

DIGITAL INSTRUMENTATION AND CONTROLS UPDATE

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Advisory Committee on Reactor Safeguards

DI&C Subcommittee Briefing

May 17, 2018

Agenda

- Introductions
- Integrated Action Plan
- Draft DI&C ISG-06 Presentation
- Common Cause Failure Status Update
- Next Steps

Key Messages

- Making progress on Integrated Action Plan (IAP) activities
- Focused on regulatory products to support near-term upgrade needs identified by industry
- First implementable result targets safety-related upgrades under 10 CFR 50.59 (i.e., RIS supplement)
- Next priority is revised licensing process (ISG-06)
- Staff will continue to pursue broader modernization efforts

Commission Direction on Digital I&C

(SRM-SECY-15-0106 & SRM-SECY-16-0070)

- Develop an integrated strategy to modernize the DI&C regulatory infrastructure
- Engage stakeholders to identify common priorities, problems, and potential solutions to address them
- Focus on acceptable approaches to comply with requirements
- Technology neutral focus; Guidance can be tailored if necessary
- Evaluate potential policy issues

IAP – Modernization Plans

- **Modernization Plan (MP) #1 – Protection against Common Cause Failure**
 - **MP #1A – Regulatory Issue Summary (RIS) 2002-22, Supplement 1**
 - **MP #1B – Review of NEI 16-16**
 - **MP #1C – Implementing Commission Policy on Protection against CCF in DI&C Systems**
- MP #2 – Considering Digital Instrumentation & Controls in Accordance with 10 CFR 50.59
- MP #3 – Acceptance of Digital Equipment (Commercial Grade Dedication)
- **MP #4 – Assessment for Modernization of the Instrumentation & Controls Regulatory Infrastructure**
 - **MP #4A – ISG-06 Revision**
 - MP #4B – Broader Modernization Activities

MP #4A– Draft ISG-06, “Licensing Process” Revision 2

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Advisory Committee on Reactor Safeguards

DI&C Subcommittee Briefing

May 17, 2018

Agenda

- ISG-06 Scope and Purpose
- Digital I&C Integrated Action Plan
- Background
- ISG-06, Revision 2 (Draft)
 - Improved Review Process
 - New Alternate Review Process (for Approval at earlier development stage)
- Next Steps

ISG-06 Purpose and Scope

- Defines the licensing process used to support the review of LARs associated with safety-related DI&C equipment modifications in operating plants and in new plants once they become operational
- Provides guidance for activities performed before LAR submittal and during LAR review. The NRC staff uses the process described in the ISG to evaluate compliance with NRC regulations

DI&C Integrated Action Plan

- The IAP established the following ISG-06 revision goals:
 - To reduce the scope of licensee document submittals
 - To provide an alternative for earlier approval, which would precede factory acceptance testing, for digital designs that are based on approved topical reports
- The Modernization Plan #4A working group under the IAP worked with industry and internal stakeholders to improve the licensing process in ISG-06
- ISG-06 revision results:
 - The ISG-06 Rev. 1 “Tier 1, 2, and 3 Review Process” has been improved
 - A new “Alternate Review Process” has been introduced for earlier approval

Background

- ISG-06 Rev. 1 Key Concepts
 - Tiers
 - Phases
- ISG-06 Rev. 1 Lessons Learned and Industry Feedback

ISG-06 Rev. 1 – Key Concepts

Tiers

Tiers – a general guide for defining the scope or complexity of a review.

- Tier 1 – license amendments proposing to reference a previously approved topical report.
- Tier 2 – license amendments proposing to reference a previously approved topical report with deviations to suit the plant specific application.
- Tier 3 – license amendments proposing to use a new digital I&C platform or component(s) not previously approved by an NRC topical report review.

ISG-06 Rev. 1 – Key Concepts

Phases

Phases – a general guide for defining the NRC staff activities to be performed during the review.

