SMART TECHNOLOGY TO THE FOREFRONT

THE RESULT: SIGNIFICANT ENERGY SAVINGS, EFFICIENCY AND RELIABILITY FOR SEA WATER COOLING SYSTEMS IN BOTH NEWBUILD AND RETROFIT APPLICATIONS

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Razor-thin operating margins and the desire to enhance sustainable processes mean that owners and operators of commercial vessel fleets must depend on outside-the-box thinking and planning in all facets of operation. Technology, properly applied, can and should be part of the game plan to optimize efficiency and sustainability. Fleet-wide applications of such technology can result in significant operating savings, enhanced uptime, reducing the carbon footprint and an increase in profitability.

Everyone has different direct needs based on responsibilities. Finding technologies that provide solutions across all facets of operation is the key. It isa challenge for all parties involved in fleet operation.

- Owners and operators face greater economic challenges than ever. Fluctuating energy costs affect the operation of vessels. Ever-changing commodity and manufacturing costs affect the ebb and flow of world trade. And there's the pressure and the desire to operate "green." These factors magnify the importance of efficient, cost-effective and responsible operation.
- Fleet managers seek high efficiency and reliability for their vessels – to them, it's all about uptime. To the fleet manager who needs to manage tight fuel and maintenance budgets, the slightest cost-saving advantage can mean a huge impact to profitable operation.
- Chief engineers and engineering staff – responsible for the daily maintenance and operation – are faced with the immediate needs of a vessel. Any unplanned downtime or a catastrophic breakdown of components while at sea is not acceptable.

A ship's engine room fluid handling system represents approximately 20 to 25 percent of the vessel's total electric load. This presents an opportunity for savings if energy consumption can be significantly reduced. It also means greener operation and less carbon emissions. More savings can be achieved if maintenance and the risk of system failure can be minimized. This factors into additional savings as it allows the crew to focus on other areas of concern.

New technology – smart technology – is available that enables vessel and fleet operators to achieve substantial energy savings by running pumps more efficiently via a sophisticated control system. Such a system can be applied to both newbuild and retrofit situations.

It also provides condition monitoring that protects both the pump and sea water cooling system, helping to avoid unplanned downtime. The same system can also provide intelligent monitoring, delivering continuous real-time status information that initiates alarms that indicate attention is required.

Optional features such as Active Valve Control add an extra level of efficiency improvement. By automatically opening and closing valves that control the sea water cooling system, this option also eliminates the potential for human error in valve settings and provides the potential for added equipment savings and reduces maintenance by allowing certain hardware to be removed within the sea water cooling system.

The heart of the modular system is a smart controller, which can be located in the vessel's control room or close to the pumps in the engine room. The controller utilizes sensors to monitor the operation and conditions of each pump and motor. Controller boxes communicate through an Ethernet to provide real-time data and status indicators, thus lowering demands on the vessel's crew by effectively managing and monitoring the sea water cooling system.

Application of such a system reduces overall total cost of ownership through gains in efficiency as it reduces energy consumption – and costs – while working load-dependent and to prevent system failure. And crew members who might normally spend time monitoring the equipment are free to concentrate on other tasks – and the system never sleeps.

SEA WATER COOLING – CRITICAL SYSTEMS WITH POTENTIAL UPSIDE

Among the systems that support the engine room, the sea water cooling system is an essential service that ensures the vessel operates safely. These comparatively large pumps are continuously operated – 365 days a year, 24 hours per day.

The sea water cooling system is the primary loop for transporting unusable heat out of most major systems and components in the engine room and provides constant, reliable cooling to all connected shipboard consumers, such as the main engine, generators and auxiliary equipment. Ambient sea water is drawn in and is pumped into a heat exchanger that cools down the fresh water (LT – low temperature) which circulates within its own closed loop. Once the sea water has taken on the heat from the fresh water, it is pumped back into the ocean; new sea water is pumped aboard continuously.

