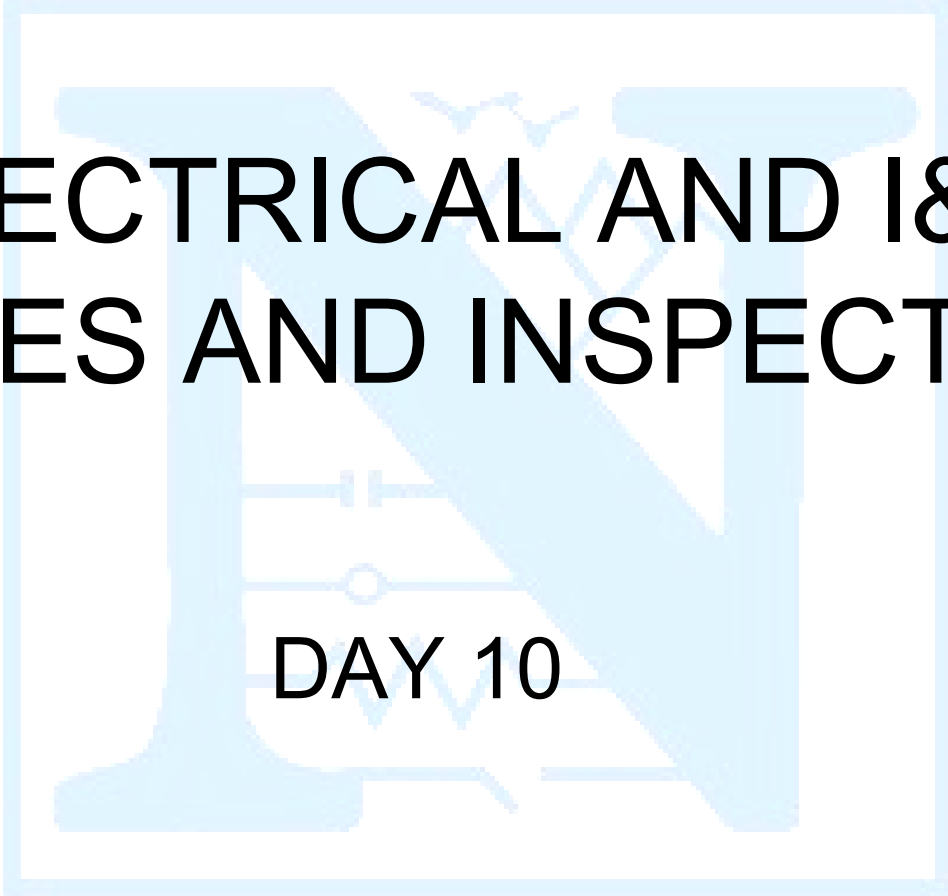




ELECTRICAL AND I&C CODES AND INSPECTION



DAY 10

DAY 10

Sessions:

- 23. Overview of International Standards
- 24. Case Studies of Construction Related Issues
- 25. Course Summary Review

DAY 10

Sessions:

26. Quiz

27. Inspector Qualification Cards

23. Overview of International Standards



23. Overview of International Standards Objectives

- Identify typical International Standards
- Provide a general overview of the purpose of these standards
- Discuss how these standards may relate to new reactor inspection in the future

23. Overview of International Standards



IEC	International Electrotechnical Commission
IAEA	International Atomic Energy Agency

International Electrotechnical Commission

- 
- 
- 94 Technical Committees
 - 80 Subcommittees

International Electrotechnical Commission

- Sample of IEC Electrical Power Standards
 - IEC 60034, Synchronous machines
 - IEC 60076, Power transformers
 - IEC 60439-1, MCC
 - IEC 60502, MV power cables



IEC 60034 – Rotating Electric Machinery

- IEC 60034-1 covers general requirements for all rotating electrical machinery
- IEC 60034-3 cylindrical rotor synchronous machines to be applied with steam and combustion turbines.
- IEEE/ANSI C50.13- 2005 covers cylindrical-rotor synchronous generators driven by steam and combustion turbines.

IEC 60529, Degree of Protection Provided by Enclosures

- IEC Enclosure Classifications do not have a one-for-one equivalent to the Types in NEMA 250, Enclosures for Electrical Equipment

International Electrotechnical Commission

- Sample of IEC Power Standards
 - IEC 60529, Enclosures
 - IEC 61508, Functional safety of electrical/electronic/programmable electronic safety-related systems
 - IEC 61800, Adjustable Speed Drives

