operating areas, and the company pays a fixed fee for the parts and services Flowserve provides.

Reagan began surveying the plant three or four months before the contract went into effect to identify bad actors and estimate initial seal inventories. "We had a game plan for most everything in our area of the plant," he says. The bad actors were easy to identify and fairly easy to fix, and that yielded some impressive early results. "A lot of it was just the wrong seal, wrong materials and the wrong seal piping plans. We were able to solve those problems quickly and show some immediate improvements."

## From square one

When the Alliance program with Rubicon began, there wasn't a single Flowserve seal in the plant. As seals failed, however, Flowserve replaced competitors' products with upgraded Flowserve products. The upgrades also contributed significantly to the lower failure rate.

Flowserve maintains a seal inventory worth \$55,000 to \$85,000 at the Rubicon plant. Although the seal maker owns the inventory until it's put into service, the cost of items used is included in its fee. Rubicon, however, handles inventory management. "It's treated like a regular stock item," Reagan says. "There are order points and minimums, and whenever they need something, they issue a purchase order—but there's no money attached to it because it's a fixed-cost deal. That way, Flowserve remains out of the inventory management business and is able to focus primarily on its reliability improvement process. All seal requirements use

Rubicon's normal process and systems are treated like ordinary inventory items, making this process transparent in nature."

Of course, it's in Flowserve's interest—and ultimately in Rubicon's—to keep inventories lean. Before the agreement took effect, Rubicon kept its own stock of seals and repair parts, and inventories were significantly larger than they are now. Thanks to more careful control, fewer failures and some standardization, Flowserve has been able to reduce inventory, which helps keep costs—and prices—in check. To the extent that he can, Reagan has standardized on cartridge seals. Occasionally that means using products that are beefier and costlier than the application warrants, but the inventory savings make it a good tradeoff.

### Continuing education

A key element in improving seal performance at Rubicon has been operator training. Without it, operators "can definitely tear up more equipment in a day than you can fix," Kennedy says. The operators "had no idea what seals were," adds Reagan. "Not only did the training teach them how seals work and how easy it is to screw them up, but it also showed them that we were really interested in helping them do their jobs more easily, and so they took a genuine interest. Training was one of the most important things we did at Rubicon."

"Basically, I'm trying to get the operators to operate the pumps correctly, operate and maintain the seals and support systems correctly, and spot plugged flush lines and fix them," says Reagan. "A lot of them do it. Some of them don't. It's just a matter of making them aware of it, and it takes a lot of daily coaching."

The original training sessions, held after hours at the Rubicon site, took place nearly two years ago, and Reagan reckons it's probably time to repeat it. "They've had some turnover and some new people came in," he says. "Training is an ongoing thing. You can't just do it once and forget about it."

### Effective leadership

Another key element in improving seal performance was the commitment by Rubicon's maintenance management team toward this program. Three years ago, Rubicon maintenance practices were very much reactive in nature. There were so many failures that few people had the time or took the time to properly perform a root cause failure analysis and enact corrective action solutions. It wasn't until management at Rubicon realized that something had to change, and their support and focus on correcting problems rather than simply replacing seals was ultimately the foundation for success and improvements. Like any successful problem resolution, a problem must be recognized before it can be solved. And certainly Rubicon's management team sup-

ported this mentality by not only allowing upgrades and changes to seal designs, seal piping plans and pumping systems, but encouraging millwrights, operators, and other craftsmen to become involved in the process and suggest fixing whatever may have been wrong at the pump site. This interactivity and renewed focus by plant personnel on improving reliability and the continuous support and encouragement of management are key components of the successful formula thus far at Rubicon.

"The existence of the Alliance established a competitive air in the plant among the five maintenance areas. We've improved our specifications on pump baseplates, we've improved our vibration monitoring. The Alliance enhances our continuous improvement program," said Greg Mancina, area Maintenance Engineer at the plant.