Sea water cooling systems are typically operated by pumps arranged in a 2 x 100% configuration – one pump active and running at 100% flow with the second pump redundant – or a 3 x 50% configuration that allows some savings by running a single pump at 50% system-flow or two pumps at 100% flow with a third pump redundant. Operation of only one 50% pump requires further attention and system adjustment by the crew, usually in the manual setting of the duty point for the single running pump. Traditional system design operates the pumps constantly at full speed. The complete system is designed for worst case conditions – 32° C sea water, full equipment load – and adjusted with bypass control. Even if the system utilizes efficient pumps, energy is wasted due to continuous full-speed operation, resulting in over-performance.

For example, when operating in the Caribbean, or other warm-weather venues, a vessel may indeed require full cooling performance and full power to operate the pumps; sea water would naturally be warmer, at potentially 32°C. In such a situation, the pumps are required to run at full capacity in order to maintain a constant temperature on the LT fresh water side.

Consider, however, sea water temperatures in the North Sea – typically much cooler than the water pumped aboard in the Caribbean. In this case, a smaller flow is required to achieve the same cooling performance of the heat exchanger. In fact, most of a vessel's requirements are significantly lower than the system design point. By applying a system that utilizes an intelligent controller and variable speed drives that can adjust flow rates accordingly, pump energy consumption may be automatically regulated precisely to the level required to provide exactly the flow to achieve a preset cooling temperature – not more, not less. Such operation replaces the inefficient full run/bypass system design, thus saving energy. That in turn reduces overall costs, and provides the added benefit of a reduced carbon footprint.

ADDITIONAL ADVANTAGES EXIST BY REDUCING THE PUMP'S SPEED, THE HYDRAULIC LOAD WILL DECREASE AND EFFECTIVELY INCREASES THE LIFETIME OF THE PUMPS, MOTORS AND RELATED EQUIPMENT, AS WELL AS REDUCING MAINTENANCE INTERVALS.

Efficiency levels may be further enhanced by equipping the pump with a full impeller diameter and operating the pump at a lower speed. This provides the same performance with a higher pump efficiency plus additional savings over the lifetime of the system pump.

Furthermore, these optimize net positive suction head (NPSH) performance, resulting in less risk of cavitation; reduced motor and pump speed means less energy consumed and a significant load reduction. System redundancy is also important to ensure that these benefits will be realized regardless of which pump configuration is used or which pump is operating.

As an example, a 20 percent reduction in speed – and thus a 20 percent reduction in flow – for each onboard system equipped with electric driven centrifugal pumps will cut energy consumption in half. This is proven by affinity laws – the relationship between the variable parameter of a centrifugal pump with constant impeller size is that the flow is proportional to the speed of revolution, the delivery head is proportional to the square of the speed and the power consumption is proportional to the cube of the speed.

- $Q \sim n \rightarrow Q1/Q2=n1/n2$
- $h \sim n^2 \rightarrow h1/h2=(n1/n2)2$
- $p \sim n^3 \rightarrow p1/p2=(n1/n2)3$

Depending on the application and load profile, energy reductions from 40 to 80 percent may be achieved.

ACTIVE VALVE CONTROL INCREASES POTENTIAL ENERGY SAVINGS, REDUCES EQUIPMENT COSTS

The addition of Active Valve Control to the CM-1000 Series increases the potential energy savings up to 85 percent.

Sensors monitor the freshwater cooling loop's temperatures, as well as the system's pump suction and discharge pressure. The data collected by the sensors is acted upon the CM-1000 Series controller, which regulates the flow of sea water to the cooling system based on heat loads from the main engine and generators.

The controller also monitors pump status, based on the pumps' performance curve, then automatically opens and closes the sea water cooling system valves, adjusting the pumps' duty points for optimal operation, fine-tuning the system. If the vessel is equipped with a 3 X 50% pump configuration, cascading pump operation can be achieved to maximize pump life.

