Customer Case Study

Ship Building

Compact controller-based automation on ships
Flexible and reliable sensor connection

Summary

- The complex drive solutions for ships, designed and built by MTU Friedrichshafen, require sophisticated technology to control and regulate
- Phoenix Contact Software delivers the runtime system software (eCLR) for the MTU hardware at the local control unit in the machine room
- Compact controllers ensure that the numerous measurement points can be connected flexibly and reliably to the control level
- Phoenix Contact switches and routers ensure that network operations can be maintained without interruption

Customer profile

MTU is one of the world’s leading manufacturers of large diesel engines and complete drive systems. Together with MTU Onsite Energy, MTU is one of the two core brands of Rolls-Royce Power Systems. MTU’s product line is the most comprehensive and modern in the industry. It includes diesel motors and complete drive systems for ships, heavy land and rail vehicles, and industrial drives. In its over 100 years of history, the Rolls-Royce Power Systems subsidiary MTU Friedrichshafen and its predecessors, especially Maybach-Motorenbau GmbH, have created several innovations and continue to write technological history to this day. (Figure 1).

Challenge: Two different control and regulation systems

Today’s ships often rely on modern drive systems featuring several drive machines, which usually work together via a common transmission. In combined drive systems, different machine types are selected, such as a combination of diesel motors and gas turbines. This enables ships to operate in the most efficient possible way, depending on their operational status. For example, if the ship requires a lot of power in open water, the user switches the gas turbines on. This kind of construction is very demanding, because the transmission has to switch and distribute very high loads (Figure 2).
Controlling and regulating such complex drives requires sophisticated technology. This is why MTU Friedrichshafen uses a control and regulation solution that it developed in-house for the continual monitoring and control of motors, drives, and turbines.

A distinction is made between two systems here: the motor management system and the automation system. The motor management system governs the operating conditions of the machines in terms of engine speed, torque, and exhaust emissions. The automation system delivers the specifications for the motor management system and provides intelligent control functions for certain maneuvers, such as a crash-stop. This is understood as an emergency stop, when the captain has to slow the ship down as quickly as possible. Furthermore, the automation system enables the ship to steer a course by adjusting the drive-shaft speed in ships with more than one propeller. This maneuver, known as a delta throttle, has the advantage of setting a course correction that results from a change in differential speed and the resulting change in thrust. The rudder position is circumvented, which would require higher energy for a course correction (Figure 3).

Solution: Industrial automation meets the demands

Phoenix Contact Software GmbH delivers the runtime system software (eCLR) for the MTU hardware at the local control unit in the machine room. Along with the drive system, large ships include other systems that also require monitoring, control, and regulating. These are often distributed solutions based on classic programmable logic controllers (PLCs) that are used everywhere in the ship to collect and process sensor data to serve actuators installed at different locations. This environment is called the ship area, and it also includes such things as fire and smoke detectors or IP camera systems.

It’s not surprising that modern ships have a modern network infrastructure. Because of fail-safe requirements, ship networks are organized either as two parallel networks or in a redundant ring structure. MTU Friedrichshafen also uses switches and routers from Phoenix Contact to ensure an immediate reaction when a network cable is disrupted, so that network operations can be maintained without interruption.

Freely programmable Ethernet interfaces

In addition to the components that connect directly to the network, ships also have fire detectors, door contacts, pump drives, and other applications that cannot be connected directly to the network. This is where compact controllers from Phoenix Contact come into play. The Inline installation system has a modular design. This makes it easy to custom-configure the I/O stations to meet the specific application requirements. The Inline controller then pre-processes the electrical sensor signals and transmits them over the network to the control level. This may sound simple at first, but a single ship can have up to 20,000 measurement points and 25 control stations. OPC technology enables the ILC 1x1 connection to the control level.

In addition to the one to six operator platforms, on-site operation can be done in the machine room. All operator platforms and on-site control units are connected with each other. Notebooks equipped with the right software can be connected via the onboard network, for example in the machine room, to directly
control the drive machine in manual mode. Displays show the staff their respective user interfaces, depending on control role and location, on installed control stations and mobile operator stations (Figure 4).

Results: Robust display devices with maritime authorization

To create an engineer alarm system, MTU Friedrichshafen uses maritime display devices from Phoenix Contact that were designed especially for the harsh environmental conditions posed by the sea and salty air. Phoenix Contact is a longtime partner in implementing automation tasks for the ship-building industry. MTU Friedrichshafen benefits from Phoenix Contact’s comprehensive expertise in software components for runtime environments, controllers (PLC) with corresponding I/O modules, switches and routers for ship infrastructure, and maritime control devices.

Highly communicative compact controllers for diverse applications

Phoenix Contact introduced compact controllers in 2006. The ILC 1x1 controller, as part of the Inline installation system, always has at least one Ethernet interface and supports almost every Ethernet-based protocol. Along with standard devices, both ILC 191 ME compact controllers offer additional interfaces such as RS-485, PWM (pulse-width modulation)/PTO (pulse train output), fast counters, analog inputs and outputs, and incremental encoder inputs. This makes them particularly well suited for mechanical engineering applications.