LOCKHEED MARTIN

LOCKHEED MARTIN CONTROLS & AUTOMATION

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Next Generation of Plant Management

Lockheed Martin has launched a new generation of ship machinery control and automation products with platform adaptability and customer affordability in mind. Leveraging over 25 years of experience in fielding machinery controls systems for the U.S. Navy and international military, our products provide complete plant management tailored to customer needs. Our modular components work seamlessly together to provide stem to stern control and automation for propulsion, electric plant, and auxiliaries. Our products include world class damage control, system data recording and prognostics, automated fuel/lube oil sampling and analysis, integrated onboard training with complete plant simulation and a fully automated system test capability. No other set of plant management products on the market offers the same level of capability and adaptability in a modern, affordable, open platform. Built on a solid pedigree of experience, innovation and technical performance, Lockheed Martin's control and automation products take ship platform management to a new level.

Embark with Confidence and Peace of Mind

Lockheed Martin's product line development tools and processes allow us to rapidly tailor each control and automation application to customer and platform requirements while minimizing development. Our simulation and test environment provides an unparalleled level of system test and verification before ever installing software aboard ship. Each application employs a full plant simulation environment that's built into our system test tools and our on board trainer for consistency and realism across all aspects of system behavior. Every signal is rung out and every element of system automation is verified prior to light off of the system to ensure smooth ship integration. Our test automation environment performs continuous testing throughout the system implementation process right up to ship deployment so you can be confident that your plant management system has been subject to thousands of hours of tests before ever going to sea.

All major system components are COTS-based and many are fully supported across the globe with replacements available in less than 24 hours. Lockheed Martin also provides a remote monitoring capability so you can perform system predictive maintenance or condition based maintenance activities for one or more vessels either on board or from shore, giving you confidence in mission success.

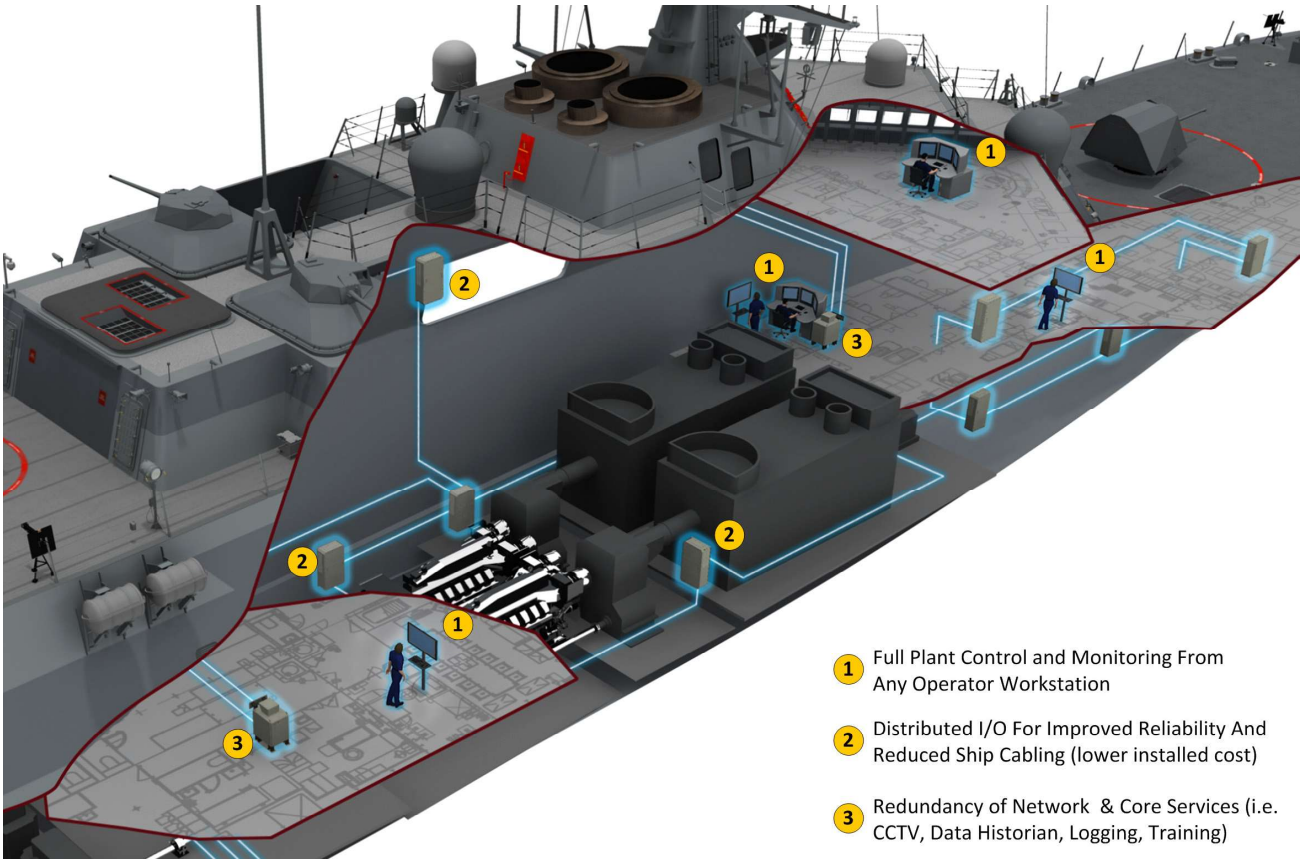
Axis™ Integrated Plant Management System