International Electrotechnical Commission

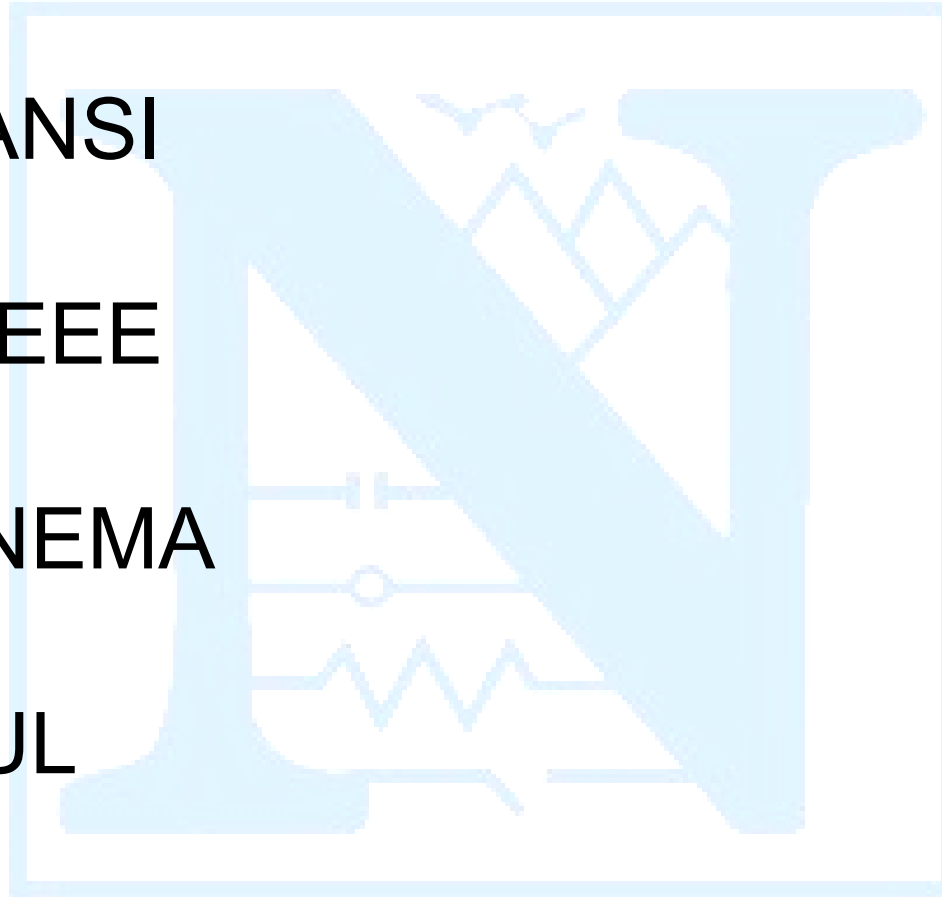
- IEC 62040-3, UPS, Part 3: Method of specifying the performance and test requirements
- IEC 62271, High-voltage switchgear
- IEC 62305, Protection against lightning

International Electrotechnical Commission

- Sample IEC I&C Standards
 - IEC 12207 Standard for Information Technology Software Life Cycle Processes
 - IEC 61000 Electromagnetic Compatibility

Cooperation with IEC Technical Committees

- ANSI
- IEEE
- NEMA
- UL



CATEGORIES IN THE IAEA SAFETY SERIES

- 
- Safety Fundamentals
 - Safety Standards
 - Safety Guides
 - Safety Practices
- 

International Atomic Energy Agency

- Safety Fundamentals
 - Thematic Areas
 - Facilities and Activities

Facilities and Activities

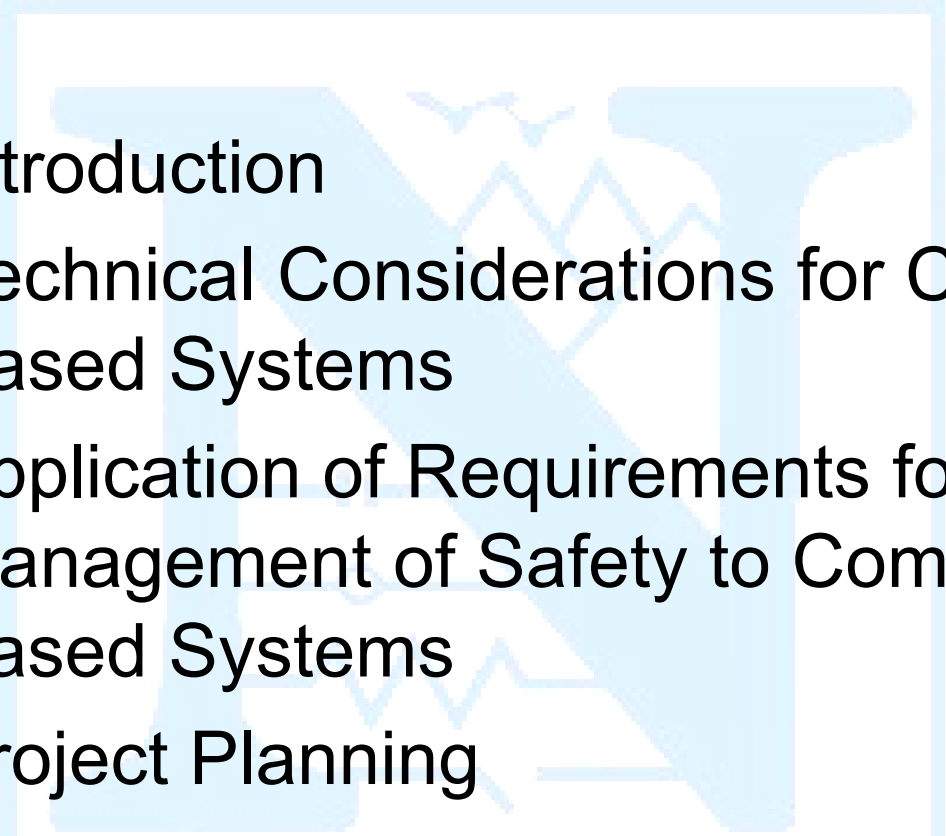
- Nuclear Power Plant Design
- Nuclear Power Plant Operation