Automatic valve adjustment eliminates the risk of incorrect manual valve settings. The immediate gain achieved through this optimal performance: incremental energy savings over the basic system and enhanced overall efficiency.

An added benefit is the ability to reduce system complexity on the coolers' freshwater side. This reduces the potential for pipe turbulence. It also essentially eliminates the need for the system's three-way valve and bypass line. This reduces a significant hardware equipment cost, as well as the need to maintain these components.

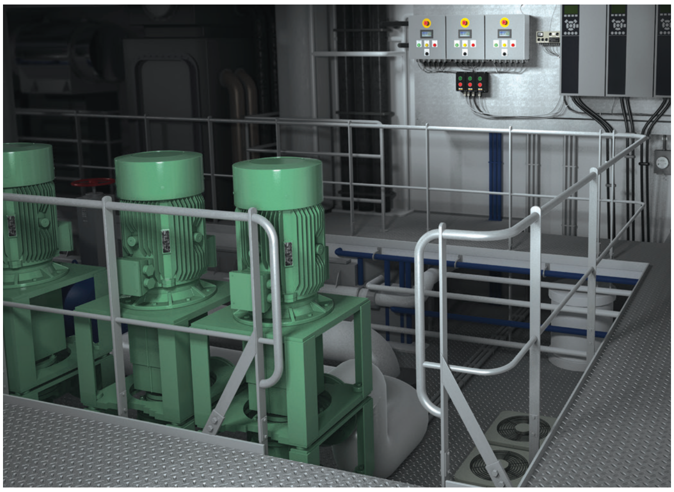
INTELLIGENT MONITORING – EARLY WARNING SYSTEM THAT HELPS PREVENT DOWNTIME

Significant maintenance savings – up to 50% annually – may also be achieved by the same smart technology system. Monitoring systems exist to detect misalignment, coupling damage, bearing damage, shaft seal damage/leakage monitoring and protection against dry running.

For example, two pre-set temperatures may be set for ball bearings. Assume a temperature level 1 is reached; a signal for a yellow warning will be transmitted to the control room, signifying the need for attention. Should the temperature exceed that and reach temperature level 2, a signal for a red alarm will be sent, indicating the need for immediate action, or the option exists to switch to the standby pump while shutting the affected pump down, reducing the potential for further component damage.

These early warning alerts assist in preventing catastrophic breakdown, thus maintaining operations and minimizing potential equipment damage. In essence, by preventing damage to a fairly inexpensive part, such as a ball bearing – replacements for which are kept in a vessel's emergency stock – the potential for damage to an expensive and less commonly stocked component such as a pump shaft or impeller is reduced. Loss of a ship's essential service machinery, depending on the type of vessel and the situation, can cost tens of thousands of dollars per day in downtime.

This also eliminates the need for regularly scheduled physical monitoring. It also frees the crew to perform other tasks unless a fault condition is detected and action is required.



OPERATION MONITORING – MAINTAINING SAFE, CONSISTENT OPERATION

Another means of preventing unexpected downtime on this critical system may be achieved through the intelligent system's operation monitoring capabilities. In essence, this feature helps to avoid dry running and pump overload and partload operation. Dry running will quickly damage the mechanical seal that is typically a standard shaft sealing on water pumps such as these. Operation outside the permitted limits (partload and overload) carries the risk of excess bearing load and cavitation – a condition in which liquid air bubbles occur and snap together (implode) and damage a pump's impeller and casing. Any of these may lead to an unexpected breakdown.

Early detection of these material damaging conditions extends "mean time between failures" (MTBF) and reduces wear levels, providing safe operation and consistent pump performance.

SYSTEM COMMUNICATION/EMERGENCY SCENARIOS

Full communication may be achieved between two or three controllers (depending on the pump configuration and providing redundancy) and frequency converters via the Ethernet, as well as with the control room itself. The Ethernet provides full communication to the control room in regard to overall system status, operation parameters and can also provide a clear text message in the event of a warning or an alarm.

