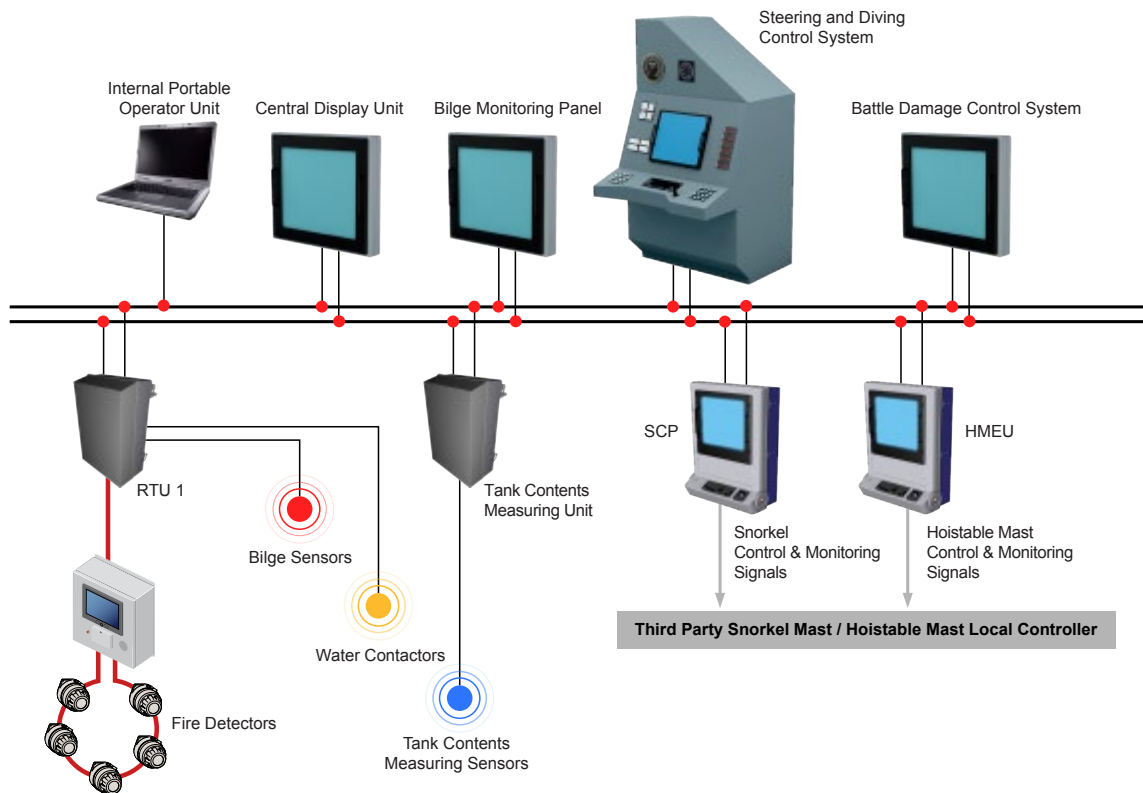




Designed to improve safety and equipment performance, the L3 MAPPS submarine control systems scope includes IPMS, Steering & Diving System and manoeuvring aids, autopilot functions as well as other mission-critical controls. Whether conventional or nuclear, the L3 MAPPS systems are utilized on submarines worldwide. L3 MAPPS can supply equipment/systems such as:

- Steering & Diving/Autopilot
 - Hovering control system
- Platform Management Systems (PMS):
 - Diesel engine/generator and propulsion system control & monitoring
 - Generator excitation and control for submarine battery charging & battery monitoring system
 - Hoistable mast controls/snorkel controls
 - Tank contents measuring system/bilge monitoring system
- Hydraulic systems control and/or monitoring
- Trim, ballast and out-of-trim estimation control system
- Personnel tracking system and security alarm system
- Fire Detection Systems
- High-pressure air systems ventilation and air conditioning systems control and/or monitoring
- Water distribution systems control and/or monitoring



Alarm Monitoring System Architecture

SUBMARINE AUTOPILOT SYSTEM

L3 MAPPS' submarine autopilot system is a one-man control system, which automatically and safely controls the submarine planes and rudder for course and depth settings while minimizing any overshoot.

Some of the key features provided in the autopilot system are:

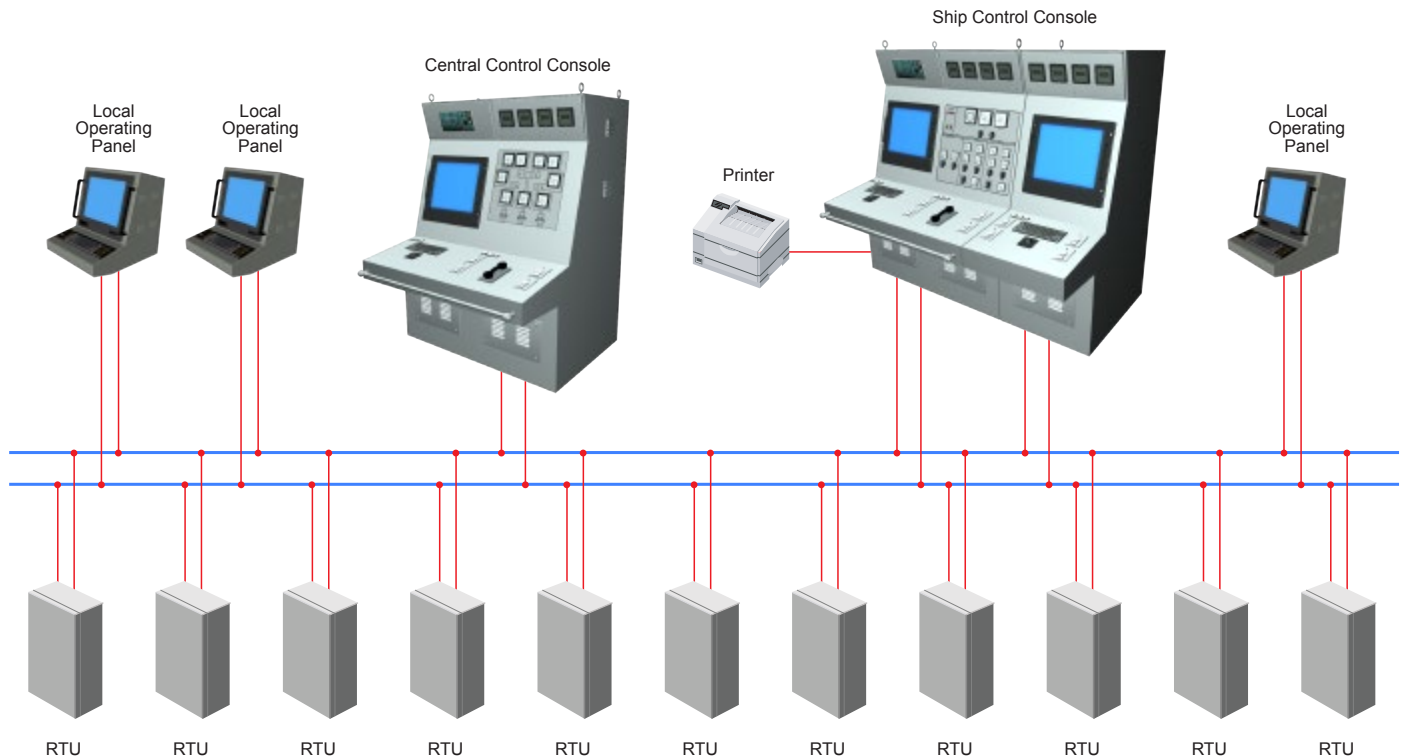
- Out-of-Trim Estimation and Prediction (OTE/OTP) for buoyancy correction
- Automatic derivation of plane ratio as a function of speed, for optimum depth keeping
- Automatic autopilot testing allowing the autopilot system to automatically issue test orders for depth and heading
- Operator adjustment of all setpoints (depth, heading, rudder/plane position, etc.)

STEERING & DIVING SYSTEMS

L3 MAPPS has developed a state-of-the-art fly-by-light control system which centralizes the steering and diving functions of a submarine facilitating the supervision and control of the vessel. The Steering & Diving Control System is a subset of the total submarine platform management system, which enables the submarine to maintain or change its depth and course, are managed from the Submarine

Control Console located within the submarine control room. L3 MAPPS has designed, developed and deployed all elements of the Steering & Diving System using its safety-certified hardware and software components. The major elements of the system are:

- Submarine Control Console, sometimes referred to as one-man control console
- Data acquisition hardware, sometimes referred to as Remote Terminal Unit (RTU)
- Redundant Control and HMI processing hardware
- Dual-redundant network
- Data acquisition, management and communication software
- Human-machine interface software
- Steering & Diving System software, including the autopilot software

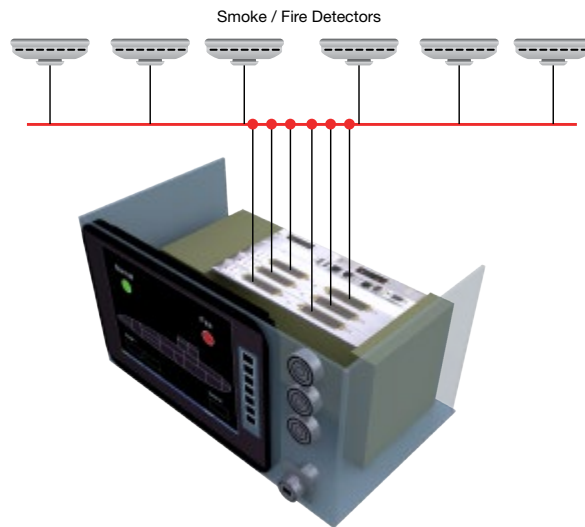


Submarine Control System Architecture

FIRE DETECTION

L3 MAPPS has successfully deployed fire detection and alarm systems on board submarines. The addressable fire detection system includes a central display panel utilizing L3 MAPPS' Human Machine Interface software for operator

notification of system events and messages. The fire detection system central alarm panel is custom built to fit into an existing space.



