



# Dedication of Commercial Grade Software

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# Ethernet Switch



- This presentation is applicable to the RuggedCom Ethernet switches.
- It looks like a simple item, but looks can be deceiving...

# Standards, just to name a few...



- IEEE Std. 344-1987
- IEEE Std. 323-1983
- EPRI TR-102323, Rev. 3
- RG 1.180, Rev. 1
- EPRI TR-102348, Rev. 1
- EPRI TR-106439
- IEEE Std. 7-4.3.2-1993
- IEEE Std. 730-1989
- IEEE Std. 1028-1998
- IEEE Std. 828-1997
- IEEE Std. 829-1990
- IEEE Std. 830-1998
- IEEE Std. 1008-1987
- IEEE Std. 1074-1995
- IEEE Std. 1012-2004

# Dedication Process



- Identify the safety function of the equipment.
- Identify the critical characteristics that must be verified.
  - NLI's dedication plan for this device has over 50 CC's.
- Method for verification of the critical characteristics. All NLI software dedication programs consist of both:
  - Software commercial grade survey (CGS) at the manufacturer's facility.
  - Testing at NLI.

In our experience, both a CGS and in-house testing is required.

# Dedication Methods



- Method 1 – Special Tests & Inspections
- Method 2 – Commercial Grade Survey
- Method 3 – Source Surveillance / Verification
- Method 4 – History/Item Performance
  
- This project required Methods 1, 2 & 3

# Method 2 - CGS



- Performed at RuggedCom facilities by NLI Lead Auditor and SME.
- V&V activities performed prior to test specimen completion
- Must have cooperation of manufacturer
- Allow more time than initially thought
- CGSR-AVL-1030-V&V, Rev. 0 (37 CC's)

# Production Units



## Methods 1 & 3:

- 9 CC's to verify at the manufacturer, including ROS download for each unit. SIR-AVL-1030-01, Rev. 0
- Final testing at NLI per NLI VP-26713879-1, Rev. 2.
- Most of the client specification requirements were tested.

# Qualification



- Seismic Qualification at NLI
- EMI/RFI Qualification
- NLI-QR-26713879-1 for above completed 12/2010
- Firmware V&V (included in separate report). VVR-26713879-1 Rev. 1, issued 9/2011. Includes final dedication report.

# Identify the Critical Characteristics



## Types of Critical characteristics (CC's)

- Lifecycle.
- Hardware/software.
- Functional.
- Abnormal conditions and events (ACE's).
- Configuration control.
- Cyber security.
- Human Machine Interface (HMI).
- Reliability and operating experience.

# Lifecycle CC's



- Most are related to the vendor QA controls. A CGS is required.
- Examples:

Critical Characteristic	Acceptance Criteria	Acceptance Method
Software specification /software requirements	Software specification, or equivalent, documents the software requirements.	Software CGS.
Error/problem handling by the manufacturer.	<ol style="list-style-type: none"><li>1. Software errors are identified, documented, evaluated, and reported in a controlled manner.</li><li>2. Manufacturer has a mechanism for identifying and evaluating user reported errors.</li><li>3. Identified problems are reported to the end user.</li></ol>	Software CGS.

# Hardware/Software CC's



- Examples:

Critical Characteristic	Acceptance Criteria	Acceptance Method
Watchdog timer or equivalent.	The product contains a method to detect a failure to complete a cycle and resets.	Software CGS.
Processor restart and initialization	Following power removal and restoration, the item restarts and maintains the initial configuration.	NLI dedication/ FAT testing

# ACE CC's



- External and internal ACE's (also referred to as Hazards) are addressed
- Examples:

Critical Characteristic	Acceptance Criteria	Acceptance Method
EMI/RFI qualification	Item operates properly before, during, and after the EMI/RFI event (specific acceptance criteria are identified in the qualification plan).	NLI testing
Unused function isolation	<ul style="list-style-type: none"><li>• No unused resident functions.</li><li>• Development aids removed.</li><li>• Portions of the code that are not used for the end user specific application will not impact operation.</li></ul>	Software CGS. NLI testing.

# Configuration Control CC's



Examples:

Critical Characteristic	Acceptance Criteria	Acceptance Method
Revision control	Revision control is used by the vendor on hardware and software.	Software CGS.
User setpoints configuration control	NLI dedication/FAT testing is performed at the plant specific user setpoints and the setpoints are documented (specific acceptance criteria are in the dedication/FAT plan).	NLI dedication/FAT testing

# Cyber Security CC's



Examples:

Critical Characteristic	Acceptance Criteria	Acceptance Method
Cyber security during product development and manufacturing.	Vendor maintains an effective cyber security program that prevents malicious code from being installed.	Software CGS.
Product security.	The equipment contains the product security (passwords, physical security) per the plant requirements and vendor specifications.	NLI dedication/ FAT testing

# Reliability and Operating Experience CC's



Examples:

Critical Characteristic	Acceptance Criteria	Acceptance Method
Product operating experience.	Installed units have good operating history. Document the following and evaluate: <ol style="list-style-type: none"><li>1. # operating units by revision level.</li><li>2. Time in service.</li><li>3. Number and types of identified problems (hardware , software).</li></ol>	Software CGS.
Software revisions due to problems.	Software revisions that were made due to identified problems fully resolves the problem.	Software CGS.

# Production Units



- Software V&V/dedication of the RuggedCom Operating System (ROS) was accomplished by software V&V audit of the RuggedCom facilities, NLI testing and NLI analysis.
- The audit was performed on v3.8.2 and analysis for v3.9.1.
- Verification of RCTS (RuggedCom Test Script) used to download the ROS

# Key Issues/Lessons Learned



- This type of project is impossible without the cooperation of the manufacturer.
- Upfront dialogue is key to a successful project.
- Be Honest with the manufacturer, especially if they have never experience the “nuclear way”

# Key Issues/Lessons Learned



- There are regulatory and implementation differences between dedication of commercial grade software and development of digital equipment under a 10CFR50 Appendix B quality assurance program.
- Both a software CGS and FAT/dedication testing are required for proper dedication.

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**Questions?**

