SPINLINE 3 Digital Safety I&C Platform

Overview of the Equipment Qualification

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Non proprietary

Overview of the presentation

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Introduction to the Equipment Qualification Plan

Objective of Generic Qualification (1/2)

- **Objective:**
  - To receive U.S. NRC generic approval for use of the generic ***SPINLINE 3*** digital safety I&C platform in U.S. nuclear power plant and nuclear facilities in nuclear safety I&C applications such as: Reactor Trip System, Engineered Safety Features Actuation System, Neutron Instrumentation System, Diesel load sequencer

- **Project rationale:**
  - ***SPINLINE 3*** previously has been qualified to European standards.
  - There are differences between U.S. and European standards.

Objective of Generic Qualification (2/2)

- **The following *SPINLINE 3* hardware items will be qualified:**
  - Chassis
  - Power Supply Modules
  - Digital Processing Modules
  - Communication Modules
  - Signal Input Modules
  - Signal Output Modules
  - Signal Conditioning Modules
  - Terminal Blocks
  - Cable and Wire Sets
  - Fan Cooling Hardware
  - Power Distribution Hardware

References for Generic Qualification

- **Qualification testing will be performed in accordance with the following primary references:**
  - USNRC RG 1.89, “Environmental Qualification of Certain Electrical Equipment Important to Safety for Nuclear Power Plants”
  - USNRC RG 1.209, “Guidelines for Environmental Qualification of Safety Related Computer-Based Instrumentation and Control Systems in Nuclear Power Plants”
  - IEEE Standard 323-2003, “IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Stations”

Approach for Generic Qualification

- **The generic qualification program for the *SPINLINE 3* digital safety I&C platform uses guidance from EPRI Technical Report TR-107330, "Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants" as applicable to meet the requirements of IEEE Standard 323-2003 and other USNRC guidance.**
  - EPRI TR-107330 describes an approach for generically qualifying commercial Programmable Logic Controllers (PLCs) for safety-related applications.
  - This approach was found acceptable by the USNRC, as documented in the USNRC Safety Evaluation Report dated 30 July 1998.
  - This approach is applicable to the generic ***SPINLINE 3*** digital safety I&C platform

Scope of Qualification Testing

- Rolls-Royce will test a Qualification Test Specimen (QTS) comprised of hardware components from the generic ***SPINLINE 3*** platform.
- The QTS also will include a fit-for-purpose (non-safety) Test Specimen Application Program (TSAP) which will be running on the QTS during testing to facilitate assessing hardware status.
- QTS qualification testing will consist of the following:
  - Pre-Qualification Acceptance Testing
  - Qualification Testing
    - Radiation exposure withstand testing
    - Environmental testing
    - Seismic testing
    - EMI/RFI testing
    - Electrical fast transient testing
    - Surge withstand testing
    - Electrostatic discharge (ESD) withstand testing
    - Class 1E to Non-1E isolation testing
  - Performance Proof Testing
    - Operability testing
    - Prudency testing

Safety Functions to be Tested During Qualification

- Qualification testing is intended to demonstrate the following QTS behavior:
  - Correct functioning during normal and abnormal plant operating conditions.
  - Correct functioning includes:
    - Proper response of inputs to applied input signals,
    - Proper response of outputs to application program control,
    - Proper control of connected output devices,
    - Proper operation of communication interfaces,
    - Proper implementation of application program logic,
    - Acceptable input/output accuracy,
    - Acceptable response time,
    - Proper response to momentary interruption of input power,
    - Proper response to loss of input power,
    - Proper response to input power quality (voltage and frequency) variations,
    - Proper failover to redundant components.

Timeline for Qualification Testing

Overview of Specific Hardware Qualification Testing

Description of Qualification Testing (1/3)

- Pre-Qualification Acceptance Testing
  - Demonstrate that the ***SPINLINE 3*** QTS hardware and the Test Specimen Application Program (TSAP) operate as intended prior to start of qualification testing,
  - Provide baseline acceptance data for qualification testing implementation of the Operability and Prudency Tests
  - Follows guidance from EPRI TR-107330