Total Ship Integration

Lockheed Martin's Axis Integrated Plant Management System is at the core of our control and automation products. Axis is built upon an open modern software framework designed from the ground up to be easily adapted to numerous platforms.

Using published interfaces and an open adaptation layer, Axis takes the complexity out of integration across numerous protocols and hardware platforms.

Axis is an ABS/NVR Certified machinery control system and provides all the requisite capability to control your plant from propulsion, electrical and auxiliaries to damage control, alarm management and condition based maintenance functions.



Plant Management Made Simple

Axis utilizes a distributed control architecture with a simplified, high speed, Ethernet-based network to ensure reliable communications while minimizing cabling and network equipment by over 30% compared with traditional server-based or linear bus architectures. We have also incorporated an open IEC 61131 compliant software PLC within Axis to provide options for further space/weight reductions by elimination of heavy PLC cabinets. Axis drives plant control down to the distributed application processors further reducing system space/weight and complexity by eliminating the need for large server racks. Axis components are available off the shelf from a number of industry suppliers for ease of upgrade or maintenance. Global availability of components, usually within hours, will ensure ship availability 24/7.

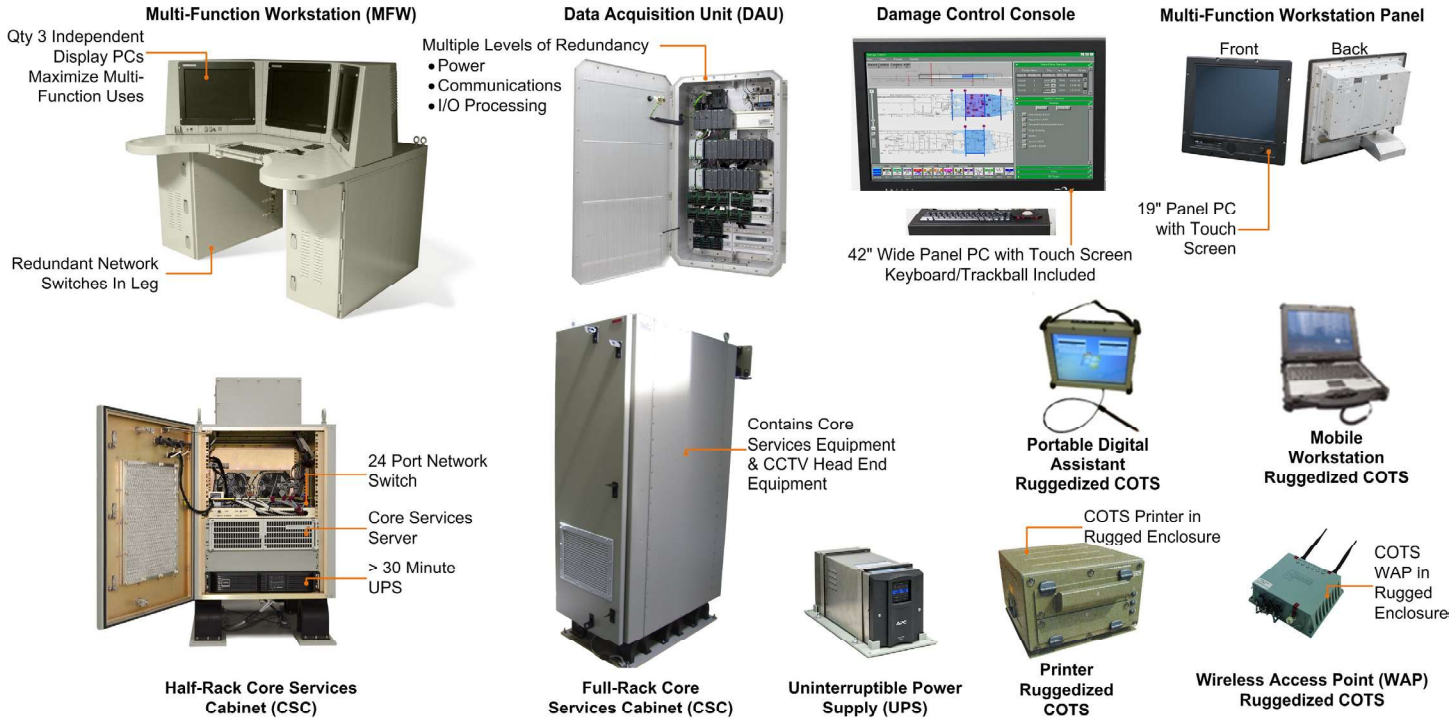
With Axis, the crew can focus on operating and maintaining the plant, not the plant management system.

