FIVE KEYS TO INTELLIGENT SEA WATER COOLING

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

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Ship owners are using intelligent pump controllers to reduce energy and maintenance costs for sea water cooling systems.

Optimizing a vessel's performance is something all ship owner and operators would like to achieve – sooner rather than later. In fact, demands for efficiency and savings have never been greater. At times, it can seem to be a daunting task – reduce operating costs and increase efficiencies to reduce carbon footprint, all while maintaining peak performance. But new technologies exist that can help optimize efficiency and sustainability. Ship owners who apply this technology to their fleet can see significant operating savings, enhanced uptime, reduced carbon footprint and an increase in profitability.

The fluid handling system in a ship's engine room represents approximately 20 to 25 percent of the vessel's electric load. This presents an opportunity for savings if energy consumption can be significantly reduced. The result is fewer carbon emissions and greener operations. A ship owner can greatly reduce these energy costs through smart sea water cooling.

TRADITIONAL SEA WATER COOLING

Sea water cooling systems are essential support systems for the engine room, allowing the vessel to operate safely. A traditional system utilizes comparatively large pumps that are operated continuously – 365 days a year, 24 hours a day.

The primary loop for transporting unusable heat out of most major systems and components in the engine room, sea water cooling systems provide constant, reliable cooling to all the connected shipboard consumers, such as the main engine, generators and auxiliary equipment. The systems pump ambient sea water into a circulating loop that provides a heat exchange with the vessel's freshwater cooling system, which works to cool shipboard energy consumers. Once the sea water has taken on heat from the fresh water, it is pumped back into the ocean as cooler ambient sea water is drawn in and introduced to the system in a continuous manner.

These traditional cooling systems are typically operated by pumps arranged in a 2x100% configuration – one pump active and running at 100% flow with the second pump redundant – or a 3x50% configuration that allows some savings by running a single pump at a 50% system-flow or two pumps at a 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.

These traditional systems are designed for worst case conditions:

- 32° C sea water
- Full Engine speed/load
- Continuously runningWith this system configuration, even the most efficient pumps will have energy wasted due to continuous full-speed operation. The result: a higher carbon footprint and a needless waste of money in terms of energy, maintenance and replacement expenses, along with the need for constant attention from the crew.

So what are the keys to a more effective, intelligent sea water cooling system?

KEY ONE: VARIABLE SPEED OPERATION

A system that operates at variable speeds can reduce energy consumption, reduce hydraulic loads and extend the life of the pumps. And while these cooling system pumps were indeed designed for the worst case scenarios, conditions at sea often don't fit these parameters. Consider for example the water in the North Sea. Temperatures are 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. With variable speed drives and an intelligent controller regulating those drives, pump energy can be automatically regulated precisely to the level required. The pumps provide exactly the flow to achieve a preset cooling temperature; not more, not less.

For example a 20% reduction in speed – and thus a 20% reduction in flow – for each onboard system equipped with an electric driven centrifugal pump 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% may be achieved. Not only do energy reductions decrease the vessel's carbon footprint, but they extend the life of the pump and related equipment through minimized hydraulic loads. Over time, this energy reduction significantly lowers the operating cost of the vessel.

KEY TWO: CONDITION MONITORING

Monitoring systems exist to detect misalignment, coupling damage, bearing damage, seal damage, dry running, and cavitation. Dry running, for instance, will quickly damage the mechanical seal that is typically a standard shaft sealing on water pumps. 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 occurrences may lead to unexpected breakdowns and higher cost. Early detection of any of these damaging conditions can extend "mean time between failures" (MTBF) and reduce wear levels; providing safe operation and consistent pump performance. In addition, maintenance savings of up to 50% can be achieved.

EARLY DETECTION OF CONDITIONS, SUCH AS COUPLING DAMAGE, DRY RUNNING AND CAVITATION CAN EXTEND "MEAN TIME BETWEEN FAILURES" (MTBF) AND REDUCE WEAR LEVELS; PROVIDING SAFE OPERATION AND CONSISTENT PUMP PERFORMANCE.

KEY THREE: OPERATION MONITORING

A smart sea water cooling system controller includes a series of warning and alarms. Monitoring is constant – literally maintenance on demand which means that a component issue can be detected at a moment's notice. This contrasts with the traditional method of assigning crew members to do regular system and component checks, freeing valuable manpower for other shipboard tasks and reducing the potential for human error. For example, two pre-set temperatures may be set for ball bearings. Assuming 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 signifying immediate action. This system of early warnings ensures continuous, safe operation of the pumps.

This image of a typical engine room demonstrates the placement of three intelligent controllers for a 3 X 50% pump configuration. Individual pump controllers ensure optimum energy savings and reliability.

