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AP1000 Construction

Translating Technical Requirements and Licensing Commitments into Construction

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Region II
July 28, 2016

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Agenda

- Overview of design implementation at AP1000 construction sites
- Examples of inspection findings associated with translation of structural code requirements into final design output documents
- Digital I&C inspection implementation

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Overview

- Vogtle Units 3 & 4 and V.C. Summer Units 2 & 3 are first AP1000 Plants under construction in U.S.
- Both plants licensed under 10 CFR 52 and reference AP1000 design certification document (Pt. 52, App. D)
- The detailed design of structures, systems, and components must comply with AP1000 DCD Tier 1 & Tier 2* information, including applicable codes and standards, and Inspections, Tests, Analysis and Acceptance Criteria (ITAAC)

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Overview

- The importance of design control to safety is reflected in quality assurance requirements and the construction reactor oversight process (cROP)
  - Design Control one of 18 Quality Assurance Criteria in 10 CFR Part 50, Appendix B
  - Design/Engineering one of six cornerstones of safety identified in cROP

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Overview

AP1000 design implementation during construction verified through:

- Routine ITAAC and programmatic inspections conducted by regional and resident inspectors in accordance with IMC 2503 and 2504
  - Review final construction documents
  - Review design deviations (disposition of nonconformances) and design change documents
- Engineering Design Verification (EDV) and ITAAC inspections conducted at vendor facilities in accordance with IMC 2507 and IMC 2503

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Overview

Current status of AP1000 construction sites:

- 14 NRC identified violations associated with design control since implementation of cROP (6 Vogtle & 8 V.C. Summer)
- All violations of Very Low Safety Significance (Green)
- Both Plants currently in Licensee Response Column of Construction Action Matrix

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Structural Inspection Examples

Anchorage and spacing of headed shear reinforcement in structural components of the nuclear island not in compliance with licensing basis (NCV 05200027/2013010-01)

- Bars used to resist out of plane shear forces in slabs and walls
- Typically used to enhance constructability/ alleviate congestion
- Anchorage and spacing not in compliance with Tier 2* code - ACI 349-01
- Bars too short and spaced too far apart to be fully effective

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Structural Inspection Examples, cont.

Issue Resolution

- Adopt alternate acceptance criteria provided in ACI 318-11.
- Revise design as necessary where does not meet ACI 318-11 criteria for headed reinforcement
- LAR (License Amendment 5) required due to departure from Tier 2* information (ACI 349-01)

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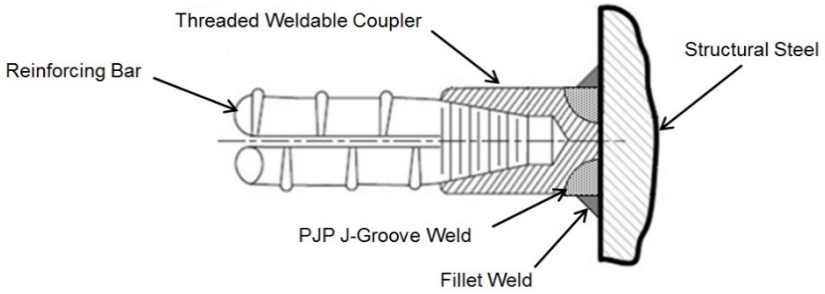
Structural Inspection Examples, cont.

Weld allowable stress calculation not in compliance with licensing basis (NCV 05200025/2015002-01)



- Design of weld attaching mechanical coupler to steel plate not in compliance with Tier 2* code - AISC N690-94
- Embedments used to transmit loads to concrete structures
- Identified at V.C. Summer but affected both sites

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Structural Inspection Examples, cont.

Issue Resolution

- Destructive testing of weld to verify sufficient capacity and to support approval of special system of design or construction in accordance with AISC N690-94

- LAR (License amendment 40) due to departure from Tier 2* information (AISC N690-94)

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AP1000
Digital I&C ITAAC Inspection

Region II

July 28, 2016

Background

- IP 65001.22, Inspection of Digital Instrumentation and Control (DI&C), Issued 12/19/2011
- Front-Load Approach – Series of programmatic, implementation, and in-process testing observations
- Sampling Focus – System/Software life cycle attributes and design outputs. For DI&C, there is reliance on the Licensee having a rigorous process and Independent Verification & Validation (IV&V) program
- Inspection Emphasis: Process, Configuration Management, IV&V, Traceability throughout the development life cycle

Inspection Strategy

- Inspections driven by milestones
- Milestones coincide with IP 65001.22 Appendices 1-6 also modeled as system/software life cycle phases:
  - Planning Phase (Milestone 1)
  - Requirements Phase (Milestone 2)
  - Design & Implementation Phase (Milestone 3)
  - Integration Phase (Milestone 4)
  - Validation & Testing Phase (Milestone 5)
  - Installation Phase
- Inspections consist of a coordinated effort between Region II and NRO