- Phase 0 – Pre-Application
 - Phase 1 – Initial Application (LAR)
 - Phase 2 – Continued Review and Audit (Supplemental Information)
 - Phase 3 – Implementation and Inspection
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ISG-06 Rev. 1 – Lessons Learned and Industry Feedback

- ISG-06, Rev. 1 has been used to review the Diablo Canyon Plant Protection System DI&C LAR (ADAMS Accession No. ML16139A008), the Hope Creek Power Range Neutron Monitoring System LAR (ADAMS Accession No. ML17216A022), and DI&C topical report reviews
- The concepts of tier labels and review phases are useful
- The “one-stop shop” approach of Revision 1 created challenges:
 - Duplication of SRP Chapter 7, IEEE Std 603 and IEEE Std 7-4.3.2 guidance
 - References to Regulatory Guides and other documents became outdated
 - Revision 1 focused more on specific documents, instead of the information needed to make the required regulatory findings

ISG-06 Rev. 1 – Lessons Learned and Industry Feedback (Cont.)

- The Tier 1, 2 and 3 Review Process could be further improved/streamlined
- Industry has expressed concerns with ISG-06, Rev. 1:
 - Significant resources are required for procuring, developing, and testing a full digital I&C design before the license amendment is issued
- Staff lessons learned, and industry feedback on Revision 1 informed the development of ISG-06, Revision 2

ISG-06 Review Process Focus

ISG-06, Rev. 1 (current)

Tier 1, 2, and 3 Review Process

Approved Platform
Topical Report
(Previously Approved for Tier 1 and 2)
(Concurrent Review for Tier 3)

Application Specific
System Design meets
Regulatory Requirements

Application Software
Design, Implementation
and Test Plans and
Processes are Acceptable

Application System
Development and Testing
produced Acceptable
Outputs

ISG-06, Rev. 2

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Application Specific
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ISG-06, Rev. 2

Alternate Review Process

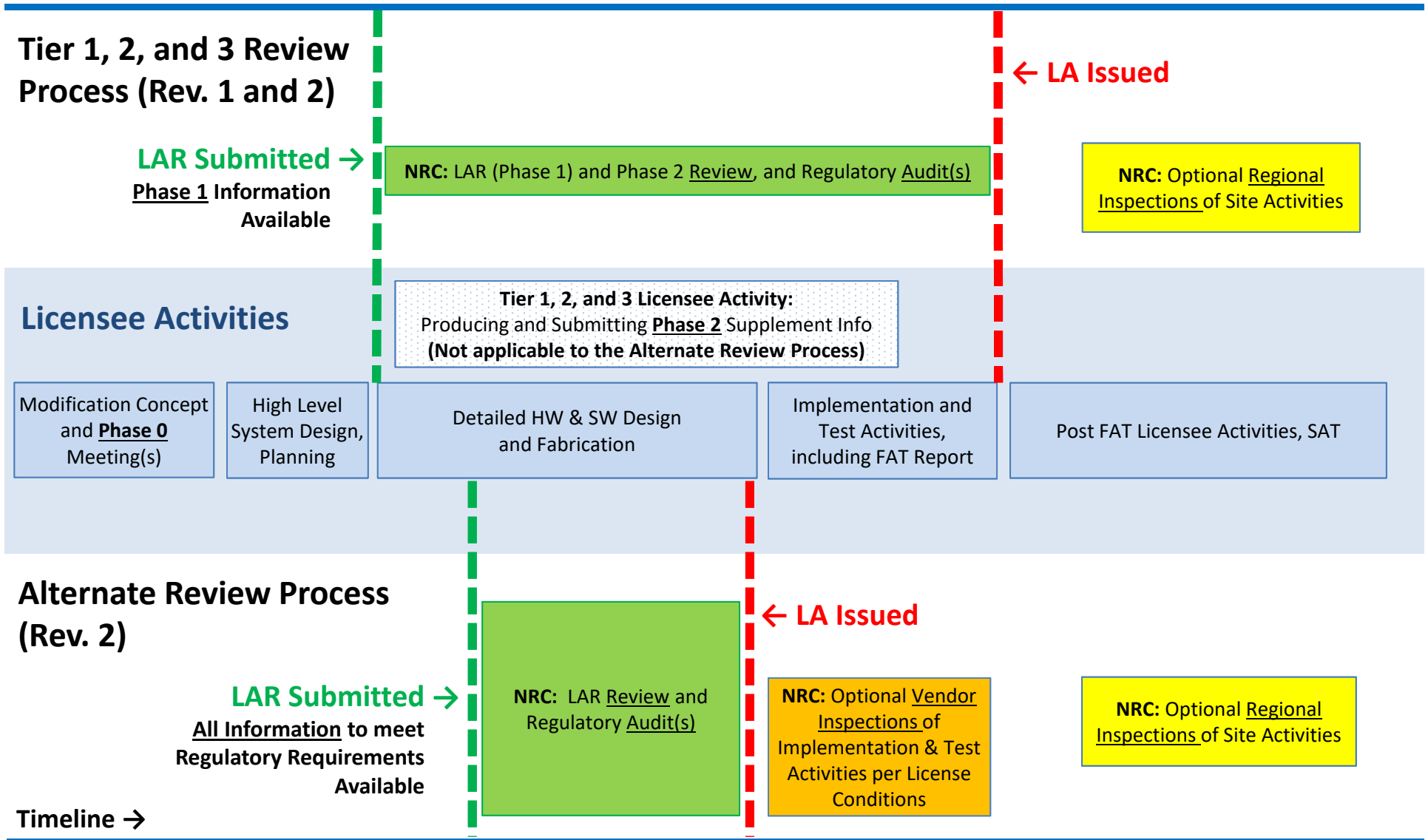
Approved Platform
Topical Report
(Previously Approved)

