

An Efficient Hardware Maintenance Capability for the National Ignition Facility Computer Control System

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Mark G. Miller

Controls Hardware Manager

Lawrence Livermore National Laboratory • National Ignition Facility & Photon Science

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NIF operations is supported by multiple maintenance facilities



The controls system contain 1,800 processors that operate the NIF laser and target devices



Controls 66,000 actuators, triggers, cameras, digitizers, pulse power and a variety of digital & analog I/O

ICCS hardware technology designed to meet NIF controls functional requirements



Hardware responsibilities cover systems life cycle

- Engineering
 - System and circuit design
 - Configuration and inventory management
 - Reliability, Availability, Maintainability (RAM) improvement and technology refresh





- System Maintenance
 - Unplanned & preventative maintenance
 - Calibration
 - Online/offline troubleshooting



Team has focused on maintenance processes the last two years

Production

- Assembly and test
- Installation & qualification testing

Maintainability is governed by many factors



Maintenance strategy has focused on a few key areas

Maintenance Facility

- Optimize for test and repair rigor as well as efficiency
- 30% Complete of multiyear effort

Maintenance Policy

Update predictive and unplanned policies and procedures

Largely complete. Continuous effort

Sparing Plan

 24/7 access to large inventory of tested hardware

Completed in 2013 with ongoing effort

Refresh

- Hardware approaching EOL
- Aging technology

Continuous process. Major upgrades planned for 2014

Process Tools

Automate and integrate tools to increase rigor and efficiency

80% Complete of two year effort

Maintenance Facility incorporating specialized test stations to test and repair controls hardware

- Test standards are defined and repeatable
 - Written test procedures
 - Documented calibration specifications
 - Trained and qualified staff
- Scheduled "verification" of station functionality



Improved test and repair capability increases our controls reliability

Predictive maintenance minimizes unplanned impact and downtime

- Calibration insures and maintains device performance and accuracy
 - In situ onsite calibration by trained staff
 - Offsite calibration by instrument vendors
 - LRU devices tested onsite





- Preventative Maintenance (PM) minimizes unplanned outages
 - Determine replacement schedule before predicted EOL
 - Periodic equipment inspections

Spares strategy for unplanned maintenance

- Critical spares storage area for rapid facility failures
 - Certified replacement units
 - 24/7 access
 - Inventory tools trigger reorder
- Guiding principles
 - Number units deployed
 - Failure rates
 - Unit availability
 - Expansion needs



Inventory of 1,100 different assemblies assures timely repairs

Refresh strategy to replace aging HW is based on product availability and modern technologies

- Analyze inventory to identify refresh candidates
- Guiding principles identify replacement hardware based on:

Current industry standards	Maturity level
Leverage technical base and experience	 Use existing personnel experience where feasible
Hardware replacement costs	 Units cost Spare costs Cabling
Software replacement effort	 Software conversion Additional coding Language change New board support package

Tight integration with the CIS software team delivers an integrated cost effective solution

Understanding inventory highlights areas to target for refresh which improves our RAM



Consolidation of compute platforms and software languages is an active project focus for the Controls team



Reduction of required inventory will help minimize maintenance and spares costs



Transition to current/future OS'es will increase reliability and minimize software support required



Maintenance work processes are assisted by a variety of tools and procedures

- Inventory management tools
 - Multi-level bill of materials
 - Warehouse inventory
 - Shortage reports
 - Configuration
- Maintenance training and tools
 - Qualification cards
 - Rack layout and cabling database
 - Document retrieval tools specific to control systems
- Work control tools
 - Maintenance work orders
 - Preventative maintenance plan
 - Improvements in process

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Work Package:		Route:		Start Date:	08/12/2013 00:00	
Maintenance Pattern - Sequence:		Inspection Status:	Unfinished	Date Completed:	08/12/2013 15:17	
Scheduling Session		Repair Duration Hours:	4	Shift:		
Type:		Functional Availability		Project		

SMART - System Maintenance

Tools help manage the work, assure quality control and maintain inventory

In summary, our experienced team has proven capable of maintaining and expanding NIF's controls

- Maintenance facility fully established
 - Fabrication and assembly work centers complete
 - Motor test and evaluation station operating in clean environment
 - Ready spares warehouse and tactical logistics in place
 - Dedicated test stations continue to come online
- Adequate resources are planned to be available
 - Engineering and tech support
 - Instrumentation and troubleshooting aids
 - Spare parts and hot spares
- Maintenance processes and procedures are maturing
 - Work control, inventory and configuration management