Proven Performance

Our machinery control systems (MCS) and engine control systems (ECS) have been in service in the global military market on over 200 vessels for more than 25 years. We have delivered mission-ready DDG 51 Class MCS on schedule and on budget since 1990 and Our MCSs have consistently exceeded all initial quality and in-service requirements. Our latest plant management systems are fielded on LCS and DDG 1000 class ships bringing with them the latest in fault tolerance technology, network reliability and system performance, not found in any other machinery control system on the market. Axis will give your fleet the advantage of commonality across vessels and will give your vessels the flexibility needed to keep up with changing technology as your mission needs change.

Modern COTS-Based Components

In today's environment of short technology development cycles and rapid tech refresh, you need a system that can keep up with the state of the market without expensive redesign impacts. Axis is based on a solid foundation of proven COTS components with an extensive global OEM supplier base. That translates into world class obsolescence management support, form, fit & function replacement support and lead times for most items in under 24 hours. Combine that with Axis's open architecture design and hardware modularity and you can be sure that your delivered machinery control system will be modern and supported for the life of your vessel.



Built for Harsh Naval Environments

The complete set of MCS equipment has been certified to meet the American Bureau of Shipping Naval Vessel Rules (ABS/NVR) and all required environmental tests necessary for use on Navy vessels. Including at a minimum:

- Ambient Air: Low Temp 0° C, High Temp 50° C, with 95% humidity
- Sea Conditions: Static & Dynamic Inclination 22.5 deg per IEC 60092-504
- Shock, Blast, Vibration: MIL-STD-901D, Grade A Shock. MIL-STD-167-1A, Vibration
- EMI: MIL-STD-461E
- Noise: Complies with ABS Guidance Notes for the Application of Ergonomics to Marine Systems (Category E & F)

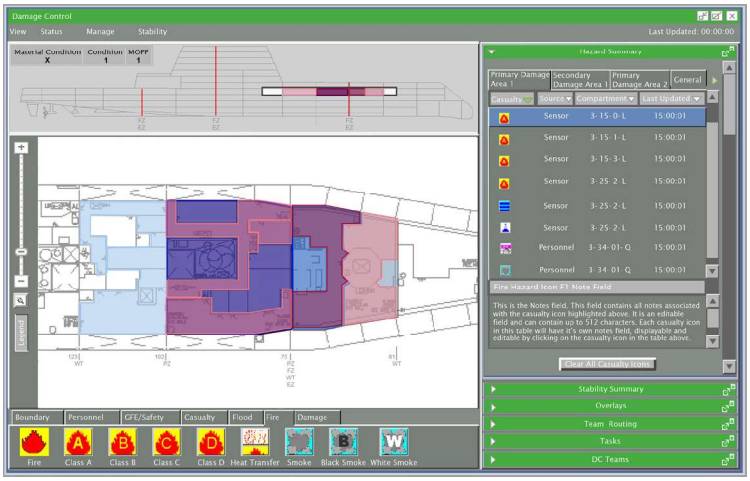
Crusader™ Damage Control Automation

Complete DC Management

I&C Crusader™

Lockheed Martin's Crusader Damage Control (DC) Automation System is a best-in-class product with a solid pedigree. Initially developed to meet the stringent requirements of DDG 1000, the US Navy's most sophisticated surface combatant, it provides an intuitive automation capability that strikes a balance between operator friendly functionality and technology.

Crusader is designed to handle multiple simultaneous casualties from fire, smoke, flooding, stability and hull stress to chemical, biological and radiological hazards. With its advanced hazard modeling and sensor data fusion capabilities, Crusader provides unprecedented situational awareness while reducing both the cognitive and physical workload on the operator. Doctrine-based and model-based automated responses provide a level of safety, expediency, consistency and repeatability in your DC operations that cannot be achieved with traditional manual DC systems. Whether it's a pipe