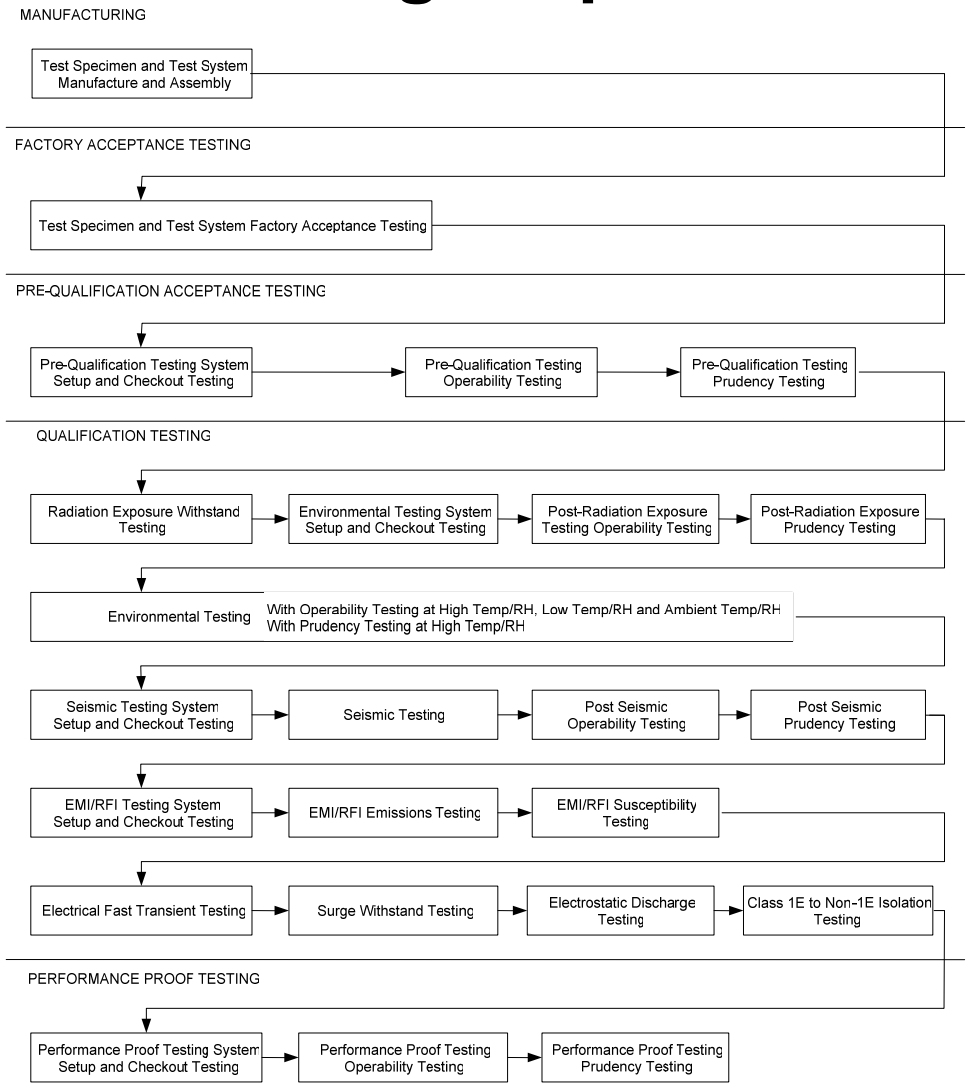
Description of Qualification Testing (2/3)

- Qualification Testing
  - Includes:
    - Radiation exposure withstand testing
    - Environmental testing
    - Seismic testing
    - EMI/RFI testing
    - Electrical fast transient testing
    - Surge withstand testing
    - Electrostatic discharge withstand testing
    - Class 1E to Non-1E isolation testing
  - RRCN has selected Wyle laboratories in Huntsville, Alabama for qualification testing performance (US national laboratory with a 10CFR50, Appendix B compliant Quality Assurance Program)
  - Uses guidance from EPRI TR-107330 as applicable to meet the requirements of IEEE Standard 323-2003 and other USNRC guidance, in particular:
    - USNRC 1.100 and IEEE Standard 344-1987 for seismic testing
    - RG 1.180 and MIL-461E for EMI/RFI emission testing
    - RG 1.180 and IEC 61000-4 series for EMI/RFI susceptibility testing, Electrical fast transient, Surge withstand testing and ESD

Description of Qualification Testing (3/3)

- Performance Proof Testing
  - Demonstrate the continuing acceptable operation and performance of the ***SPINLINE 3*** QTS following completion of all hardware qualification testing
  - As an alternative to the requirement of Section 5.5 of EPRI TR-107330, Performance Proof Testing will include a final performance of both the Operability and Prudency Test procedures following completion of all hardware qualification testing, and comparison of the test results to the results for all previous performances of the Operability and Prudency Test procedures