Presets can be created that allow switching to standby pumps in the event of warnings and alarms, as well as the ability to shut down a motor in the event of a dry running condition. Should a motor become damaged, the system will automatically switch to a standby pump.

CONCLUSION

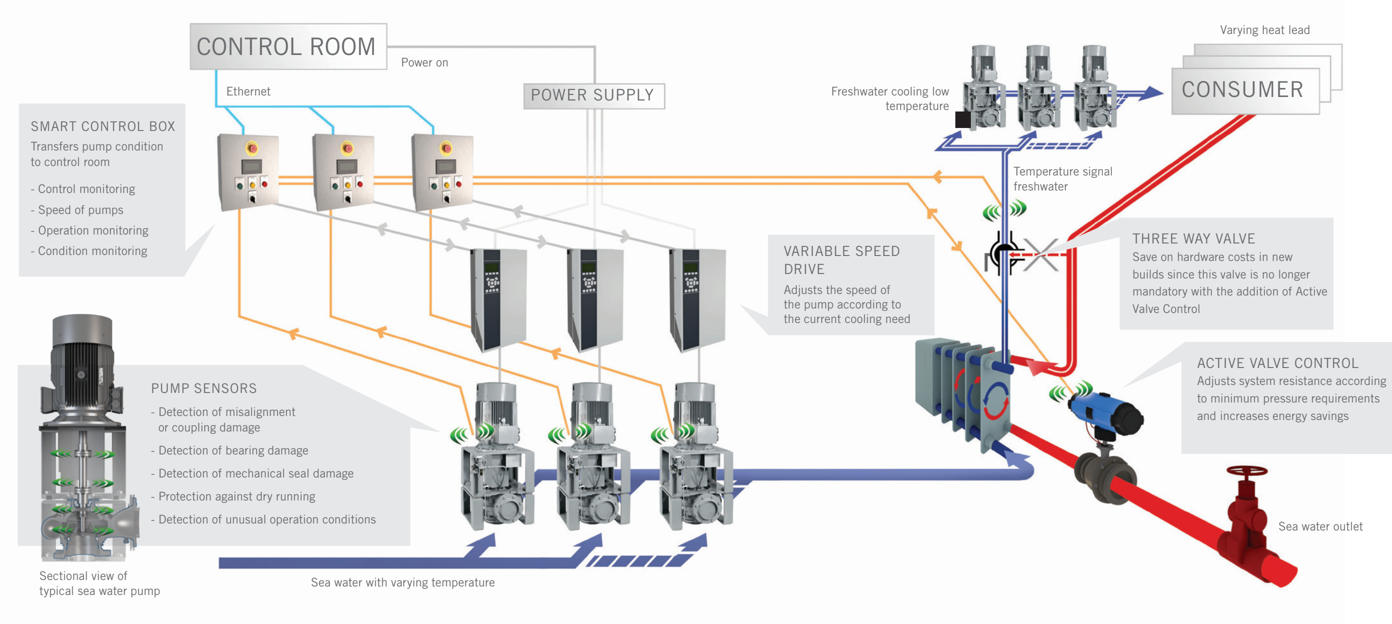
Perhaps the best case for smart technology for onboard systems is the peace of mind such a system can deliver.

While increasing efficiency and delivering energy savings may be rationale enough, application of such a system may minimize potential damage caused by an inattentive crewman or a previously unknown condition that may cause catastrophic system failure.

Such smart technology systems can provide payback in several ways; savings calculators exist that allow owners and operators to input specific parameters to gauge their effectiveness and potential, both short-term and long-term.

Effective sea water cooling system operation that increases uptime, reduces costs and maintenance, enhances sustainability and safety, and provides long-term savings is no longer a thing of the future. It is a technology that is available and in use today, delivering added value to users in both newbuild and retrofit applications.

OPTIMIZED 3x50% SEA WATER SYSTEM SET UP (2x100% SEA WATER SYSTEM ALSO AVAILABLE – NOT SHOWN)



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