THORDON
NewsWORKS

ISSUE 2004-1

ENVIRONMENTALLY FRIENDLY BEARING SOLUTIONS

THORDON COMPAC INTEGRAL IN NEW, ULTRA-QUIET FISHERIES SURVEY VESSEL (FSV)

Anglers understand the need to run quietly, as to not scare the fish away. That's relatively easy for a small boat with a trolling motor. But what about a mid-sized diesel-electric powered ship with a 4.3 m (14 ft.) diameter propeller? Such was the challenge faced in building the new Fisheries Survey Vessel (FSV) for the U.S. National Oceanic and Atmospheric Administration (NOAA). To ensure that fish populations could be studied effectively, the specifications featured the most advanced noise suppression technologies in the world - including Thordon COMPAC Water Lubricated Propeller Shaft Bearings.

Built by VT Halter Marine of Mississippi, U.S.A., the newly christened *Oscar Dyson* FSV will play a vital role in maintaining the health of the northern Pacific fishing industry. The ship will use a variety of techniques - including hydroaccoustic surveying - to collect the essential data required to establish accurate quotas.

At 64 m x 15 m x 8.5 m (210 ft. x 49 ft. x 28 ft.), a powered ship of this size would normally generate enough background noise to hinder surveying operations. Therefore, achieving a low acoustic signature was a critical design parameter right from the start. "One of the areas where a lot of noise infiltrates the water is in the propulsion system," says Thordon Bearings distributor, Jim Bright, Sales Manager for Marine Industries Corporation. "So Thordon COMPAC was the obvious choice for the bearing material. In fact, it was written into the vessel specification."

According to the specifications, the stern tube bearing needed to be "of environmentally safe and acoustically inefficient materials". Thordon COMPAC Propeller Shaft Bearing Systems have a proven track record in Naval and Coast Guard applications featuring:

- Pollution free water lubrication (a renewed innovation pioneered by Thordon);
- No use of oil and, therefore, zero risk of oil pollution from the stern tube;
- An expected 10-year bearing wear life or longer; and
- A low coefficient of friction and superior hydrodynamic performance at lower shaft speeds resulting in quiet operation.

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U.S. NOAA FSV Oscar Dyson equipped with Thordon COMPAC Water Lubricated Propeller Shaft Bearings

THIS ISSUE

THORDON HAS WHAT IT TAKES FOR NEW MSC T-AKE VESSELS

During war and in peacetime, the supply chain is one of the most critical elements of a military operation. Consider the number of U.S. forces currently deployed overseas. If needed supplies are not furnished consistently, lives are put at risk. That's why U.S. Navy Military Sealift Command (MSC) took no chances in the design of their new T-AKE vessels. In fact, the proven reliability of Thordon COMPAC bearings was written directly into the specifications.

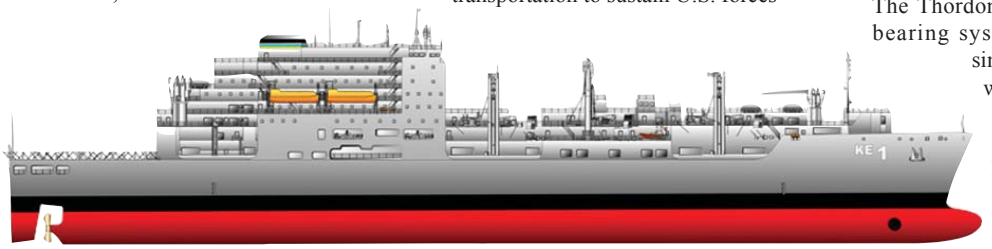
"These are single shaft ships," says Dave Marshall, Thordon's Area Sales Manager for the southern United States, "so a reliable propulsion system is of paramount importance."

T-AKE ships are a new class of underway replenishment ships for the MSC, designed for extended periods at sea. At 210 m (690 ft.) length x 32 m (105 ft.) beam and draft of 9 m (30 ft.), each will have a single 744 mm (29 in.) diameter shaft with one fixed pitch propeller. "That's why the propulsion components used must be first rate."

Supply chain reliability is key

The mission of MSC is to provide ocean transportation to sustain U.S. forces worldwide. During both Gulf wars, for instance, 95% of all needed equipment, fuel, food, supplies and ammunition were carried by sea. MSC currently operates about 120 ships worldwide with another 100 in reserve status. The T-AKE program consists of building 11 new state-of-the-art vessels with a total budget of approximately $4 billion.