Application Specific
System Design meets
Regulatory Requirements

Application Software
Design, Implementation
and Test Plans and
Processes are Acceptable

Comparison of Licensing and Oversight Activities

Timeline →



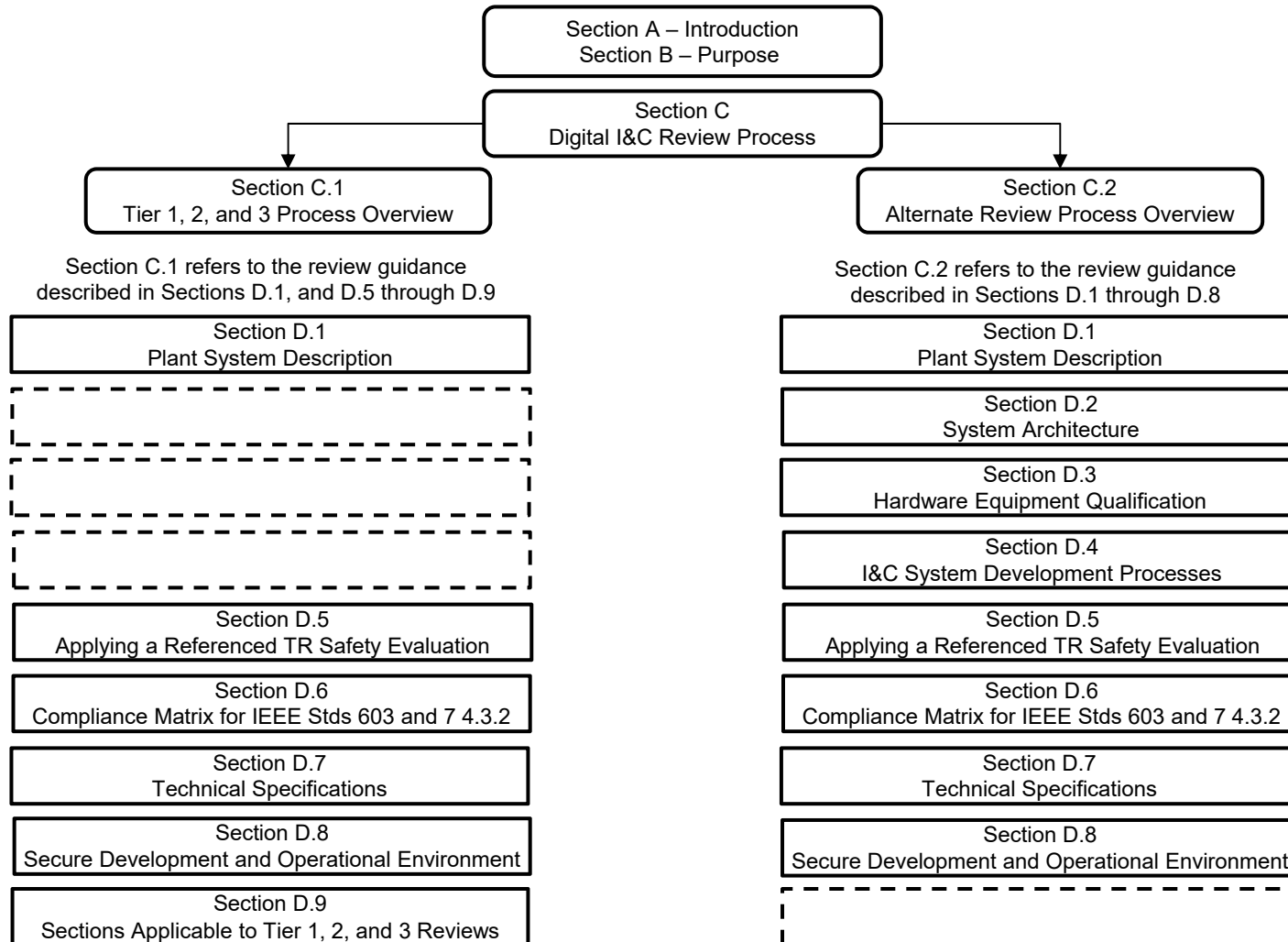
Characteristics of a LAR using the Alternate Review Process