IAEA Nuclear Power Plant Design Safety Standards

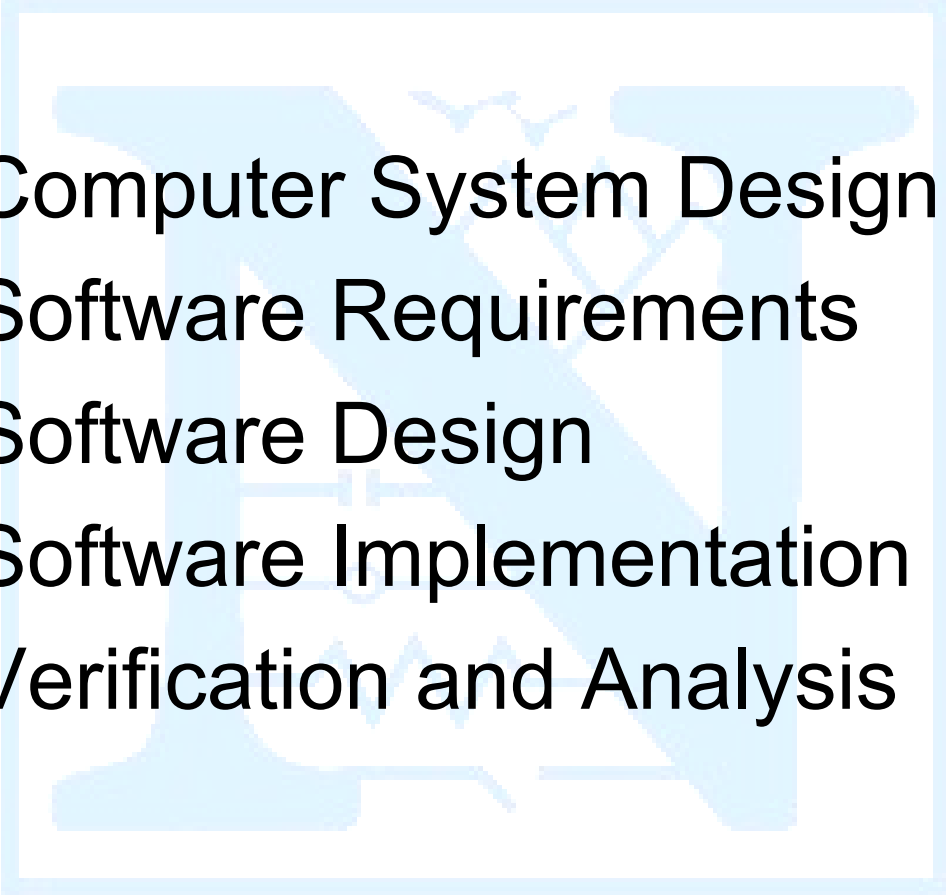
- IAEA NS-G 1.1 Software
- IAEA NS-G 1.3 I&C
- IAEA NS-G 1.6 Seismic Qualification
- IAEA NS-G 1.8 Emergency Power System



