CRANE HIL TESTING

Verification and testing of control system software with Marine Cybernetics Advisory

Crane HIL testing helps to detect hidden software errors, erroneous configuration parameters and design flaws in the crane control system software before it is put into use on board the rig. All types of cranes can be HIL tested, and the result is a safer and more reliable automation system.

Why do we test?
Many crane types are designed to suit different vessels and operations, being used in harsh environments and ultra-deepwater locations. In order to operate efficiently cranes use sophisticated computer-controlled systems. Failures in the crane software will affect safety and precision, and may even cause or fail to prevent an incident or accident. Crane Hardware-in-the-loop (HIL) testing by DNV GL is the optimum solution for avoiding software problems. To detect failures at an early stage, the testing should be conducted before commissioning.

The benefits of HIL testing are:
- More efficient commissioning, because the system logic will work from the start
- Difficult/dangerous items tested in a safe lab environment
- Safer and more reliable automation systems
- It gives the owner confidence in the acquired system
How do we test?
Crane HIL testing is performed by connecting a simulator to the target control system so that testing can be conducted in a controlled environment. The HIL simulator acts as a virtual world for the control system by simulating necessary actuators, dynamics and sensors. The HIL simulator will respond in the same way as the actual system would do in a real operation on board the vessel. The environment of the crane controller is simulated, including elements such as: load cells, position encoders, pressure sensors, hydraulic cylinders/motors/pumps/valves, gears, winches, electric drives/motors, etc.

This technology was created by the aerospace industry, followed up by the avionics and automotive industries. DNV GL is the pioneer in HIL testing in the maritime segment. Since 2002, the Marine Cybernetics service line has been providing this service for a variety of vessels and control systems.

When do we test?
A typical crane HIL test is performed over a five-day period during the factory acceptance test (FAT) stage at the crane system supplier site using the actual system controller or a replica system without disrupting its commissioning or sea trial. The HIL simulators can also be reused as part of periodic testing to secure the control system software during the vessel’s life cycle. This testing must ensure that software or hardware updates/upgrades, or changes in operational conditions during the life cycle, do not introduce new weaknesses or errors into the target system.

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Test scope
Examples of functional tests include:
- Winch control: interlocks, upper and lower limit control, override limit switch
- Brake control and monitoring
- Movement monitoring system: slewing, boom, main/aux winch
- Constant tension mode: operation, interlocks
- Manual and automatic overload protection systems
- Lateral boom protection system
- Safe working load
- HPU control and monitoring
- Personnel lift modes: operation, interlocks
- Heave compensated modes: operation, interlocks
- Prohibited sectors / anti-collision system

Failure testing covers:
- Winches, slew and boom: brake failures, machinery not moving on command or in the wrong direction, crane not being able to hold load, machine speed deviation
- Feedback, sensor and encoder failures: wire breaks, failure within/outside range, frozen value, etc.
- Equipment not starting or stopping on command
- Hydraulic supply failures