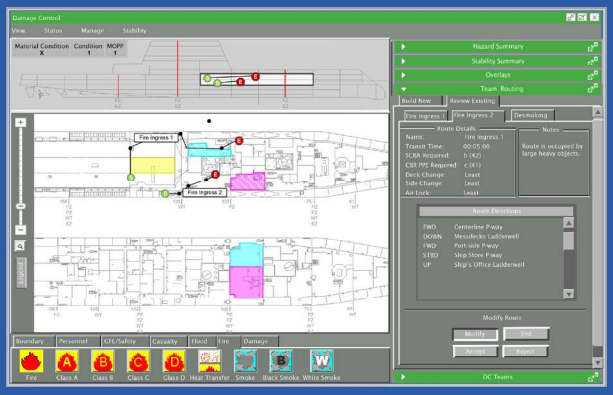


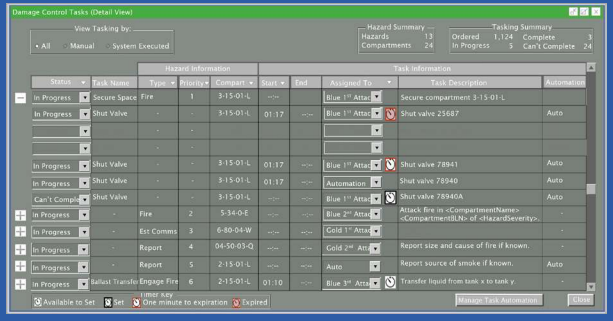
rupture, a trash can fire or a major conflagration, Crusader's displays have been designed by industry experts to provide timely information using clear, NSTM approved symbols and simple navigation functions that will keep you informed without losing sight of the big picture.

Prepared for Anything

Lockheed Martin has worked with industry and the US Navy to combine the capabilities of two leading DC programs of record, while adding significant capability to vastly improve the way we do shipboard damage control.

With the feature rich capabilities of Crusader you can rest assured that you'll be prepared to handle any damage control situation with confidence.





Crusader is more than just a damage plotting tool. While plotting is certainly a valuable function, Crusader also provides:

- Advanced Fire/Smoke/Flooding Assessment and Response Functions
- Automated DC Plotting
- Automated Kill Cards
- Automated Load Reports
- CCTV Integration
- Crew Routing
- DC Crew Management
- Dynamic Zoom and De-clutter Features
- Intelligent Decision Aid for Manned Responses
- Machinery Plant Control Integration/automation
- Real Time Stability Management (flooding, icing, grounding, etc.)
- Ship Maneuvering Guidance and Safe Operating Envelope
- Stability Planning

I&C Visionary™

Visionary™ Data Historian and CBM System

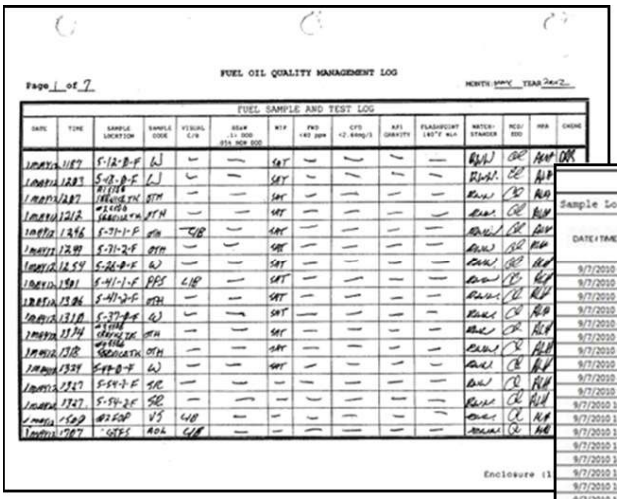
If it isn't broke, don't fix it...

The Visionary monitoring system works around the clock to provide data about the ship's hull, mechanical and electrical systems to crew and remote personnel anywhere in the world.

Using the ship's embedded plant management system sensors, Visionary crunches data that helps predict potential system and equipment problems. Visionary provides a simple and intuitive way to search through signals based on time, system or other filters to quickly get to the root of an anomaly.

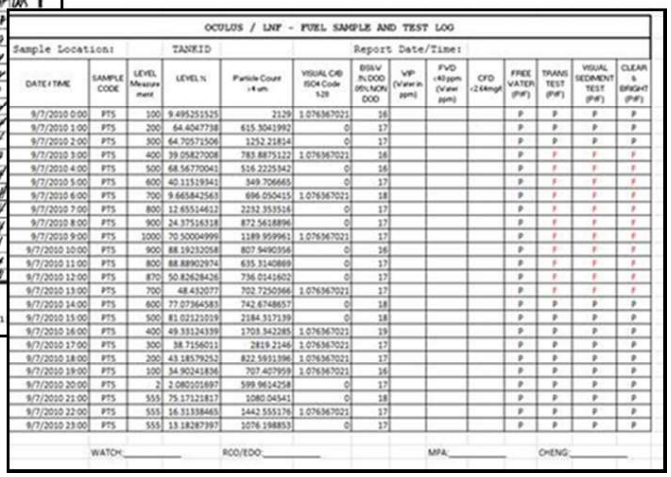
Visionary has been used successfully during light off, trials and Post Shakedown Availability (PSA) events to interrogate system failures and has saved our customers weeks in delays and millions of dollars in equipment tear down and disruption costs.

Additionally, Visionary provides a number of automated reports and logs that can save the crew hours of manual entry each day.