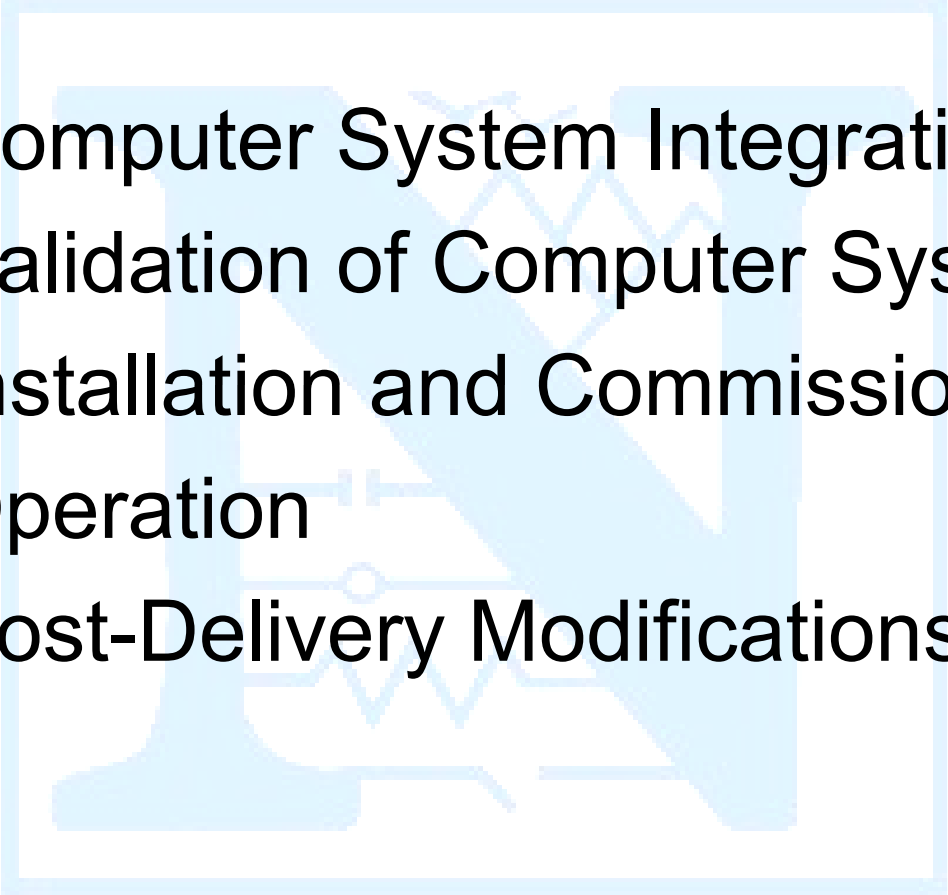
IAEA NS-G 1.1 Software

- 
1. Introduction
 2. Technical Considerations for Computer Based Systems
 3. Application of Requirements for Management of Safety to Computer Based Systems
 4. Project Planning
 5. Computer System Requirements

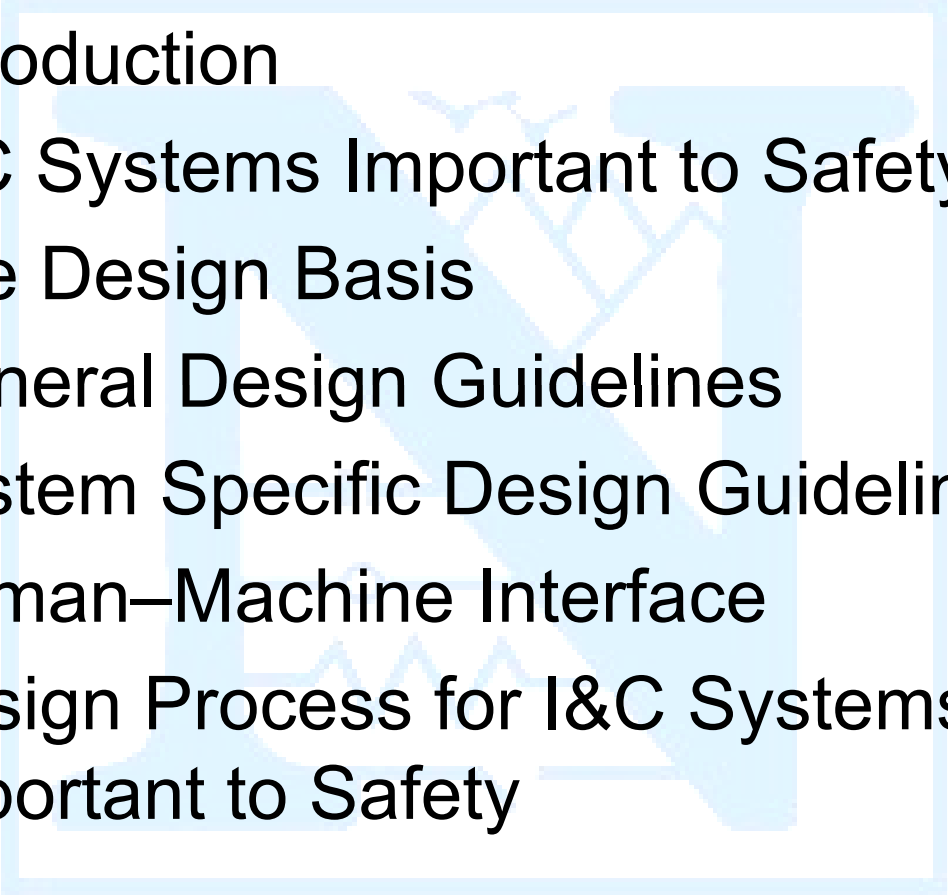
IAEA NS-G 1.1 Software

- 
- 
- 6. Computer System Design
 - 7. Software Requirements
 - 8. Software Design
 - 9. Software Implementation
 - 10. Verification and Analysis

