THORDON
NewsWORKS

ISSUE 2009-1

ENVIRONMENTALLY FRIENDLY BEARING SOLUTIONS

WORRY-FREE TRAVEL FOR SEABOURN ELITE

Seabourn Odyssey installed with COMPAC seawater lubricated propeller shaft bearings

Vacationers on luxury cruises don't necessarily understand – or even care about – the propeller shaft bearings that help propel them to exotic destinations. Nor are they impressed when you cancel their cruise because of a bearing failure.

It was after this happened not once, but twice, that Carnival Corporation began the shift to Thordon COMPAC propeller shaft bearings. Chris Joly, Carnival's Principal Manager of Marine Engineering, was so impressed with the new bearings' performance that word quickly spread within the corporation.

"Water lubricated bearings are the present for many of our ships," wrote Joly in a testimonial to Thordon Bearings Inc. "I would like to see them for all of our future ships."

By the time this article goes to print, Carnival will have Thordon COMPAC propeller shaft bearings on 10 of its Princess Class cruise ships.

"Once Carnival had installed COMPAC bearings on the first ships," says Stefano Resaz of Pedrotec, Thordon distributor in Italy, "they were so happy that all sister ships have been designed with the same bearings."

When Carnival introduced its upcoming line of extreme luxury vessels, Thordon Bearings was the obvious choice. Two Seabourn Cruise ships, which Resaz describes as "superluxury megayachts," are set to install COMPAC propeller shaft bearings. The first of these is *Seabourn Odyssey*, which travels at a cruising speed of 19 knots, has a crew size of 335, guest capacity of 450, and gross tonnage of 32,000. The ship is targeted for delivery in June 2009 in Genoa, Italy.

In the COMPAC propeller shaft bearing system, clean seawater is

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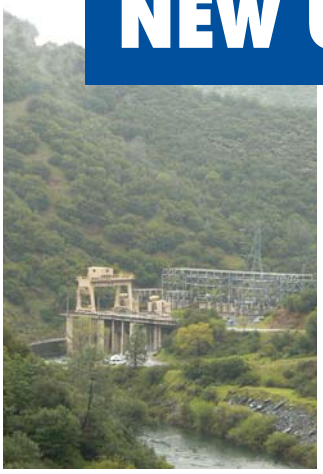
THIS ISSUE

S.M.U.D. HYDRO WORKERS FIND NEW USES WITH THORDON BEARINGS



It was late 2007, and the White Rock Powerhouse was overdue for an overhaul. Two of the largest hydroelectric generating units operated by the Sacramento Municipal Utility District (SMUD), California, U.S.A. were to be shut down for extensive repairs.

Among the necessary repairs, the wicket gate liner plates had to be replaced. High-pressure water had eroded them over the years and was costing thousands of dollars a day in water leakage. Having the machine open would also present a rare opportunity to inspect, repair and upgrade other components that are not normally accessible, such as the wicket gate bushings.

The 40 wicket gates – each weighing 1,500 pounds – have sleeve-like bushings that support the shafts. The original bronze bushings require constant lubrication from grease lines. Grease is also supplied to numerous bushings that make up the gate operating mechanism. Although the SMUD facility was using organic, vegetable-based jelly grease, not considered a harsh pollutant like petroleum, the use of grease as a lubricant had created quite a housekeeping issue in the units turbine pits.

Significant grease had accumulated in each turbine pit, coating various parts and surfaces. Before proceeding with the disassembly, crews spent five days removing 40 years' worth of grease ultimately filling two 55-gallon (208 L) drums two-thirds full.

"It was quite a mess, and an unsafe place to work," says Bill Collins, Principal Mechanical Engineer in SMUD's Power Generation department. "These guys were in their coveralls, covered in grease and pumping it into containers. The prospect of eliminating the grease lubrication system was clearly attractive, not just because it was difficult to work in there but because it looked terrible."

