AP1000 I&C Testing Strategy

Public Session

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Agenda

- Safety
- I&C Testing Licensing Basis
  - Regulatory Guides & Industry Codes and Standards
  - Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC)
- Testing Methodology

Safety

- Nuclear Safety and Construction Principle
- Uncharted Seamounts

Uncharted Seamounts
Ever Vigilant

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Prelude

On January 5th, 2005, a United States Naval Service Los Angeles Class Fast Attack Submarine, operating from Guam Naval Station, received orders to proceed to Brisbane Australia for a 5 day port call.

The good ship and crew pulled all the charts they needed and devised a voyage plan.

On January 7th, 2005, after an uneventful reactor startup the maneuvering watch was set and the ship left the harbor at Guam.

Prior Planning Prevents Poor Performance

Event

January 8th, in transit, at or about 525 ft depth, answering ahead flank, the fathometer indicated about 935 Fathoms of water beneath the keel. The charts in use by the Navigation team indicated that there should have been about 1200 to 1300 fathoms of water beneath the keel. Readings were taken every 15 minutes.

No action was taken to reduce depth, reduce speed, or verify the charts.

At 1142, the USS San Francisco collided with an uncharted seamount.

2 distinct impacts

Aftermath

One Fatality, 98 injuries (crew of 137)

Post Mortem

- Navigation Chart in use did not show the seamount
- Other information on board would have warned the crew of other obstacles in their path.
- Platted course was in close proximity to Caroline Islands
- Commanding Officers Night Orders authorized “Full”.
- Officer of the Deck ordered Flank to “get ahead” of plot to allow for Drills.

Lots of small links in the accident chain

Discussion

I&C Testing Licensing Basis

Regulatory Guides & Industry Codes and Standards

- Applicable Regulatory Guides (RG) are included in UFSAR Appendix 1A, Chapter 7 and Chapter 14. Primary RGs related to I&C testing are:
  - 1.68 Initial Test Programs for Water-Cooled Nuclear Power Plants
  - 1.168 Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants
  - 1.170 Software Test Documentation for Digital Computer Software Used in Safety Systems of Nuclear Power Plants
  - 1.171 Software Unit Testing for Digital Computer Software Used in Safety Systems of Nuclear Power Plants
  - 1.173 Developing Software Life Cycle Processes for Digital Computer Software Used in Safety Systems of Nuclear Power Plants

Regulatory Guides & Industry Codes and Standards

- Applicable IEEE Standards are described in UFSAR Chapter 7. Primary Standards are:
  - 7-4.3.2 IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations
  - 1012 IEEE Standard for System and Software Verification and Validation
  - 829 IEEE Standard for Software and System Test Documentation

ITAACs

- ITAACs are described in COL Appendix C
- Main ITAACs to be discussed today are:
  - AP1000 Protection and Safety Monitoring System (PMS)
  - AP1000 Plant Control System (PLS)

I&C Testing Methodology

Testing Methodology

- Overall testing methodology is described in UFSAR. Specific safety system tests includes those described in Westinghouse documents:
  - WCAP-16096, “Software Program Manual for Common Q Systems”
  - APP-PMS-T5-001, “AP1000 Protection and Safety Monitoring System Test Plan”
  - WNA-PT-00058-GEN, “Testing Process for Common Q Safety Systems”
  - WNA-PV-00009-GEN, “Verification and Validation Process for the Common Q Safety Systems”

Questions