The first ship in the T-AKE series is currently under construction by General Dynamics' National Steel and Shipbuilding Company (NASSCO), a company that has been designing and building naval ships and other commercial vessels since 1960. Located in San Diego, California, NASSCO is the only major ship construction yard on the U.S. West Coast.



Military Sealift Command New Class of T-AKE Vessels (Photo Courtesy of NASSCO)

The propulsion system is supplied by Wartsila Lips Inc. of North America. "We have worked with the Thordon people on a number of major projects, all very successful," says Joe Amyot, Manager of Wartsila Lips. "Thordon main shaft bearings have significant operating experience in many other naval vessels. I suspect that was one of the reasons why Thordon was specified."

Proven in applications around the globe

The Thordon COMPAC propeller shaft bearing system - with its innovative single key bearing design - is water lubricated and utilizes Thordon as the bearing wear surface. The lower half of the bearing is smooth while the upper half has water grooves for lubrication and cooling. This proven design has been used in many naval and commercial applications around the globe.

Thordon and Wartsila Lips have worked together on several major projects recently. These have included vessels for BP and the Staten Island Ferry system. "Thordon consistently demonstrates a commitment to the high quality levels required for us to achieve success on these projects," says Amyot.

The first T-AKE vessel, *USNS Lewis and Clark*, is due to be delivered in October 2005. Soon to follow is *USNS Sacajawea*, also under construction by NASSCO. Along with the other nine planned in the series, these ships will operate around the globe delivering what U.S. forces need to complete missions successfully.

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THORDON SXL GUIDE BEARING ELIMINATES RISK AT THE STAR LAKE GENERATING STATION

Reliability was an important factor in the Star Lake Hydro Partnership's decision to replace the Star Lake Generating Station's turbine guide bearing. The 18-MW facility — owned by a partnership of Abitibi-Consolidated Inc. (51 percent) and Enel North America, Inc. (49 percent) — runs about 98 percent of the time, shutting down for scheduled maintenance for only six to seven days a year.

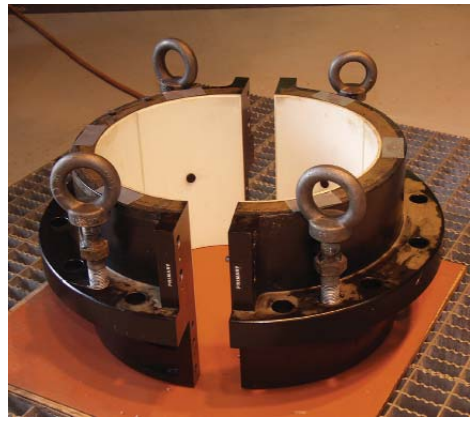
As manager of the Star Lake Generating Station in southwestern Newfoundland, Canada, Robert Conlon wanted to replace a water-lubricated, hydrostatic turbine guide bearing in a vertical Francis unit that required a complex high pressure filtered water supply. This filtration system was very costly to maintain and a previous hydrostatic bearing failure during initial startup had required the replacement of both the turbine shaft and the bearing, which meant a month-long and costly outage.

"The second water-lubricated, metal turbine guide bearing has performed fine for four years," says Conlon. "However, we were concerned of the consequences if this bearing failed at full load. The result could be an unexpected failure destroying the bearing, damaging the shaft and possibly damaging the generator."

Those fears were eliminated, however, when the hydrostatic metal bearing was replaced with a water-lubricated, Thordon SXL turbine guide bearing operating in hydrodynamic conditions.

For water lubricated metal bearings such as the one at Star Lake, the fluid film must be consistent between the shaft and the bearing. If abrasives are present in the lubricating water, the fluid film may be disrupted and the bearing will fail. The water supplied to water lubricated metal bearings has to be extremely clean (contaminants removed to 25-30 microns).

Thordon SXL bearings allow a larger diametrical clearance between the shaft and the bearing surface and require more water than the metal bearing. The water flow requirements to the SXL bearing surface for cooling purposes are 0.15 litres/minute per mm (1 U.S. gallon/minute per inch) of shaft diameter at standard clearances. However, the water filtering requirements are not as stringent for SXL bearings, because wear life is not seriously effected with water contaminants up to 150 to 200 microns.



Thordon SXL Main Guide Bearing ready for installation at Star Lake

Thordon SXL is an elastomeric polymer bearing material with a 25-year history of long-life performance in water lubricated main shaft guide bearings. "It was certainly the right choice for us," says Conlon. "Even if the Thordon SXL bearing were to fail, it would not fail suddenly and unexpectedly. The most that would happen is that the Thordon material would wear a little bit."