Once the first machine was disassembled, the crew set out to replace the greased bushings with Thordon's bronze-backed HPSXL TRAXL bearings, which require no maintenance and run grease-free. They started with the 20 wicket gates, each of which has a lower, an intermediate and an upper bushing, thereby eliminating 60 grease points. Next, at the upper stem of the wicket gate is a thrust cap that secures the wicket gate lever as it rotates between the open and close positions. Engineers machined the thrust caps to provide a smooth surface for a Thordon SXL washer to ride against, and installed the washer over the gate lever flanges thereby eliminating 20 more grease points. Collins and his foreman came up with that idea – a custom job that eliminated a grease point beyond what was outlined in Thordon's product catalogue. "The crews got really excited about the process of eliminating 60, then 80 grease lines, and we thought there were certainly other things we could do," says Collins. "Then we got really carried away."

They decided to use ThorPlas, a thermoplastic grease-free bushing from Thordon, to replace the small sleeve bushings installed within the link levers for the gate operating mechanism, eliminating yet another 40 grease points. In addition, the servo connecting rod bushings and the PRV connecting rod bushings were replaced with ThorPlas greaseless bushings.

The crew has now completed work on both units. Not only are the units free of grease, but the turbine pits look new, with freshly painted gate levers, gate arms, floors, and walls.

The new bearings are expected to outlast the previous, greased ones. Collins, who set out to reduce leakage from the Powerhouse, says the Thordon bearings provided the added bonus of minimizing the greased systems used for lubrication at the powerhouse.

"It's kind of nice to be able to complete your work in such a nice looking area and take pride in it," he says, "without any grease on the horizon."

White Rock refits with grease free ThorPlas bearings

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THORDON BEARINGS INC.

3225 Mainway,
Burlington, Ontario L7M 1A6
Canada
Tel: (905) 335-1440 Fax: (905) 335-4033
info@thordonbearings.com
www.thordonbearings.com

Editor: Craig Carter

(Statements made and opinions expressed do not

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FINNISH NAVY FINISHED WITH RUBBER BEARINGS

Water jets are generally used in most Finnish Navy light and fast patrol vessels bigger than open outboard motor boats. The first of their fast attack missile boats to use them were the *Rauma* class vessels. In the propulsion shaft line is a water lubricated line bearing, located inside the stator of the water jet's jet pipe.

The vessels are operated in the Finnish coastal waters and the Northern Baltic Sea. They have a shallow draft and can be operated within the archipelago, where this is always some risk of debris in the brackish (semi-salty) water. Originally, the *Rauma* vessel water jets were equipped with traditional rubber bearings.

"We had good experience with rubber," says Klaus Salkola, Head of Technical Inspection Unit, Finnish Navy Headquarters, "but for some reason these bearings failed due to manufacturing errors."