- The LAR would provide the necessary and sufficient design information to demonstrate regulatory compliance
 - The LAR would describe the licensee's Vendor Oversight Plan that ensures the vendor executes the project consistent with the LAR and the requirements of the 2015 version of NQA 1, Part II Subpart 2.7 on Quality Assurance Requirements for Computer Software for Nuclear Facility Applications
 - The LAR would include appropriate commitments to complete plant specific actions that are included in the referenced topical report
 - The LAR would include appropriate commitments to complete lifecycle activities under the licensee's QA program
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Alternate Review Process: Licensee Commitments and License Conditions

- The Alternate Review Process relies on the LARs containing licensing information and additional regulatory commitments to implement remaining development phases by the licensee's QA program, after the license amendment is issued
- The NRC staff may likely translate some of the regulatory-significant commitments into license conditions, as part of the approval (e.g., factory acceptance testing)

ISG-06 Rev. 2 Structure



ISG-06, Rev 2, Enclosure B Tables

	AR	Tier			Plant-Specific Information Submitted with License Amendment Request (Phase 1 for Tier 1, Tier 2, Tier 3)
		1	2	3	
1.1	X				System Architecture (D.2)
1.2	X				(Summary of) Application Software Planning and Processes (D.4)
1.3	X				(Summary of) Hardware Equipment Qualification (D.3)
1.4	X	X	X		Approved Topical Report Safety Evaluation (D.5)
1.5	X	X	X	X	System Description (D.1)
1.6	X	X	X	X	(Unified Compliance Matrix for) IEEE Stds 603 and 7-4.3.2 (D.6)
1.7	X	X	X	X	(Changes to) Technical Specifications (D.7)
1.8	X	X	X	X	Setpoint Methodology and Calculations (D.7)
1.9	X	X	X	X	Secure Development and Operational Environment (D.8)
1.10		X	X	X	Software Requirements Specification (D.9.1)
1.11		X	X	X	Software Design Specification (D.9.2)
1.12		X	X	X	Design Analysis Reports for Platform Changes (D.9.3)
1.13		X	X	X	System Response Time Analysis Report (D.9.7)
1.14			X	X	Design Report on Computer Integrity, Test and Calibration, and Fault Detection (D.9.7)
1.15				X	Commercial-Grade Dedication Plan (D.9.10)
1.16				X	Quality Assurance Plan for Hardware (D.9.11)
1.17				X	Equipment Qualification Testing Plans (Including EMI, Temp., Humidity, and Seismic) (D.9.9)
1.18				X	(Summary of) Hardware Development Process (D.9.11)