KEY FOUR: AUTOMATED BACK-UP

It's important for the efficiency of the cooling system that backup pump operation is fully automated when certain conditions occur. Individual pump controllers help facilitate automatic switching from the operating pump to the standby pump. Automated back-up eliminates potential downtime because the sea water cooling pump system remains operational until repairs are made. This functionality also helps to reduce further damage to the original operating pump.

KEY FIVE: ACTIVE VALVE CONTROL

Active Valve Control increases energy savings by automatically opening and closing the vessel's cooling system's valves according to minimum pressure requirements. These controls have sensors to monitor real-time operating conditions such as temperatures in the freshwater cooling loop, as well as the pumps' suction and discharge pressure. The sensor signals the controller to regulate the flow of the sea water to the coolers according to varying head loads from the main engine and generators. Because valve adjustments are made automatically, the risk for incorrect manual valve settings is eliminated and incremental energy savings and overall system efficiency are enhanced. Changing the cooling system characteristics to allow extra speed reduction results in additional savings of up to 85%.

Active Valve Control also reduces system complexity on the coolers' freshwater side, significantly reducing pipe turbulence and essentially allowing the removal of the three-way valve and the by-pass line, reducing both equipment cost and associated maintenance cost.

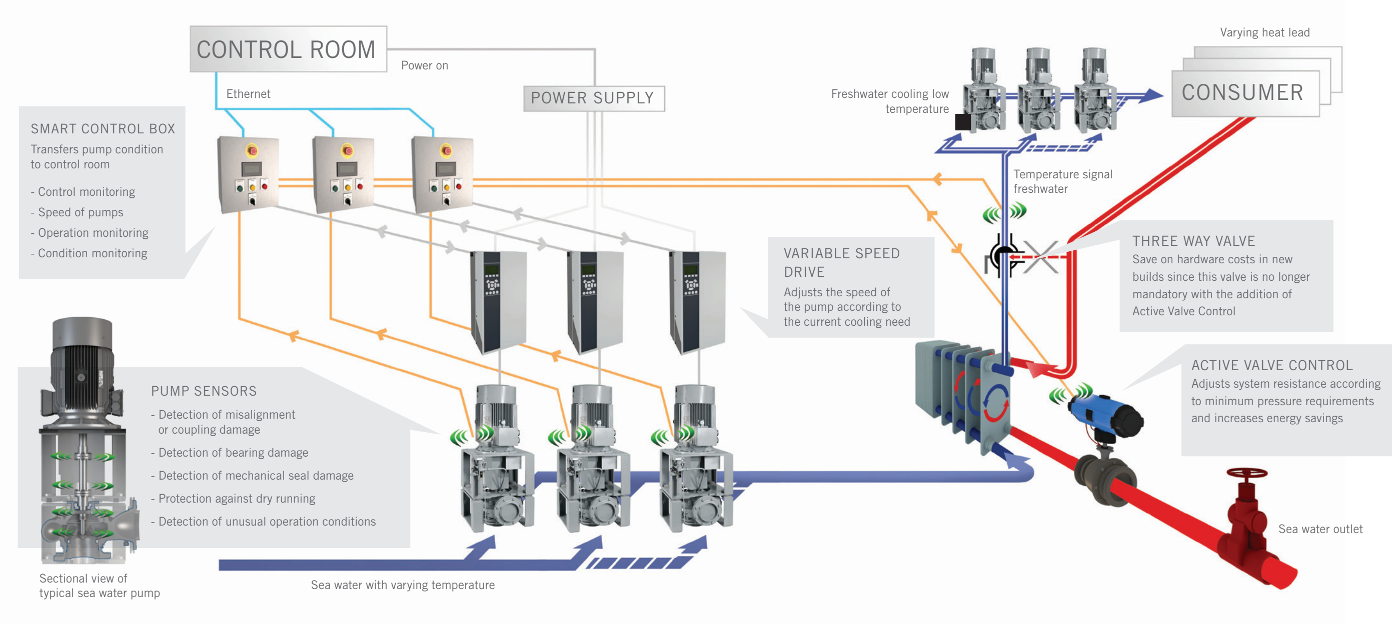
BECAUSE ACTIVE VALVE CONTROL MAKES ADJUSTMENTS AUTOMATICALLY, THE RISK FOR INCORRECT MANUAL VALVE SETTINGS IS ELIMINATED AND INCREMENTAL ENERGY SAVINGS AND OVERALL SYSTEM EFFICIENCY ARE ENHANCED.

CONCLUSION

Stricter international regulations from the International Maritime Organization (IMO) on CO2 emissions as well as increased fuel costs (300% in the past 5 years)*are forcing ship owners and operators to examine every possible avenue to reduce fuel consumption. By utilizing the five keys to intelligent sea water cooling for both new build and retrofit vessels ship owners can make significant strides to meet those regulations.

**International Chamber of Shipping, Shipping World Trade and the Reduction of CO2 Emissions*

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



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