Before making the commitment to purchase the Thordon SXL bearing, the Star Lake Hydro Partnership researched the product extensively. This included checking references in North America and Europe. "Satisfied with the experience of others," says Conlon, "the order was eventually placed for two bearings (one plus a spare) in July 2003".

Rapid installation reduces downtime

Normally, the turbine shaft has to be dismantled to install a solid journal bearing. Disassembly and re-assembly is an arduous process. In addition, the whole unit has to be realigned as a part of the process.

Working with Thordon's engineers, however, the decision was made to design and fabricate the bearing in two halves. "We simply took the two halves and bolted them together around the shaft," says Conlon. "Once the Thordon bearing was in place, it was positioned with a constant annulus around the shaft." Before removing the old bearing, the turbine runner had been wedged in position so that the turbine shaft was centered on the old bearing. As a result, no time-consuming realignment was necessary.

The Thordon bearing was so simple to install, in fact, that the outage lasted just six days, which Conlon observed, "was a large saving in time and money."

Confident that the Thordon SXL bearing will not fail unexpectedly, the Star Lake Hydro Partnership is comfortable that they have made a major improvement in Station reliability. The Thordon SXL bearing is performing as anticipated.

GM2401 SHOWS NO VISIBLE SIGNS OF WEAR IN DIRTY WATER PUMP APPLICATION

When the engineers at Peach Bottom Atomic Station (Pennsylvania, USA) needed to improve the facility's river water circulation system, they were faced with two options: a costly upgrade of the water filtration system by installing new corrosion-free piping to protect the current bearings; or, a much less expensive upgrade of the Bingham pumps by replacing the bearings with Thordon GM2401. They choose the latter. Two years after installation, an inspection has revealed no visible signs of bearing wear, despite the dirty water conditions.

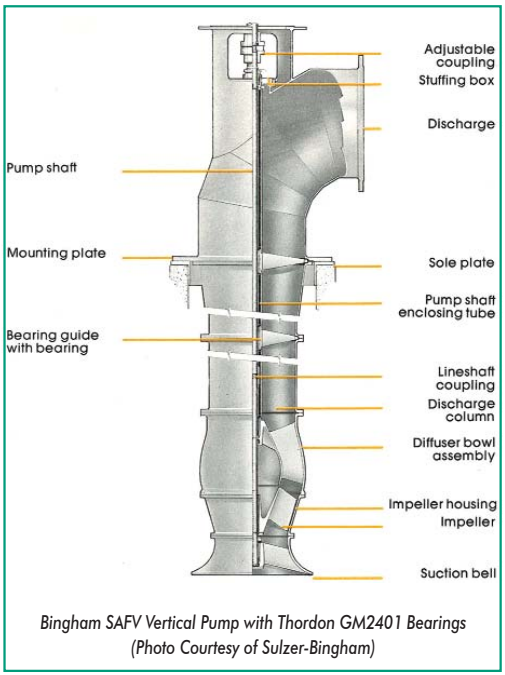
"Obviously, the Peach Bottom engineers are very pleased," says Larry Bohn, Sales Engineer for Fleetwood Industrial Products, the Thordon Bearings distributor in Pennsylvania. "They now expect to get several years out of the bearings before replacement is required."

Long life in abrasive conditions

Thordon GM2401 is a tough elastomeric polymer bearing material that was introduced by Thordon in 1974. In applications around the globe, the product has demonstrated incredible wear resistance in extremely abrasive environments when used in combination with a hard shaft surface. The bearing material has significantly outperformed rubber - often by a factor of two or more - in pump and propeller shaft bearing applications.

"We needed reliable, water-lubricated pump bearings that could stand the test of time in abrasive-laden water conditions," says Phillip Hennessy, Equipment Reliability Engineer for Exelon Nuclear, the operator of the station. "Thordon was the obvious choice."

Peach Bottom Atomic Power Station is situated on the Susquehanna River in York County, Pennsylvania, U.S.A. Peach Bottom has two boiling water reactors, which jointly produces over 2,300 megawatts. The station is co-owned by Public Service Electric & Gas of New Jersey and Exelon Corporation.



Bingham SAFV Vertical Pump with Thordon GM2401 Bearings (Photo Courtesy of Sulzer-Bingham)

River water is circulated throughout the facility and is used for cooling a variety of systems and components. Although Susquehanna waters are relatively clear on most days, rain and other weather conditions can stir up silt from the river bed. These particles remain suspended in the water and are highly abrasive.