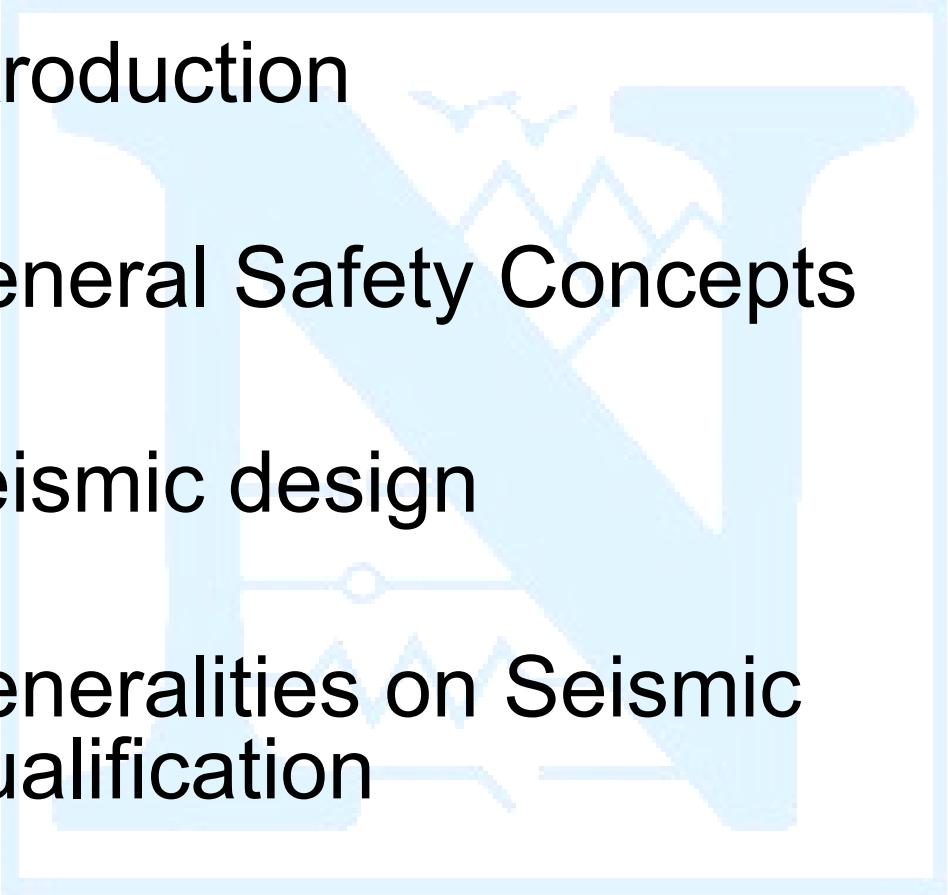
IAEA NS-G 1.1 Software

- 
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- 11. Computer System Integration
 - 12. Validation of Computer Systems
 - 13. Installation and Commissioning
 - 14. Operation
 - 15. Post-Delivery Modifications