Qualification Testing Sequence



Rolls-Royce

Qualification Test Specimen (QTS), the Test Specimen Application Program (TSAP), and Software Qualification

Qualification Test Specimen – Hardware Modules (1/3)

- **Requirements from EPRI TR-107330:**
  - One of each module
  - Additional modules if needed to support operability / prudency testing
  - Dummy modules as needed to support the qualification

- The ***SPINLINE 3*** QTS include the following types of hardware modules and components:
  - Chassis with I/O boards for signal acquisition and generation
  - Power Distribution Hardware
  - Terminal Blocks
  - Cable and Wire Sets
  - Fan Cooling Hardware

- The QTS will include a Test Specimen Application Program (TSAP) that will be driven by a simulator during testing.

Qualification Test Specimen – Hardware Modules (2/3)

- **Signal conditioning:**
  - RTD conditioning : 8PT100 board and I.8PT100 interface board
- **Signal Acquisition:**
  - Discrete: 32ETOR TI SR board and I.32ETOR/T interface board
  - Analog: 16EANA ISO board and I.16EANA interface board
  - Pulse: ICTO board and I.ICTO interface board
- **Digital Processing:**
  - UC25 N+ board
- **Signal Generation:**
  - Discrete: 32ACT board and I.32ACT interface board, MV16 voting module and 8SRELAY relay terminal blocks
  - Analog: 6SANA ISO board and I.6SANA interface board

Qualification Test Specimen – Hardware Modules (3/3)

- **Network Communication:**
  - NERVIA daughter board and I.NERVIA interface board
- **Power Supply :**
  - ALIM 48V/5V-24V board and I.ALIM 48 interface board
- **Power Distribution Hardware:**
  - First stage to convert 120 VAC field power supply to DC power supply
  - Second stage providing 24 VDC and 48 VDC required by ***SPINLINE˚3***

Rolls-Royce

Qualification Documentation

Documents to be delivered *

RRCN Document Title	Versions: Proprietary (P); Non-proprietary (NP)	RRCN Document Number	Planned date to send to NRC
Generic *SPINLINE 3* Licensing Documents Available Upon Application			
Equipment Qualification (EQ) Plan	P	3 006 501C	Delivered Jul 09
	NP	3 006 501C-NP	
System Specification of the Qualification Test Specimen and Data Acquisition System	P	3 006 404C	Delivered Jul 09
Generic *SPINLINE 3* Licensing Documents Available Within 12 Months of Requested Approval			
QTS Master Configuration List	P	3 010 612 A	31-Mar-2010
Factory Acceptance Test Procedure	P	3 010 783 A	31-Mar-2010
Radiation Exposure Test Procedure	P	3 010 286 A	31-Mar-2010
Environmental Test Procedure	P	3 010 287 A	31-Mar-2010
Seismic Test Procedure	P	3 010 288 A	31-Mar-2010
EMI / RFI Test Procedure	P	3 010 289 A	31-Mar-2010
Electrical Fast Transient Test Procedure	P	3 010 290 A	31-Mar-2010
Surge Withstand Test Procedure	P	3 010 291 A	31-Mar-2010
Electrostatic Discharge Test Procedure	P	3 010 292 A	31-Mar-2010
Class 1E to Non-Class 1E Isolation Test Procedure	P	3 010 293 A	31-Mar-2010
System Setup and Checkout Test Procedure	P	3 010 294 A	31-Mar-2010
Operability Test Procedure	P	3 010 295 A	31-Mar-2010
Prudency Test Procedure	P	3 010 296 A	31-Mar-2010
Summary EQ Test Report	P	TBD	30-Sep-2010
	NP	TBD	

* Consistent with guidance in draft ISG-06.

Documents available for audit *

RRCN Document Title	Versions: Proprietary (P); Non-proprietary (NP)	RRCN Document Number	Planned date to send to NRC
Generic *SPINLINE 3* Licensing Documents Available for Audit			
Completed EQ Test Procedures	P	See list of EQ test procedures delivered within 12 months of requested approval	Available for audit
Equipment Mounting Details for Seismic Testing	P	3 009 634 A	Available for audit
Interconnection of Qualification Test Specimen and Data Acquisition System	P	3 010 520 A	Available for audit
Board circuits schematics	P	TBD	Available for audit
Qualification Test Specimen wiring diagrams	P	3 008 630 B	Available for audit
Data Acquisition System wiring diagrams	P	3 010 140 A	Available for audit
QTS software listing	P	TBD	Available for audit

* Consistent with guidance in draft ISG-06