A world of references

During plans to upgrade the river water circulation system, Peach Bottom engineers were enthusiastic - yet cautious - about a bearing material that claimed to perform well in dirty water. Replacing the pump bearings would be significantly less costly than replacing the piping. Yet, convincing evidence was required before Thordon GM2401 could be specified.

"That's where that staff at Thordon was very helpful," says Bohn. "The Peach Bottom people were definitely impressed by what we were telling them [about the bearing material], but they wanted to contact references before making a final decision."

Fortunately, references were not a problem.

Thordon GM2401 is installed in dozens of hydroelectric and pump systems worldwide. Numerous references were available involving applications that were just what the Peach Bottom engineers were looking for: large, vertical pump bearings operating in dirty river water and seawater. "Those references really helped us close the deal."

Peach Bottom is now another application of a long history of successes featuring Thordon GM2401. The bearings have been operating for approximately two years; running on 215 mm (8.5 in.) nickel-chrome-boron coated sleeves in the six Bingham pumps with a capacity of 250,000 GPM. Divers were recently sent into the river to inspect for bearing wear. They didn't find any. "In fact," says Hennessy, "they described the bearings using just one word: pristine."

THORDON HONOURED FOR INNOVATIVE TECHNOLOGY

Early in April, at the GLOBE 2004 Business and the Environment Symposium in Vancouver, Canada, Thordon Bearings Inc. a Canadian company manufacturing oil free stern tube bearing systems, was one of several companies awarded Environment Canada's Environmental Technology Verification (ETV) certificate. "ETV promotes the credibility of Canada's environmental industry internationally and I commend these companies for their innovative efforts," says David Anderson, Federal Minister of the Environment, who presented the Certificates.

Dr. Tracy Thomson, Executive Vice-President , Thordon Bearings Inc. receiving Environmental Technology Verification Certificate from David Anderson, Minister of the Environment, Canada

Specifically, Thordon Bearings earned an ETV Certificate for its TL3G lubricant developed for the Thor-Lube Stern Tube Bearing System. This technology replaces traditional oil-lubricated stern tube systems with non-metallic bearings and a biodegradable, water-based lubricant eliminating any risk of stern tube oil pollution or sheen. Thor-Lube systems have already been specified by major ship owners and are installed or on order by Daewoo Shipbuilding and Marine Engineering, Hyundai Heavy Industries and Mitsubishi Heavy Industries for eleven LNG carrier projects for Shell Group (2), ALSOC (1), Bergesen DY ASA (4) and Nigeria LNG Ltd. (4).

Independent laboratory testing - part of the ETV verification process - confirmed that TL3G lubricant conforms to the United States Clean Water Act under these parameters: i) it is readily biodegradable to a level greater than 70% after 28 days; ii) it exhibits water solubility at all compositions (so it will not accumulate on the shoreline or settle in clumps); iii) it does not form a surface sheen and iv) it is "relatively harmless" and "practically non-toxic" in two U.S. Environmental Protection Agency (E.P.A.) marine toxicity tests.

Performance Claim Verified by the ETV Program

"Thordon Bearings is committed to continuous research and development," says Dr. Tracy Thomson, Executive Vice-President of Thordon Bearings who accepted the award. "Our materials are increasingly specified in numerous industrial and marine applications where high performance and environmentally-safe operation is required."

While proud to have earned the ETV Certificate, innovation is nothing new to Thordon Bearings. The company has been the industry leader in advanced, environmentally friendly oil free and grease free propeller shaft and rudder bearing systems to the global marine market for more than forty years. Thordon systems and bearings are available worldwide through over 70 agents and distributors.

TL3G Lubricant Conforms to these Clean Water Act Specifications

"Thordon Bearings' TL3G product, when applied in accordance with the manufacturer's specifications, conforms to the United States Clean Water Act, 40 CFR 110.3, and the FWPCA 33, U.S. Code Section 11, as follows:

1. Is readily biodegradable[1], at a level >70% after 28 days;
2. Exhibits water solubility at all compositions (>50% or 10^6 mg/L[2]); therefore, it does not form a cohesive mass on discharge, and is able to be removed from a shoreline (no accumulation on shoreline);
3. Does not form a surface sheen[3],; and,
4. Based on results from aquatic marine toxicity tests, can be considered, as follows:
   - "relatively harmless"[4], based on the 96-hour acute LC50 for sheepshead minnow; and,
   - "practically non-toxic"[4], based on the 96-hour LC50 mysid shrimp (96-hour acute) of >1,000 ppm and 556.1 ppm, respectively, acccording to U.S. EPA toxicity test methods for chemical product testing[5]."