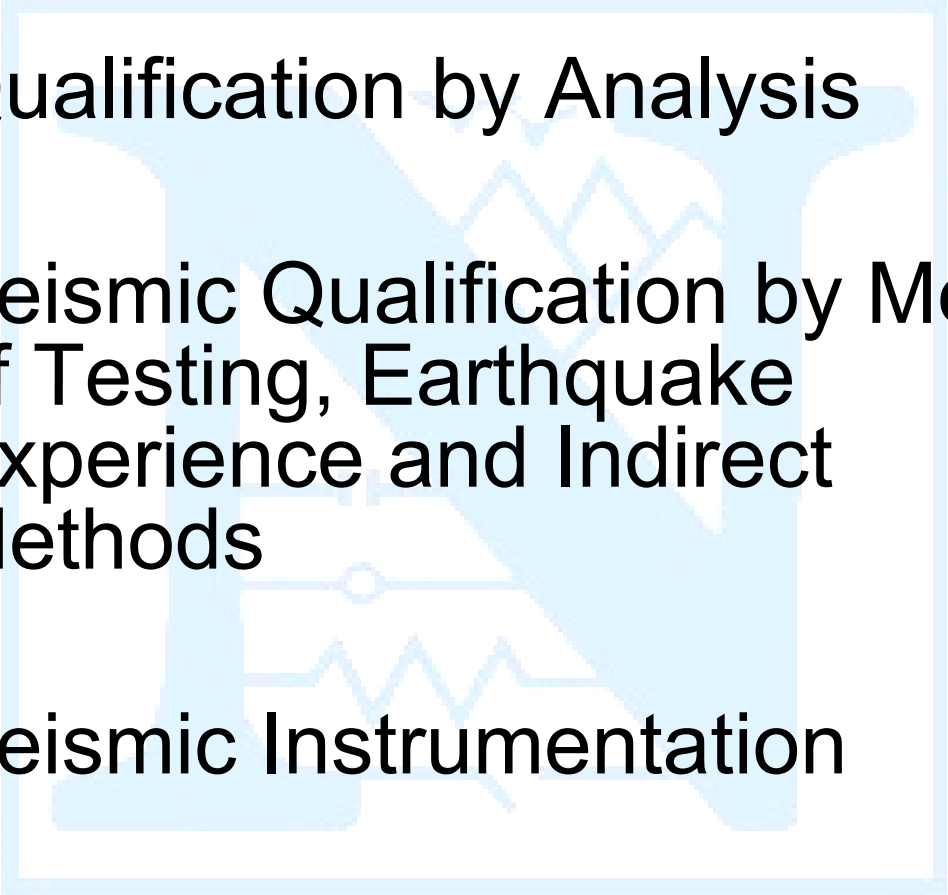
IAEA NS-G 1.3 I&C Systems Important to Safety in NPP

- 
- 
1. Introduction
 2. I&C Systems Important to Safety
 3. The Design Basis
 4. General Design Guidelines
 5. System Specific Design Guidelines
 6. Human–Machine Interface
 7. Design Process for I&C Systems Important to Safety

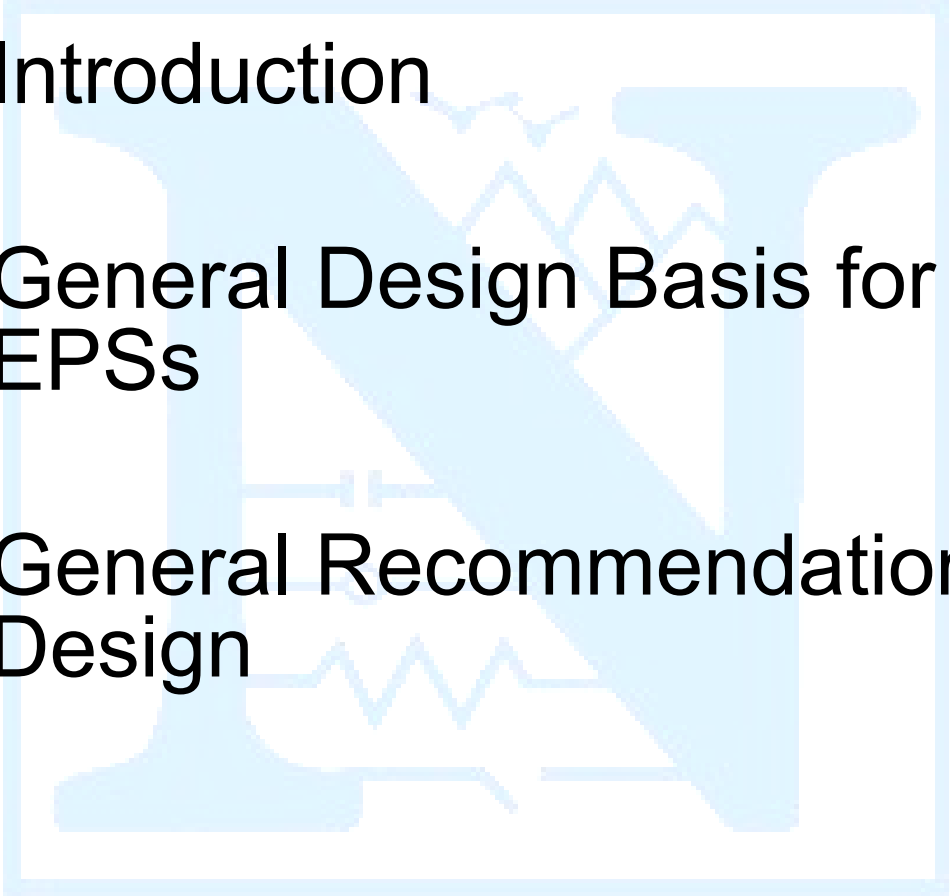
IAEA NS-G 1.6 Seismic Design and Qualification