Fire Detection System Architecture

TRAINERS

L3 MAPPS has also supplied operational and maintenance training systems, including a motion platform-based training system for nuclear powered submarines. The Submarine Control Trainer (SCT) is developed to train the submarine crew on the steering and diving operations of the submarine. The SCT consists of a fully dynamic 6-degree-of-freedom motion system with a simulator cabin. The simulator's cabin incorporates an SCC that is identical to the shipboard unit. The SCT hosts high-fidelity simulation models of the

submarine systems and hydro-dynamics. The submarine control systems and human-machine computer interface software are reproduced on the SCT, providing an identical operability environment for the submarine crew. The control room sounds, communications and lighting conditions are simulated to provide a realistic training environment. This SCT has also enabled our customer to troubleshoot submarine systems.



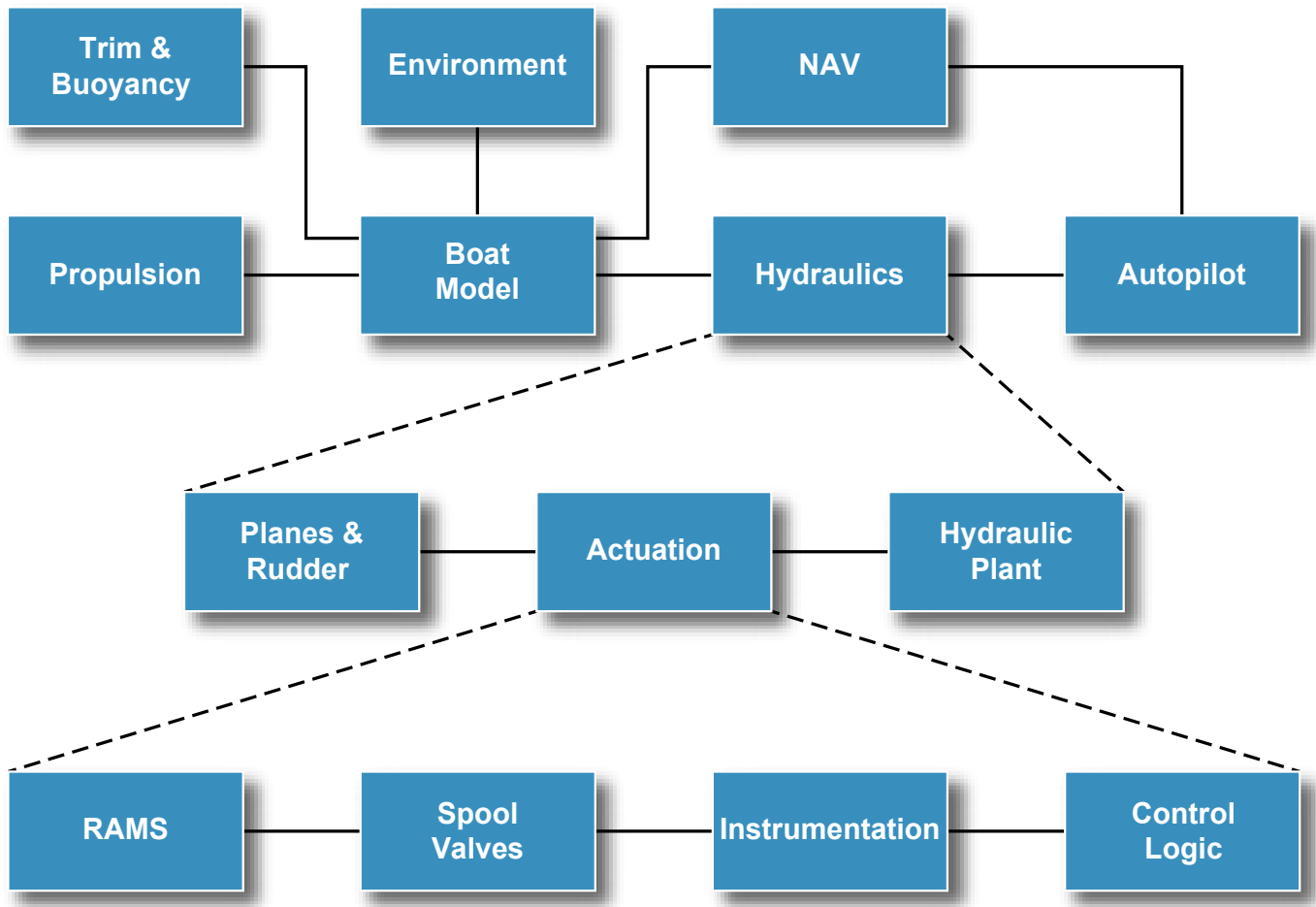
Submarine Control Trainer



SIMULATION AND MODELING

In the early system definition phase of any submarine development project there are few known parameters and many assumptions. Finding the optimum solution, from the wide variety of available technologies and techniques, is an onerous task for the development team. L3 MAPPS has

developed tools that can be used for whole boat simulation models to support the development team in the functional and performance analysis of submarine systems. This exercise is also referred to as Simulation-Based Design (SBD).



Whole Boat Simulation



MAPPS

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