[1] According to OECD method 301D; OECD, 1998.
[2] According to ASTM method D1401 "Standard Method for Water Separability of Petroleum Oils and Synthetic Fluids" (ASTM, 1998).
[3] According to U.S. Coast Guard Static Sheen Test (45 CFR 1, Part 435; Appendix 1 to Subpart A).
[4] U.S. Fish and Wildlife Service, 1984. U.S. Fish and Wildlife Service Research Information Bulletin No. 84-78.
[5] U.S. EPA, 1996. OPPTS Methods 850.1075 and 850.1035, for marine fish and invertebrates, respectively.

ALLEN TAYLOR'S MANAGEMENT FOCUS - AN UN-YIELDING COMMITMENT TO CUSTOMER SATISFACTION

Allen has worked with Thordon Bearings since 1990 when he came to work for one of our oldest distributors, Marine Industries Corporation. In 1996, he formerly joined Thordon Bearings working as an Area Sales Manager for the United States, and later South America. In 2001, Allen and wife, Anne took time off for a long awaited sabbatical and cruised the Gulf of Mexico and the Eastern Caribbean in their 12 m (38 ft.) sailboat. After this 2½ year adventure, he has returned to rejoin Thordon Bearings as Commercial Director. His primary role will be to continue to build Thordon Bearings into a world class bearing manufacturing company.

Thordon's New Commercial Director, Allen Taylor, at Helm of S/V Anicca with friends in Gulf of Mexico

Lessons learned from his experiences as a Thordon end user, a Thordon distributor, and a Thordon Sales Manager have reinforced a simple but often unpracticed management principle: **An UNYIELDING COMMITMENT TO CUSTOMER SATISFACTION must be the most important mission!** This encompasses the customer's experience from the day they discover Thordon and it's unique environmentally friendly products forward, including initial discussion of projects, quoting at reasonable and consistent prices, follow up to technical issues, production, timely delivery, installation, and ongoing operation, as well as world class support if a problem arises.

Obviously, many companies say this, but only a few truly do it to such an extent that their name stands out in their given market and their customers become almost fanatically loyal. This is the level of satisfaction that Thordon, as a cohesive efficient team (company and distribution network), must strive to provide.

Thordon Bearings has continued to add technical expertise, new products, and innovative approaches to marketing in order to constantly build toward this ultimate goal! Thordon's R&D and engineering team is second to none as evidenced by the scope of projects that they now are involved in as well as the companies that come to Thordon for technically innovative solutions to their difficult bearing problems.

Thordon must, at the same time, realize that it operates in an ever shrinking and more competitive world and as such, must work to provide truly cost effective solutions to our customers. Through this commitment and constant ongoing improvement, Thordon will continue to both grow and improve the world we live in for decades to come. Allen (allent@thordonbearings.com) and the entire Thordon team look forward to working for you and solving your bearing problems!

Thordon COMPAC Integral... *(continued from page 1)*

In addition to being acoustically stealthy, *Oscar Dyson* is also equipped with a Dynamic Positioning (DP) System to help the ship hover at a fixed point on the ocean. This allows the vessel to more accurately monitor undersea activity.

"Of course keeping a large ship in one place isn't as easy as coming to a full stop," says Bright. "The DP coordinates the thrusters and main shaft to effect the station keeping duty and hold the vessel in one position. Starts, stops and low shaft speeds are necessary to maintain the vessel at a precise geographical coordinate.

When a ship operates in this manner, shaft squeal - or "stick slip" as it is colloquially referred to in the industry - is the noise generated when the shaft is operated at slow speeds and is literally trying to stick to the bearing. This noise will radiate from the vessel into the water. Thordon COMPAC's inherent self-lubricating properties and hydrodynamic design keeps breakaway friction low which helps to eliminate stick slip effects. Thordon engineers also did some further customization as Dave Rickman, Chief Mechanical Engineer for VT Halter, points out: "NOAA specified the Thordon bearing because of its experience showing that Thordon has a low acoustic signature. We had Thordon modify the standard offering to allow for sustained hydrodynamic operation at very low shaft RPM."

Delivered in October 2003 and due to be operational in the fall of 2004, *Oscar Dyson* will survey Alaskan waters and the Bering Sea in its mission to protect, restore and manage the use of living marine, coastal and ocean resources through ecosystem-based management. NOAA recently announced plans to exercise its option to build a second NOAA FSV at VT Halter Marine with delivery in 2006.