- 
- 
1. Introduction
 2. General Safety Concepts
 3. Seismic design
 4. Generalities on Seismic Qualification

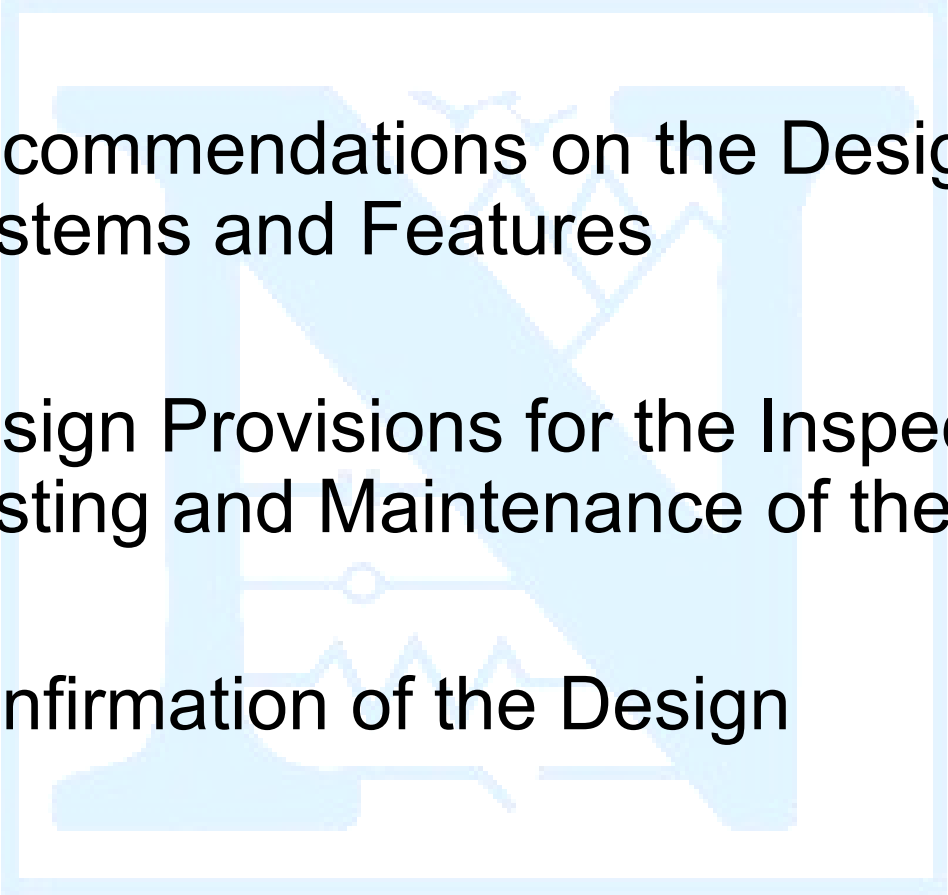
IAEA NS-G 1.6 Seismic Design and Qualification

- 
- 
- 5. Qualification by Analysis
 - 6. Seismic Qualification by Means of Testing, Earthquake Experience and Indirect Methods
 - 7. Seismic Instrumentation

IAEA NS-G 1.8 Design of Emergency Power Systems

- 
- 
1. Introduction
 2. General Design Basis for EPSs
 3. General Recommendations on Design

IAEA NS-G 1.8 Design of Emergency Power Systems

- 
- 
4. Recommendations on the Design of Systems and Features
 5. Design Provisions for the Inspection, Testing and Maintenance of the EPSs
 6. Confirmation of the Design