In the early days of the Alliance, Reagan was at the Rubicon plant daily. Over time, as seal problems were brought under control, he's scaled that back a bit, but Kennedy credits his presence at the plant, and his expertise, for much of the performance improvement. "Mike does an excellent job of going out to the unit and surveying the seal systems, the flush pipes, pressures, temperatures—he monitors all those for us," Kennedy says.

### Getting close

In some of Rubicon's units, Flowserve reached the 24-month MTBR goal very quickly, says Kennedy. In others, progress has been slower. A little more than three years into the contract, overall, MTBR was around 23 months this past March and April. Reagan is confident they will reach the 24-month goal before the end of summer, and eventually exceed it. "We're close," he says, "real close."

"The Alliance has raised the capability of the workforce to a higher plane. We want to be recognized as a place that is the best. Flowserve has reached some lofty levels (of performance) and there is no telling where it will level off," Mancina added.

The ANSI pumps could eventually limit improvements, however. "If you get the right seal and install it and maintain it correctly, it lasts as long as the bearings last," says Reagan. "That's really becoming the limiting factor at this plant. We see more and more bearing failures because we're getting some seals to last as long as the bearings."

The current Alliance agreement, Kennedy says, is a trial. If all continues to go well, Flowserve will stay at Rubicon and possibly expand into other areas. A lot of things are in place that will cause seal life to continue to improve as time goes on, explained Reagan. Maintaining the program and continually looking for ways to make improvements is a never-ending process. ●

# The right stuff... at the right time

Timely service, close customer ties make QRCs a key element in Flowserve's business approach

**T**wo or three years ago, a Gulf hurricane shut down a refinery in Mississippi. The storm took out several hundred pumps, and left the plant's maintenance and engineering people with a big challenge: some 60 mechanical seals had to be replaced, and 175 more were in need of repair. For a solution, the refinery turned to Flowserve's Quick-Response Center (QRC) in Baton Rouge, La.

"Most of the seals were repaired within two days," recalls Jamie Bourgeois, QRC manager at the Baton Rouge facility. "We were also asked to replace our competitors' seals, and the only way to do that was to design and manufacture them from scratch, and ship them out the door, sometimes in less than eight hours."

It's not unusual for a driver to bring a customer's seal in to a QRC for service and wait in the parking lot while the work's being done.

Heroics like this aren't often needed, Bourgeois admits, but they demonstrate the lengths to which the company's QRCs sometimes go to serve their customers.

The Baton Rouge QRC serves customers—mostly refineries and chemical plants—along the Gulf Coast from Louisiana to the Florida panhandle, Arkansas, and parts of Tennessee and Oklahoma. Somewhat oddly, it has one customer in Hawaii—the customer's idea. The Baton Rouge QRC is one of several regional facilities that repair existing mechanical seals; manufacture new seal parts; stock inventory for themselves, their customers and distributors; and serve as a base for sales and service personnel.

## Building trust

The point of the QRCs is to provide strategic services to the company's customers, quickly and thoroughly—partly to differentiate Flowserve from its competition, partly to back up contractual promises made to Alliance cus-

tomers and partly to serve the company's independent distributors. The goal is to build trust and nurture relationships designed to last for the long run. As a lure for new customers, especially new contract customers, the strategy seems to work.

"If you look at the design and operation of a Flowserve seal versus a comparable seal for a competitor, they're pretty much equal," says Pete Gerstenkorn, Machinery Reliability Engineer for Citgo's refinery in Lemont, Ill. "The thing that sets them apart is service, and I think Flowserve's done a good job on the service side. If we have a bad actor, we ask for their recommendations. They've been great at following up with proposed or recommended designs, getting them out to us reasonably quickly, and then if there are any problems with the installation, servicing that as well."

The Lemont refinery is in the final stages of signing an Alliance contract with Flowserve. Others, says Gerstenkorn, will be watching. "We're shifting into a phase where Flowserve can help us a lot. My expectation is that we're going to make a lot more headway in the next year."