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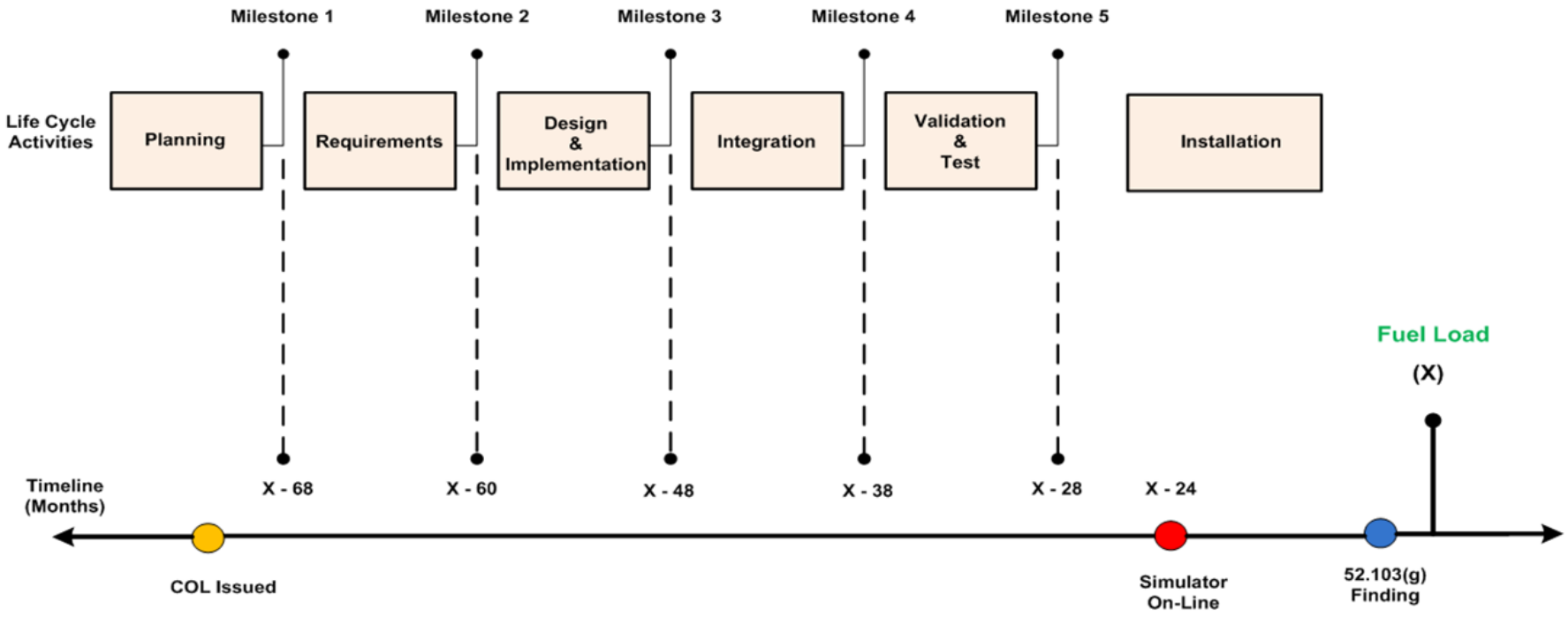
DI&C Inspection Strategy



Digital I&C Development and Inspection Chronology

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DI&C Inspection Examples

- Protection and Safety Monitoring System (PMS) Requirements Phase Inspection (Vogtle 3&4 @ Westinghouse) - May 2012
- Results: NOV, Green ITAAC Finding (ITAAC 2.5.02.11.b, 2.5.2.12)
- Inadequate translation of requirements contained in:
  - IEEE 1012, Software Verification and Validation
  - ASME NQA-1, Quality Assurance Program Requirements
  - IEEE 1074, Developing Software Life Cycle Processes
  - IEEE 803, Software Requirements Specification
- Issue Resolution: IV&V tasks and reports were completed; Traceability to Software Requirements Specification completed; Training on key processes, industry codes and standards; and Mapping of codes and standards to process and procedures performed.

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DI&C Inspection Examples, cont.

- PMS Design, Implementation, and Testing Inspection (Vogtle 3&4 and VC Summer 2&3 @ Westinghouse) - March 2015
- Results: Notice of Nonconformance
- Inadequate Equipment Qualification associated with:
  - Current Transients in Isolation Devices
  - Electromagnetic Compatibility Testing for PMS Cabinets
  - Dedication of M&TE used for EMC Testing Services
- Corrective actions are in-process and will be verified by inspection