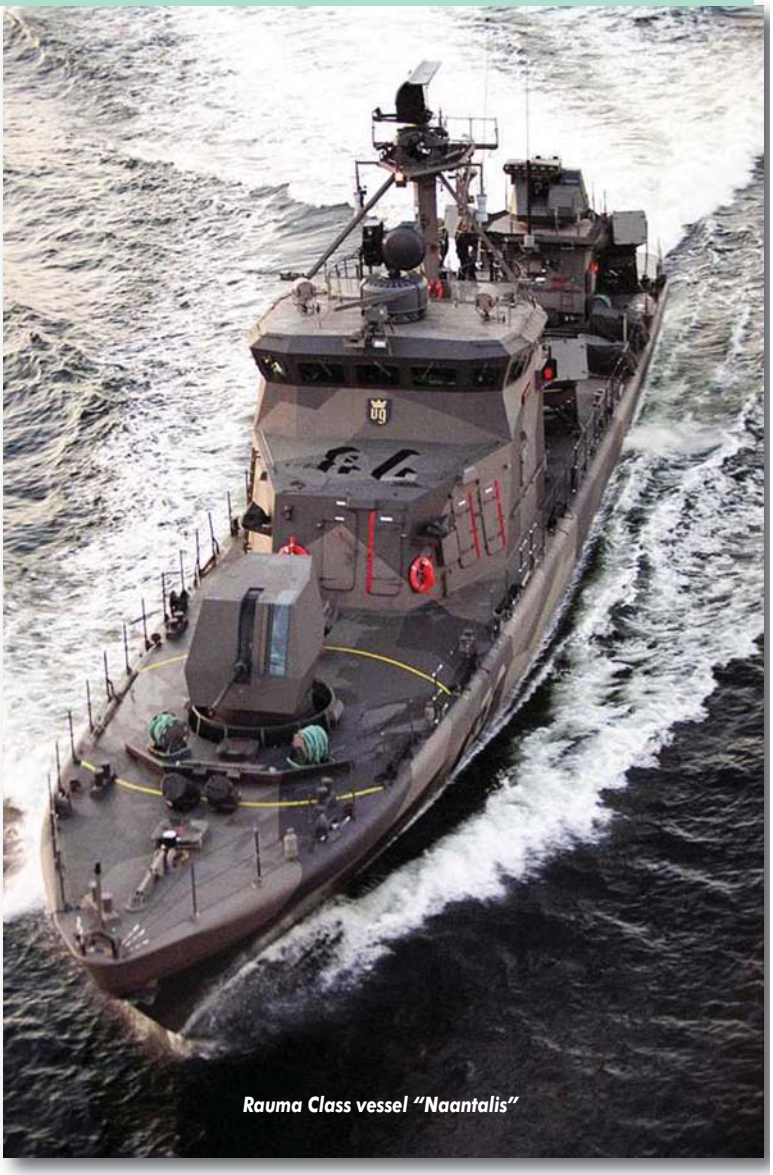
Soft rubber bearings presented two problems: they wore out fast, and their vulcanization loosened them from the bearing housing.

"Delivery time for new bearings was long," adds Salkola, "and the quality didn't improve over time. So we decided to look for other solutions."

Water jet nozzle equipped with water lubricated Thordon GM2401 line bearings

Unable to find another manufacturer of rubber bearings with the required dimensions, the Finnish Navy contacted Thordon Bearings in the early 1990's. They tried Thordon bearings in one water jet unit and have since switched to Thordon as an alternative to rubber bearings in several vessels.

They initially tried a Thordon grade that did not fix the problem– the bearings lasted longer– however there was heavy wear in the shaft. Because the jet's suction of sand and mud in low waters gathered into the cooling grooves, it created an abrasive environment when the shaft engaged. So, Thordon's Distributor in Finland, Marmex AB, offered for testing an alternative Thordon grade – GM2401 bonded to the existing bronze housing. Thordon's GM2401 is the bearing wear surface component of Thordon Composite which is a 2-component elastomeric bearing designed to operate in highly abrasive water. The Navy agreed to the testing.



Rauma Class vessel "Naantalis"

Thordon GM2401 was tested head-to-head with rubber for use in the water jet propulsion systems. A new model of a harder version of the rubber bearing was installed on one side and Thordon GM2401 on the other side. Compared with Thordon's GM2401 bearing, the newer, harder rubber bearing still wore out fast.

"The minimal installed diametric clearance for the GM2401 bearing was 0.61mm (0.024") and calculated running clearance in water was approximately 0.4mm (0.0157"). For the rubber bearing it was 0.3mm (0.0118")," reported

Continued From page 3

Finnish Navy contact Jukka-Pekka Majanen.

After 2000 hrs. running time, a visual inspection was made; both bearings appeared to be in good condition on the surface, with slightly more wear and minor dents on the rubber bearing. The shaft, however, had "clearly more wear on the rubber bearing side," wrote Majanen. "Clearances (dry) were 0.6mm (0.0236") with the Thordon GM2401 bearing, and 1.2mm (0.047") with the rubber bearing."

Based on the test results, Majanen recommended that the Navy switch to Thordon GM2401 bearings in these applications, or at least widen the testing.