Much of that headway likely will be due to the efforts of the QRC in Burr Ridge, IL, about 10 miles up the road from the Lemont refinery. Like its counterpart in Baton Rouge, the facility houses manufacturing, repair, inventory, engineering and sales operations. And, like the Baton Rouge QRC, its customers include refineries and chemical plants, but also paper mills and agricultural companies in the upper Midwest.

## Time of the essence

Regional QRC Manager, Ray Capek, prides his QRC on its ability to design, manufacture and assemble seals quickly. Recently a customer's last minute change required a complete redesign to the seal. The CAD designers were able to complete this task and get drawings to the machine shop without delaying the customers order.

"We'll start manufacturing even before the work is put into our computer system," Capek says. "That way, we're manufacturing while the paperwork is being processed. We sometimes have a part in assembly waiting for a part number, which means it's waiting for all the paperwork to

catch up to it.” Turnaround on repairs is just as quick. It’s not unusual, says Capek, for a driver to bring a customer’s seal in for service and wait in the parking lot while the work’s being done.

Much of the \$800,000 worth of inventory the Burr Ridge QRC keeps on hand is seal component parts, but Capek keeps some finished seals earmarked for specific customers in stock, too. Under an Alliance agreement with BP’s Whiting, IN, refinery, for example, the QRC keeps a supply of seals on the shelf to support the refinery’s critical pumps, and guarantees delivery of those within four hours. Other parts are earmarked for Flowserve’s independent distributors, and Capek notes his QRC occasionally ships parts and even newly manufactured seals to other QRCs when they’re overloaded. “We all help each other,” he says. “If we can’t get something done quickly enough, we call other locations. That’s how the QRC network functions as a group.”

## Gearing up

Quick turnaround, quality products and a cooperative staff at the Baton Rouge QRC brought Motiva’s Norco, La., refinery into the Flowserve Alliance program three or four years ago, says Steve Campbell, the refinery’s senior mechanical engineer. The fact that a sister plant in Martinez, Calif., had signed on with the program a number of years earlier also played a part in the decision.

“The biggest thing that pushed us toward the Alliance was the service and the quality we were getting from Flowserve,” Campbell says. “They had seals for the vast majority of our applications. They had very good service. The quality of their seals was good, and the people we worked with were good, very willing to work with us.”

Motiva is a joint venture of Shell, Texaco and Saudi Aramco that refines and distributes petroleum products in the eastern part of the U.S. The Norco plant, a few miles west of New Orleans, processes about 240,000 barrels of oil a day and operates approximately 1,400 pumps. With that many seals to worry about, inventory standardization and reduction are among key goals of Motiva’s Alliance program.

“We’re on our way to reducing inventory by going with standardized seals,” Campbell says. “Previously, we might have had a seal in stock for just about every pump. We’re working on consolidating that with the program. We’re also working to improve reliability, though we were already well on our way to making those improvements. We’ve asked Flowserve to come on board and to be more proactive in helping us look at reliability problems, and they have a guy on site here who works with us on that.”

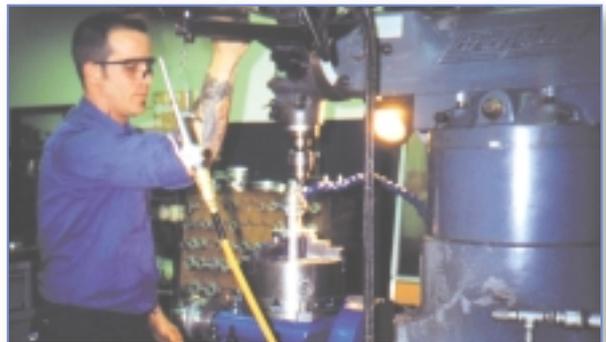
Campbell hopes to eventually move more of Motiva’s seal inventory off his site and onto Flowserve’s, but it will take time, he says, before the refinery’s operations people get comfortable



At the lathe is Rick Kush, machinist.