FUEL OIL QUALITY MANAGEMENT LOG

FUEL SAMPLE AND TEST LOG



OCULUS / LNF - FUEL SAMPLE AND TEST LOG

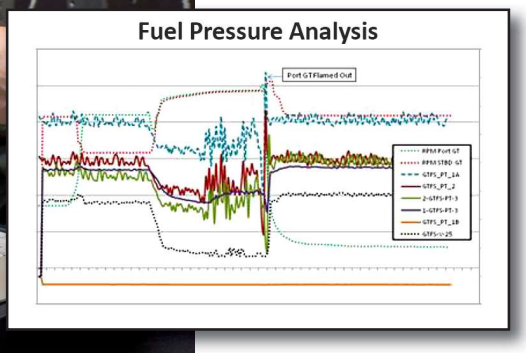
Visionary automated report features can save maintainers hundreds of hours per week in manual data entry

Affordable Maintenance Planning

Industry demands high reliability, high operational availability, and short repair times to maximize the time that systems are in service. Unexpected failures frequently result in extended system downtime due to maintenance delays and long lead time of parts.

To maximize system availability, maintenance must be performed on a preventative or condition related basis rather than on a reactive or schedule related basis and data must be made available remotely to maintenance support activities so that replacement parts may be procured in a timely manner before a failure occurs.

Visionary provides unparalleled access to data for event analysis on or off-site, multiple parameter visualization, data trending and reporting. Visionary provides libraries of maintenance event "fingerprints" that can be stored and built upon to improve event prediction capabilities over the life of the system.



LaserNet Fines Monitoring System

Time to Check the Oil... Again!

LaserNet Fines Monitoring System (LMS) analyzes fluids in real-time so crews don't have to

How often can you check the oil on board a 118 meter ship? About every minute, if you are using LaserNet Fines Monitoring System (LMS). This laser-based system analyzes fluids in real-time so crews don't have to, and it sends crews reports and alerts if something requires maintenance. Ultimately, this cost-saving tool will keep ships running at optimum performance

LMS uses laser technology installed directly in line with your fluid systems to provide on-the-spot analysis of machinery health by detecting, counting, classifying and trending fluid contamination. LMS works in real time, 24/7, so crews can track and measure fluids from any laptop or remote monitoring station to determine how clean the fluid is.

LaserNet Fines Monitoring System can be used with all types of machinery and equipment. It is perfect for high-value or remote equipment, including:

- Gas turbine engines
- Large diesel engines
- Marine propulsion thrusters
- Inaccessible equipment
- Deck machinery

Preventive Maintenance at a Fraction of the Cost

Distinctive Features of the LaserNet Fines Monitoring System (LMS)

- Only online particle counter/ classifier able to measure viscosity
- Handles up to 10 million particles/ml
- Ability to process dark oils (up to 1.5% soot)
- ATSM D7596 Certified
- Traceability to NIST SRM 2806 – no need for periodic calibration

Additional Features Fully Realize LMS's Many Benefits

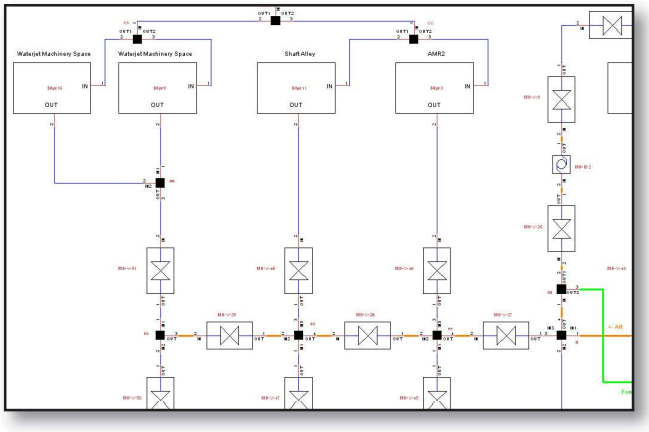
- Visionary™ Real-Time Data Collection
- Visualization
- Trending
- Analysis
- Report Generation
- Archival Software Tool

Meets Stringent Military Standards

- JOAP Certified
- Detects Wear Particles 4-100 µm
- Provides ID, Size and Trend Data
- Meets MIL-S-901D Shock Spec
- Meets MIL-STD-167-1 Vibration Spec
- Temp: -40°F to +185°F
- Input Pressure up to 3000psi
- Interface: RS232, Ethernet, USB, IRDA
- NEMA 4 enclosure
- Fluid Viscosities up to ISO 350
- NSTM 541-7.4.2 and NSTM 262