Based on a direct field comparison with similar working conditions, and after 2000 hrs of running time, the measured wear on the GM2401 bearing was significantly lower (by a factor of 2) in relation to that of the rubber bearing. Even when water absorption effects were discounted, the wear on the GM2401 bearing was negligible. Although the condition of the rubber bearing surface appeared acceptable, the fact that the clearances had increased from 0.3mm (0.0118") to 1.2mm (0.047") after the first period deemed the bearing unusable for the tight tolerances required for this propulsion system.

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WORRY-FREE TRAVEL FOR SEABOURN ELITE

pumped to the "A" bracket and the aft stern boss bearings as the lubricating medium and flows through the bearings to the sea. No aft oil seal and no oil in the stern tube saves on shaft line servicing costs of the shaft line and eliminates the risk of stern tube oil pollution. Carnival Corporation have switched to Thordon Bearings for these reasons and more.

An open system makes it possible to inspect or change a bearing without removing the shaft. "The added advantage is that the COMPAC tapered key system allows inspection of the bearing and shaft journal without pulling the shaft," said Joly. "To date, our experience is that COMPAC bearings with Inconel journals will mean worry free shaft lines for the life of the vessel."

Seabourn's intimate, yacht-like cruisers promise highly personalized service, all-suite accommodations, superb cuisine and exceptional delivery of the most desirable destinations worldwide.

Travellers pay top dollar for the privilege of cruising with Seabourn. And they also benefit from durable, pollution-free bearings – whether they see them or not – that meet Seabourn's rigorous standards for top quality, *crème de la crème*, best of the best.

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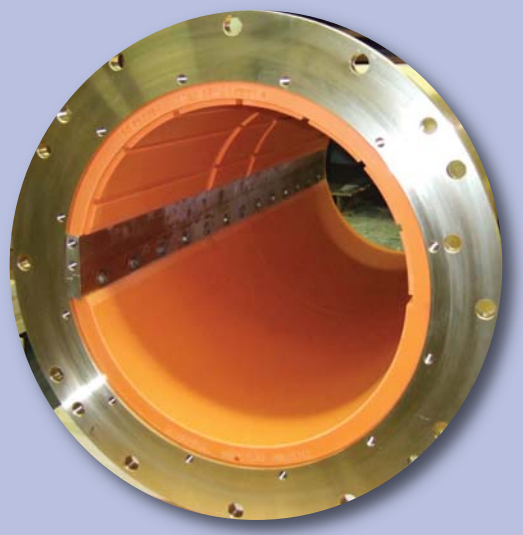

15 YR GUARANTEE ENTICES SHIPOWNERS TO RETURN TO SEAWATER LUBRICATED SHAFTS

To demonstrate to commercial ship owners that modern seawater lubricated propeller shaft bearing systems do offer wear life predictability, reduced operating costs and elimination of stern tube oil pollution risks, Thordon Bearings has introduced a 15 year bearing wearlife guarantee for its COMPAC pollution free stern tube bearings.

Using proven bearing designs and technologies developed by Thordon Bearings, ships trading in the world's oceans and seas can now eliminate both operational and accidental stern tube oil pollution (STOP) while also reducing their operating costs. Zero tolerance for any kind of ship source pollution is now becoming the norm and international regulations are becoming more and more stringent.

In newbuild applications, the Thordon COMPAC Propeller Shaft Bearing System is guaranteed to meet Classification Society wear specifications for 15 years or Thordon Bearings Inc. will supply new bearings free of charge. The bearing guarantee is targeted at commercial newbuild vessels with shaft diameters of 300mm (12") or greater and COMPAC bearings enclosed in stern tubes.

Thordon COMPAC seawater lubricated propeller shaft bearings

In order to control the bearing environment, the COMPAC propeller shaft bearing system includes non-metallic COMPAC bearings, a Thordon Water Quality Package, shaft liners, Thor-Coat shaft coating and a forward seal.

Thordon is offering this guarantee based on proven bearing wearlife experience in commercial vessels over the last 20 years.