Ray Capek, regional operations manager, checks out the seal manufacturing line.



At the helm of the milling machine, machinist Scott Buemer.

with the idea of not having seals on a shelf somewhere inside the plant’s gates. That will change, Campbell notes, as they get more comfortable with the level of service and expertise from the Baton Rouge QRC. “As the operations folks gain trust in the Flowserve folks—that they’re going to be here when we need them and that they can get things turned around quickly—we’re headed toward vendor stocking,” he says.

Meanwhile, the QRCs continue to invest in people and equipment to continually improve service. The Burr Ridge facility, for example, just invested in new machinery that cleans parts and removes corrosion without removing any metal, and Capek’s hiring more machinists. “We basically look at servicing the customer first and providing quick turnaround, then we worry about processing the paperwork,” he says. ●

# Rome wasn't built in a day

But Flowserve got close to building a GasPac seal just that quickly

One of Huntsman Corporation's Jefferson County Operations in Port Neches, Texas, covers 585 acres and employs 500 people. The plant produces, among other things, propylene oxide and methyl tertiary butyl ether in a process that uses a peroxidation recycle compressor to pressurize an isobutane stream to 450 psi.

Huntsman expects five years of life from compressor seals. The seals are inside the compressor and were last replaced in 1998. As long as the compressor shaft turns, a wind back device keeps circulating lubricating oil away from the seals. When the compressor controls shut the unit down, however, the now stationary wind back system can no longer protect the seals.

"Although the unit was originally set up with seal purge ports, the manufacturer of the competitor's gas seals never recommended that the purge system be used," said Seth Toups, the plant's maintenance engineer. Even when the system was finally activated, the enormous amount of nitrogen it consumed clearly demonstrated that its design was not cost-effective. Meanwhile, the competitor's seals suffered from a worsening leak problem from day one.

When the compressor came back on line after a shutdown in September, 2000, the leak worsened. That is when Toups had enough. He called Flowserve to perform an on-site root cause analysis to identify why the seals were so unreliable.

## Detective work

The ensuing investigation revealed several contributory factors. "The compressor seals were operating right at the limit of their [pressure] capability," said Stewart Shoefstall, the local Flowserve representative. "Also, the O-rings were being degraded from chemical attack, not by isobutane, but by the 20 or so trace contaminants. Finally, the degraded O-rings were being extruded right out of the seal.

Huntsman needed the unit to be back online immediately, but nobody, not even Flowserve, can build a set of compressor gas seals overnight (normal delivery is 16 to 18 weeks). The only practical recommendation Flowserve could make was to change the O-ring's material of construction. Although the move was acknowledged to be a mere expedient, it was a temporary measure that bought Flowserve time for more rigorous fact-finding and identification of a definitive solution to the problem.

## The solution

The Flowserve answer was comprehensive. It included a seal having a greater pressure rating. Energized Teflon gasketing protected it from chemical attack. The recommendation included replacing the wind back devices with carbon rings that can better protect the secondary seals. The answer also recommended extensive changes to the nitrogen purge system to improve its ability to protect while slashing nitrogen consumption to a mere whisper.

Huntsman could easily cost-justify the Flowserve proposal on the basis of the high cost of free-flowing nitrogen the original seals used and the OEM's price for rebuilding the worn seals. "With the cost of nitrogen and the estimated cost to rebuild the old seals, it was a wash," Toups said. "For the same money, we have new seals," he added.

While the proposal was wending its way through the Huntsman approval process, the compressor was again scheduled for a shutdown, for reasons not related to seals. Huntsman sped up the approval and asked Flowserve to provide the new seals no later than May 2001, only six weeks away.