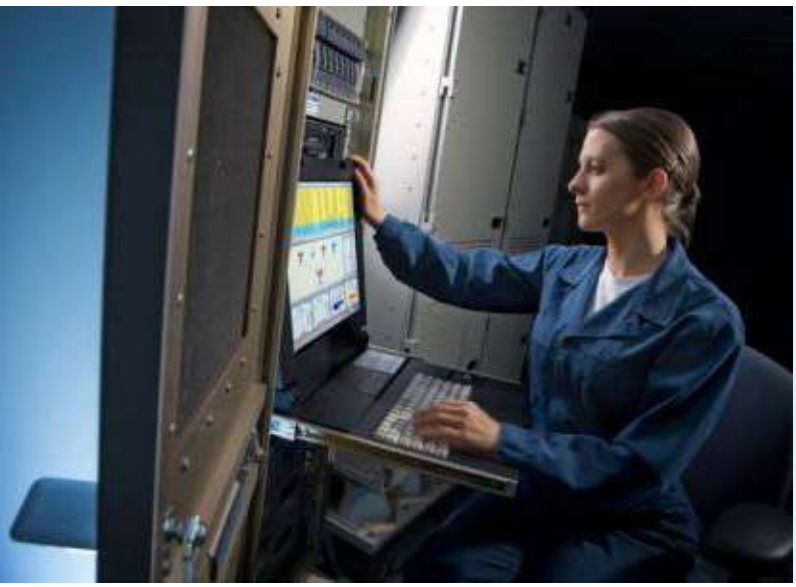
Tutor™ On Board Trainer

Realism in Operator Training



Lockheed Martin's Tutor On Board Trainer (OBT) with integrated Training Management System (TMS) not only provides a true to life training experience, but gives the user a way to manage and track their training progress. Tutor OBT is driven by a full plant simulation for complete realism in plant behavior and response to operator input.

Our machinery plant models are built upon a solid foundation of modeling tools, equipment specifications and sim/stim experience to ensure plant behavior is true to life. Our models are fully integrated and interactive to allow training either through structured, task-based scenarios or through "free play" system familiarization.



Training Management at Its Best

With unmatched experience providing Naval training programs for over 25 years, LM has created an interactive training environment that facilitates the entire training experience. From training scenario creation and curriculum development to training execution and session recording and playback, Tutor will keep your crew at their best and provide the metrics to prove it.

Our distributed training environment allows an operator or instructor to log into a training session from any workstation and participate either in a self-paced training session or in an instructor led session, giving optimal flexibility to trainees to meet their on board training commitments.

Low Cost Trainer Maintenance

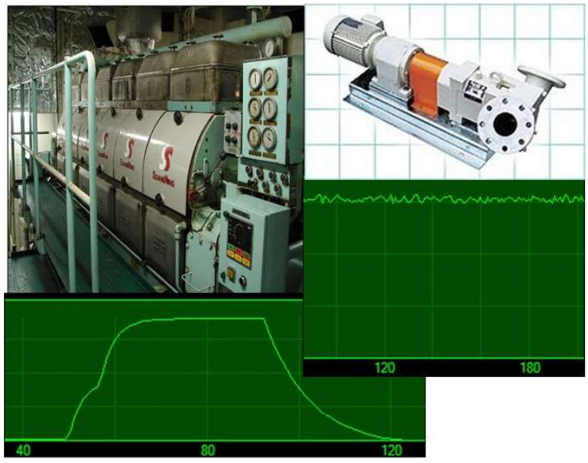
Never let your system training get out of sync with your operational system again. Tutor uses the same machinery models and sim/stim tools used in our system operational testing. By keeping the two environments common we can pass along some great cost savings to the customer while providing real technical advantages. First, changes made to the installed system always have corresponding changes made to the system sim/stim models within our test environment so that all changes can be fully tested and verified before making their way back to the installed system. As a matter of course, the training environment also receives the same model updates with no additional effort and Tutor gets updated at the same time as the installed system. This eliminates the possibility of negative training due to misaligned operational and OBT systems, while simplifying the maintenance of the OBT.

Tutor lets you run and maintain your entire training program in one place

I&CSimmetry™

Simmetry™ Total Plant Simulation

High Fidelity Machinery Modeling



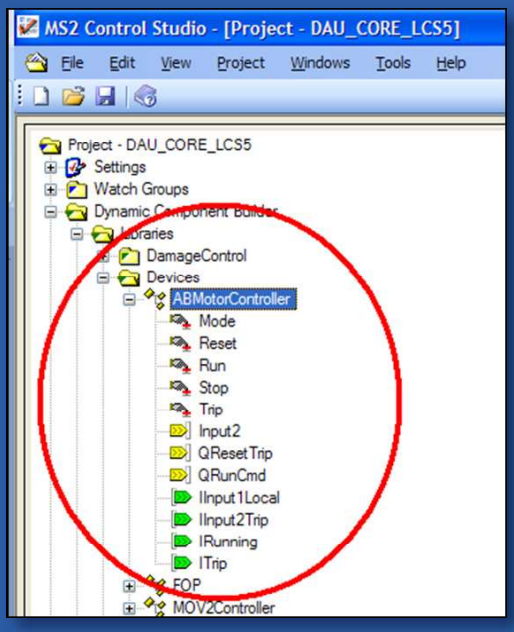
Simmetry is a real-time simulation engine that provides high fidelity modeling so you can be confident in your model-based test program. Simmetry allows you to test your entire IPMS while simulating every field hardware device, system and interface your system connects with including:

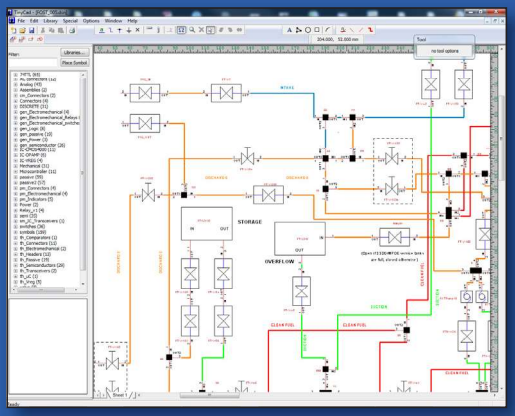
- All IPMS Data Acquisition Units
- All I/O processors, including fail-over operation
- All signals and devices controlled and monitored
- All interfaces to/from IPMS
- Piping systems (fuel, water, lubricants, sewage, etc.)
- Mechanical systems (diesel engines, gas turbines, air compressors, etc.)
- Electrical systems (switchboards, load centers, breakers, generators, etc.)
- Alarms (fire, smoke, flood, door/hatch, etc.)

All signals can be adjusted to exhibit real world behaviors by adding lag and noise and models can be interconnected so that your simulations will run end-to-end with realistic results.

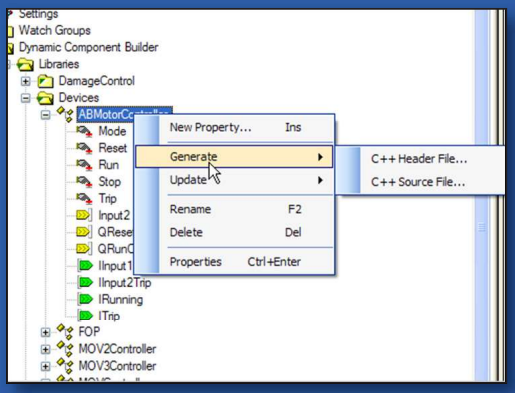
Simplified Modeling Environment

The Simmetry modeling environment uses a simplified set of tools for easily creating models of equipment and machinery systems. Equipment models are defined by their modes and behaviors and libraries of equipment models can be stored for later use and accessed quickly to build up large scale interconnected subsystem models.





Fluid and electrical system drawing tools provide a visual means of laying out various machinery systems to mimic the installed systems on board ship.

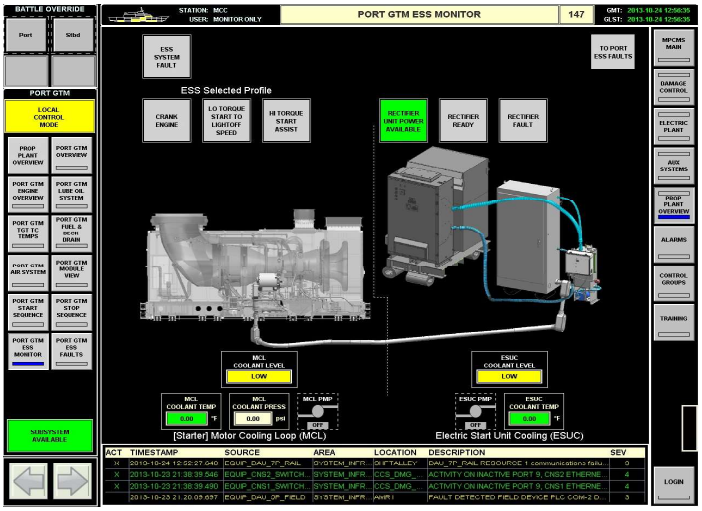


Simmetry automatically generates the back end mechanisms necessary for making linkages across subsystems, making it easy for personnel without a depth of system knowledge to create fully interconnected Simmetry models.