	Tier			Phase 2 – Submitted before Requested Approval (Tier 1, Tier 2, Tier 3 only) Note: This table does not apply to Alternate Review Process applications.
	1	2	3	
2.1	X	X	X	Safety Analysis (D.9.4)
2.2	X	X	X	As-Manufactured, System Configuration Documentation (D.9.5)
2.3	X	X	X	Summary Test Reports (Including Test Results up to FAT) (D.9.6)
2.4	X	X	X	System Response Time Confirmation Report (D.9.7)
2.5	X	X	X	Reliability Analysis (D.9.7)
2.6	X	X	X	System-Level Failure Modes and Effects Analysis (D.9.8)
2.7	X	X	X	Qualification Test Methodologies (D.9.9)
2.8		X	X	Platform-Level Failure Modes and Effects Analysis (D.9.8)
2.9		X	X	(Summary of) EMI, Temp., Humidity, and Seismic Testing Results (D.9.9)
2.10			X	Commercial-Grade Dedication Report(s) (D.9.10)

Alternate Review Process: System Architecture – Fundamental Design Principles

- Four fundamental design principles integrated into Alternate Review Process
 - Verify the design applies sufficient redundancy in the new architecture (ISG-06 Rev. 2, Section D.2.6.2.1)
 - Verify the design demonstrate physical, electrical, data communications and functional independence in the new architecture (D.2.2, D.2.5, D.2.6.2.2)
 - Verify design exhibits deterministic behavior (D.2.2.1, D.2.6.2.3)
 - Verify the design has sufficient diversity and defense-in-depth in the new architecture to ensure safety is maintained in the event of a postulated common cause failure (D.2.6.2.4)

Alternate Review Process: System Architecture – Simplicity

- Simplicity in design included in Alternate Review Process (D.2.6.2.5)
 - Application of simplicity in the new architecture (or lack thereof) and affect on four fundamental design principles.
 - If design decisions result in added complexity, balance with benefits obtained.

Licensing and Oversight Comparison Summary

	Tier 1, 2, and 3 Review Process	Alternate Review Process
<i>Document Submittals</i>	2 Submittals (LAR – Phase 1) (Supplement – Phase 2)	1 Submittal (LAR)
<i>Design Changes After LAR Submittal</i>	Design changes submitted during the Phase 2 review (before FAT) can be reviewed as part of the LAR review	Design changes during Implementation and Testing phases will need to be performed under 10 CFR 50.59, or new LAR approval
<i>License Conditions</i>	None (Typically)	Potentially: <ul style="list-style-type: none"> • Implementation of high quality software development process (e.g., NQA-1-2015) • Vendor oversight • Resolution of plant specific action items identified in the topical report • Implementation and Test activities (e.g., FAT)
<i>Inspection Scope</i>	<ul style="list-style-type: none"> • <u>Regional Inspection</u> of Post FAT Licensee Activities (e.g., Installation, Maintenance, Training, Operations, Plans, SAT) 	<ul style="list-style-type: none"> • <u>Vendor Inspection</u> of Implementation, Integration, and Test Activities (e.g. FAT) • <u>Regional Inspection</u> of Post FAT Licensee Activities (e.g., Installation, Maintenance, Training, Operations, Plans, SAT)

Next Steps

- ACRS Full Committee Briefing on June 6, 2018
- Table top exercise with industry on June 13-14, 2018
- Issue the draft ISG for formal public comment in July 2018
- Engage utilities in pre-application meetings
 - LAR submittal from lead-plant using the alternate review process is expected in 2019
 - Additional LAR submittals expected beyond 2019
- Exercise ISG and incorporate into Standard Review Plan

Questions?

Acronyms

- ACRS – Advisory Commission on Reactor Safeguards
- ADAMS - Agencywide Document Access and Management System
- CCF – Common Cause Failure
- CFR – Code of Federal Regulations
- DI&C – Digital Instrumentation and Control
- EMI – Electromagnetic Interference
- FAT – Factory Acceptance Test
- IAP – Integrated Action Plan
- IEEE – Institute of Electrical and Electronics Engineers
- ISG – Interim Staff Guidance
- I&C – Instrumentation and Control
- LAR – License Amendment Request
- MP – Modernization Plan
- NEI – Nuclear Energy Institute
- NQA – Nuclear Quality Assurance
- NRC – Nuclear Regulatory Commission
- QA – Quality Assurance
- SAT – Site Acceptance Test
- SRM – Staff Requirements Memoranda
- SRP – Standard Review Plan
- SSC – Structures, systems, and components
- TR – Topical Report