The improvements for ship owners using seawater lubricated COMPAC bearings include:

- Reduced operating costs (no aft seal and no oil required in stern tube)
- Proven performance and reliability
- Fitting and monitoring methods to meet Class Society approvals
- Zero pollution risk

Thordon Bearings also continues to offer the 15 Year SXL Rudder Bearing Wear Life Guarantee ensuring provision of a replacement if a Thordon SXL rudder bearing wears out and requires renewal before the 15 year period. The guarantee covers pintle, rudder stock and carrier disc bearings above and below the waterline in newbuild Classed vessels.

Thordon Bearings Inc. designs and manufactures a complete range of environmentally friendly propeller shaft, rudder, shaft line and deck equipment products for the global marine market. Recognized internationally for superior performance in marine applications, Thordon Bearings has a worldwide customer service network in over 70 countries.

DID YOU KNOW?

Thordon also offers a 15 Year Rudder Bearing Wear Life Guarantee on SXL rudder bearings

For more information go to www.ThordonBearings.com

AFTER-SALES SERVICE *ENSURES SMOOTH SAILING...*

Twenty million passengers a year take a ferryboat between Staten Island and Manhattan in New York. At no charge, they get a majestic view of New York Harbor on the 25-minute ride. Those five miles of water started to become a whole lot cleaner in 2004 when Thordon COMPAC propeller shaft bearings and SXL rudder bearings were installed on three Staten Island ferries.

Staten Island Ferry equipped with COMPAC bearings since 2004

With Thordon water lubricated bearings, typical growing pains tend to be minimal, but these ferries happened to experience a few.

"One difficulty," says Sean McDermott of New York City Port Engineering, "was that after the vessels were put in service, we did a dive inspection and noted that a lower pintle bearing that supports the rudder had raised itself out of its support. It had come up about an inch (25mm). A "keeper" retaining ring to prevent that from happening should have been installed."

"Theoretically it shouldn't move because it's really socked in there," he says, "but I guess vertical force was enough to raise it, because our shipyard had failed to install a keeper." The Staten Island ferries are double-ended, with a propeller and rudder at each end. So far, the other end seemed okay, but engineers weren't sure if the raised bearing would cause wear problems or alignment issues. So they called Thordon's After-sales Service team to ask what their options were.

Rather than remove the whole rudder to service it, another option was to keep the vessel in service and monitor the bearing to see how much it was rotating. In consultation with Thordon and the U.S. Coast Guard, the shipyard determined that the vessel could be kept in service until it was time to dry dock, two-and-a-half years after delivery. Periodic dive inspections would detect any unusual wear, but there was none.

"We were able to keep the boat in service until its first dry dock period," says McDermott.

When a similar problem occurred on the second vessel where a keeper had not been installed, there was enough clearance to install one. "The bearing had moved up, and it was a matter of pushing it back down to install the keeper," says McDermott. "There wasn't much clearance above it, but they got some small presses, hydraulic jaws and jacks and were able to press it back in place."

As for the third vessel, it was still under construction when the shipyard learned its lesson. Keeper retaining rings were installed on that boat before its launch.

Since making that call to Thordon, the shipyard has reported no further issues with the rudder bearings. Besides rudder bearings, the ferries also use Thordon seawater lubricated COMPAC bearings in their stern tubes supporting the propeller shafts. "Bearing wear has been negligible," says McDermott. "After three years in service there has been no unscheduled maintenance. Performance on those has been exceptional."

Besides helping out with shipyard issues during the construction period, Thordon is equally attentive to items that could impact bearing performance after delivery. When shipyard engineers noticed premature wear on the separators of Thordon's Water Quality Package, After-sales Service representative Jayson Stansfield replaced the separators with an upgraded unit and set up the water quality packages at an optimum flow level for the cooling water to reduce the amount of wear.

Stansfield says Thordon stands by its products. "We work with our customers to get past those occasional growing pains," he says, "and in some cases it goes even beyond the warranty period. If we recognize an opportunity for improvement, we go back and do the retrofits."

Improved Water Quality Package

It's smooth sailing now for Staten Island Ferries, and McDermott credits Thordon's After-sales Service department for seeing them through those initial glitches. "In terms of the support and open dialogue, Thordon was very good, very forthcoming. Their technical people provided timely action and we never experienced any delays."