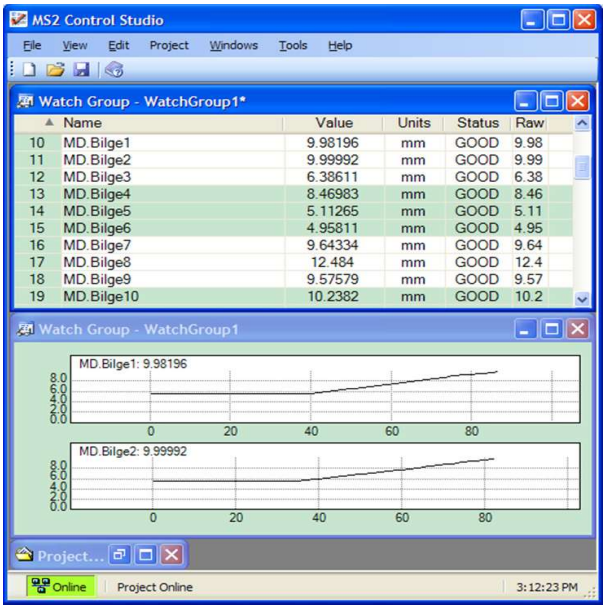
I&C Studio™ Test Automation

Light Off Right the First Time… Every Time

One of the most critical events for any ship construction is light off of the machinery control system. Is the network configured properly? Are all of the device signals and interfaces set up per the vendor data sheets? Is the control system displaying all data properly? These are concerns of the past when using Studio for your IPMS verification and factory acceptance test. With Studio, you can run the entire machinery control system through its paces before ever installing it on board ship. Every interface, every signal, every device captured within the test environment in the exact configuration to be run on board ship. No more delays, questions or uncertainty about whether the ship config will match the test config because they are exactly the same. Using Studio you can reduce light off



time by up to 75% when compared to traditional methods. Additionally, with Studio's incremental light off capability, you can light off and test any sub-sets of I/O that are wired up and powered on, while simulating the balance of the plant. This allows you to test the entire system even when all of the I/O is not on line yet, providing the flexibility to work within shipyard and system availability schedules without waiting to the last minute to perform system check out.



Verification Before Installation

Studio provides a way to perform100% signal checkout before ever installing software on board ship. Each signal is accounted for in its exact ship configuration including offsets, gains, noise, ramps, etc. so that entire subsystems can be run through a series of comprehensive tests in a lab environment instead of on the ship where delays and re-test are costly. Studio also utilizes Simmetry, our fully interconnected plant simulation system, so that signals can be checked in real operational test scenarios as well as on an individual basis. Besides signal checkout, Studio allows you to validate critical interfaces from motor controllers to large engines or gear sets and it can be used to test your network configuration (IP addresses, ring settings, etc.) so you'll have complete confidence in your machinery control system before powering up the first device on ship.

Test Automation for Consistency and Repeatability

Why build an incredible simulation and test tool if it doesn't make your job easier? Well… we didn't. Studio not only provides the simulation and test environment, but it gives you a way to automate your test program from a single test sequence to a series of full subsystem tests, including automation of operator actions at the display. Test procedures can be batched together and kicked off on an automated schedule that runs overnight so your system continues to work even when you aren't. This not only boosts your productivity and reduces your overall test schedule, but it makes your testing repeatable and consistent so that any system changes along the way can be re-tested quickly and easily without a lot of manual effort. With Studio, your test results are recorded automatically and test reports are system generated so that you can focus on getting the system up and running instead of on generating paperwork.

About Our Organization...

Lockheed Martin has been providing plant management and engine control systems for over 25 years on 200+ Vessels for 19 ship classes to 9 navies and 16 shipbuilders and have NEVER missed a contract delivery date. With offices in Baltimore, MD and Orlando, FL, we offer innovative, modern control system solutions with a focus on system affordability, reduced maintenance costs and capability that can be expanded and adapted as your needs develop. We offer complete control system solutions from full up design and integration to system maintenance and logistics services. Please contact us with any inquiries.

United States Navy
LCS 5 and follow
Machinery Plant Control and Monitoring System

United States Navy
DDG 1000
Damage Control Automation & Engineering Control System

United States Navy
DDG 51 Destroyer
Machinery Control System & Engine Control

United States Navy
AOE-6 Auxiliary Ship
Machinery Control System & Engine Control

United States Navy
MCM
Machinery Control System

United States Navy
TARC
Machinery Control System

United States Navy
AO177
Machinery Control System & Engine Control

United States Navy
FFG 7 Perry Frigate
Machinery Control System & Engine Control

United States Navy
DDG 963/993
Engine Control

United States Navy
FFG
Machinery Control System

United States Navy
PHM
Engine Control

United States Navy
CG47 Cruiser
Engine Control

Brazilian Navy
Corvette
Engine Control

Royal Australian Navy Frigate
Machinery Control System & Engine Control

Royal Saudi Navy Frigate
Engine Control

Royal Danish Navy Corvette
Engine Control

Indonesian Navy KRI Patrol Boat
Engine Control

Taiwan Navy Frigate
Machinery Control System & Engine Control

Spanish Navy Carrier
Machinery Control System & Engine Control

Spanish Navy Frigate
Machinery Control System & Engine Control

Republic of Korea Navy Frigate
Engine Control

Iraq Navy Frigate
Engine Control

Israeli Navy
Engine Control

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