## Rising to the challenge

The long-lead items in a compressor gas seal are the precision-lapped carbide faces. Flowserve found sets of the proper size in one of its warehouses. Now, the race began in earnest. Designers got involved, parts fabrication started, assembly departments waited for subassemblies to arrive. The Flowserve organization mobilized to meet the tight deadline, ultimately delivering the seals on time. And, of course, Huntsman Corporation was pleased. "What is most impressive about Flowserve is that this was a 'from scratch' project, and they met the deadline," added Toups. "I know that if I called Stewart right now, he could be here immediately," he added.

Rapid service made conditions hectic in Flowserve's Kalamazoo plant. "We brought in three or four of Phil Mosher's seal engineers over a week-end to completely design the seal," said Kevin Beik, Flowserve's project manager for compressor gas seals in North America. "On Monday, we had parts going into our system. Tuesday we started manufacturing the seals," he added. Then, Marge Nelson, Flowserve's planner in Kalamazoo, used concurrent manufacturing methods during the two and a half weeks needed to manufacture the seals. Engineers programmed the NC tools, they designed, built and commissioned the fixtures to test the seals at actual operating conditions. This kind of immediate service could have built Rome more quickly than history records indicate. ●



# Safety, energy conservation and reliability

Three reasons for developing a new mechanical seal

Nearly every fluid transfer operation that relies on a rotating shaft will need a seal to prevent leakage. This truism certainly applies to steam turbines, which use, in many cases, a seal mechanism called a “carbon box” to keep live steam inside, where it can do useful work.

The carbon box has a series of carbon rings around the turbine shaft. The rings form a labyrinth seal with similar elements on the inside of the seal housing. But, the carbon box is not an absolute seal. As the rings wear with each rotation of the shaft, the spaces between them open, which increases the leakage rate.

For many years, the phenomenon of slowly increasing rates of steam leakage from the turbines was an apparent fact of life at Celanese Chemicals in Pampa, Texas. “It’s hard to quantify the life of the carbon seals. We ran them until we couldn’t deal with the leakage anymore. When we repaired them, we found shaft damage from the carbon elements,” said Gary Sugar, reliability specialist at the Celanese plant.

The Pampa facility manufactures acetic acid and related chemicals in a process that depends on turbine-driven pumps and compressors. Operating on an inlet steam pressure of 600 psi, the turbines exhaust steam at 150 psi, which is used as process heating elsewhere in the plant.

When the weather turns cold, the entire area around the turbines is blanketed in a thick white fog of leakage steam that reduces visibility and makes operation and maintenance in the immediate area difficult.

## Maintenance and safety

It was clear that Celanese wanted to do something about this situation. “In our opinion, steam cost was a justification, along with improved visibility

during the winter months. That, and reliability,” was Sugar’s response when asked about the steam problem. He explained that the leaking steam also finds its way into the bearing housings, where it mixes with the lubricants. The combination of excessive steam fog and degraded lubrication resulted in unscheduled turbine outages that lasted two days or longer.

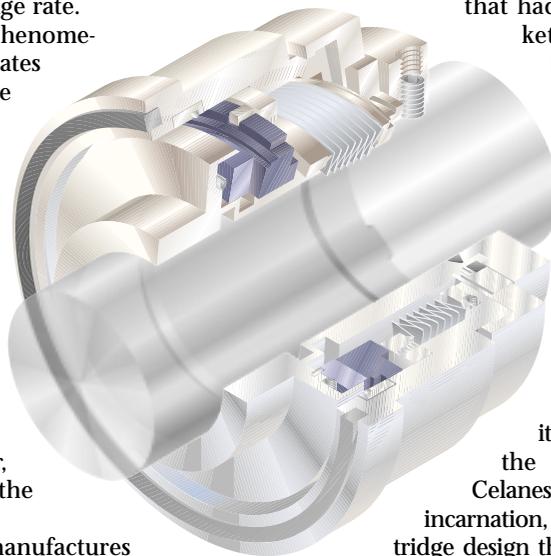
## Inventing technology

For Celanese, improving turbine reliability was an important issue. The plant tried replacing the carbon seals with a compressor gas seal that had been modified and marketed for steam service. This initiative proved to be less than adequate for the purpose.

That’s when Celanese asked Flowsolve for help. That help came in the form of designing, from scratch, a seal specifically for the turbine problem at Celanese. Thus began the development of the GTS seal. The finished product achieved its objectives, as measured by the acceptance it got at the Celanese Pampa plant. In its current incarnation, the GTS seal is a single-cartridge design that capitalizes on the recognized sealing ability of a metal bellows and the reliability of way-face technology.

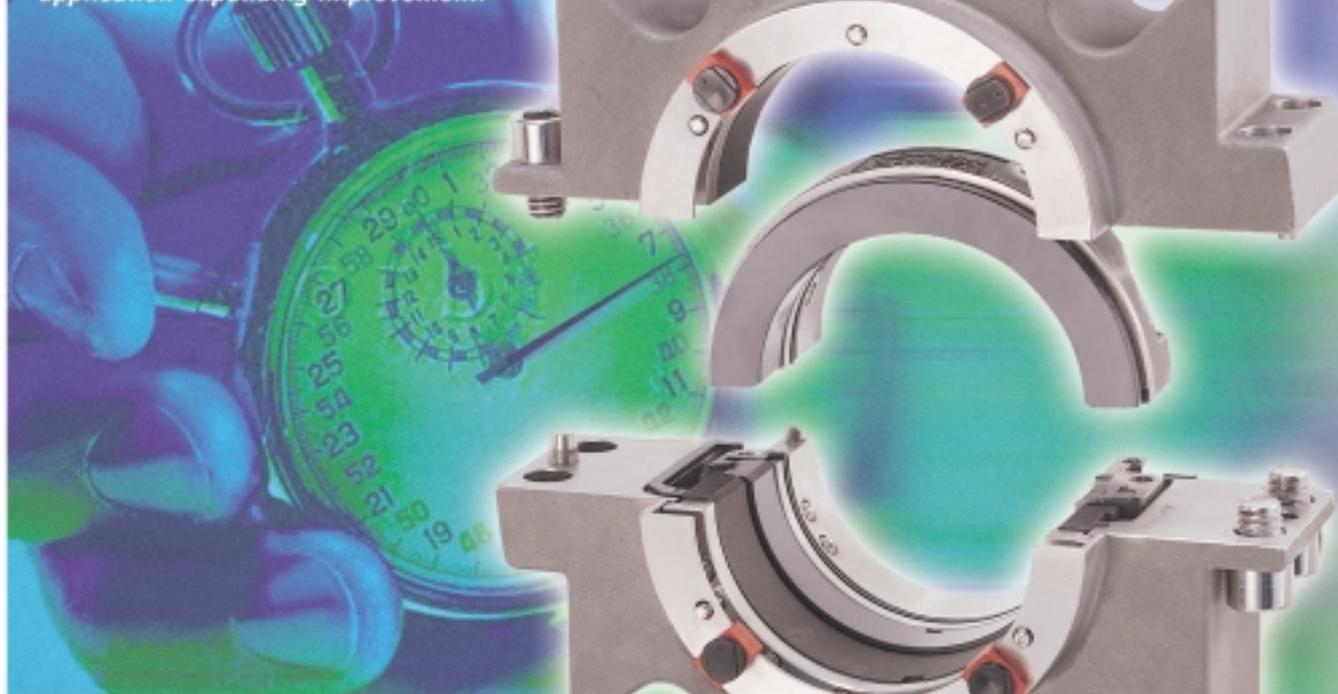
## Another problem solved

Any industrial steam supply carries suspended solids. “The wavy face is significant in terms of seal reliability. Some seals use a spiral groove to create lift. Impurities in the steam can lodge in the grooves. This leads to premature failure,” explained Sugar. “The first GTS seals were installed in October of 1997 and, except for short-term planned shutdowns, they have been operating continuously ever since without maintenance. Since the original installation, we’ve done seven more turbines and the plans are to do two more this year.” ●



# Lickety-Split

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