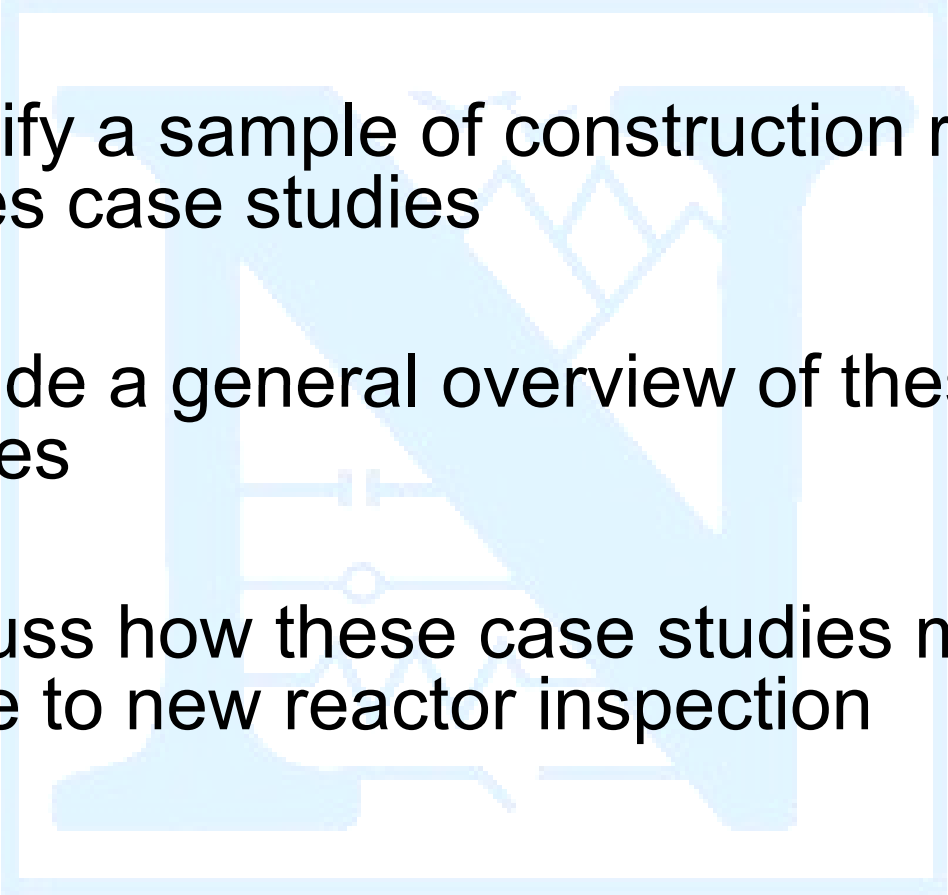
23. Overview of International Standards Objectives Review

- Identified typical international standards
- Provided a general overview of the purpose of these standards
- Discussed how these standards may relate to new reactor inspection in the future

24. Case Studies of Construction Related Issues



24. Case Studies of Construction Related Issues Objectives

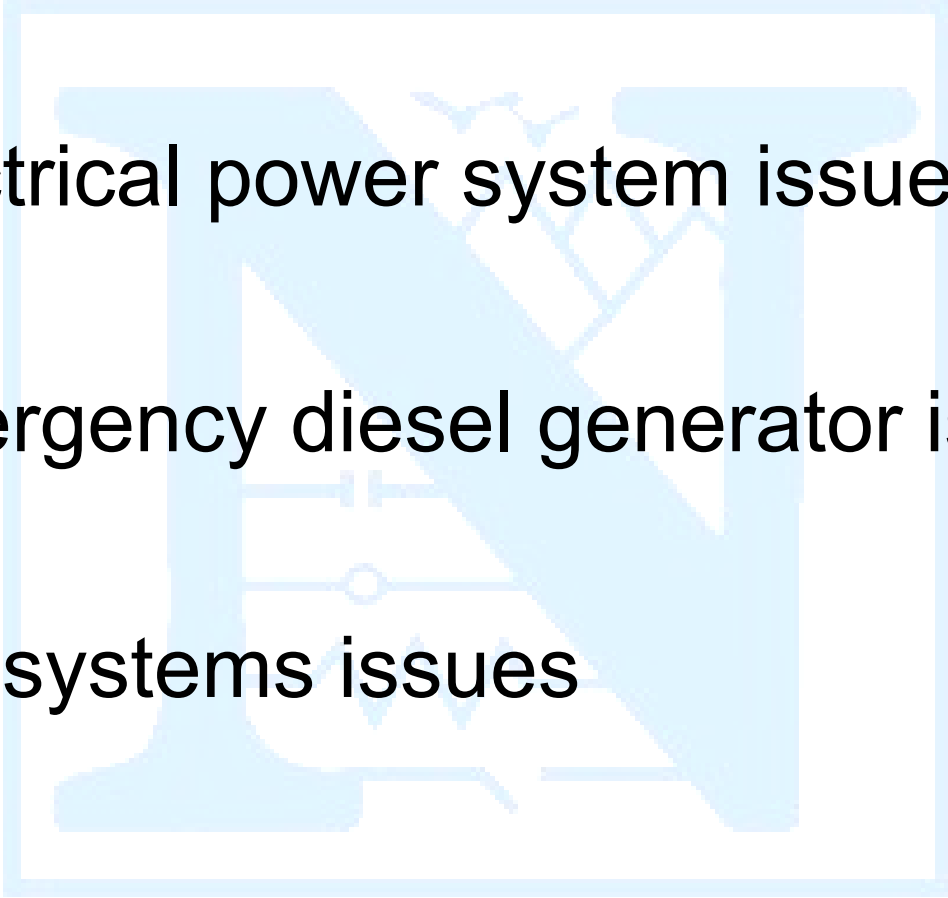
- 
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- Identify a sample of construction related issues case studies
 - Provide a general overview of these case studies
 - Discuss how these case studies may relate to new reactor inspection

24. Case Studies of Construction Related Issues

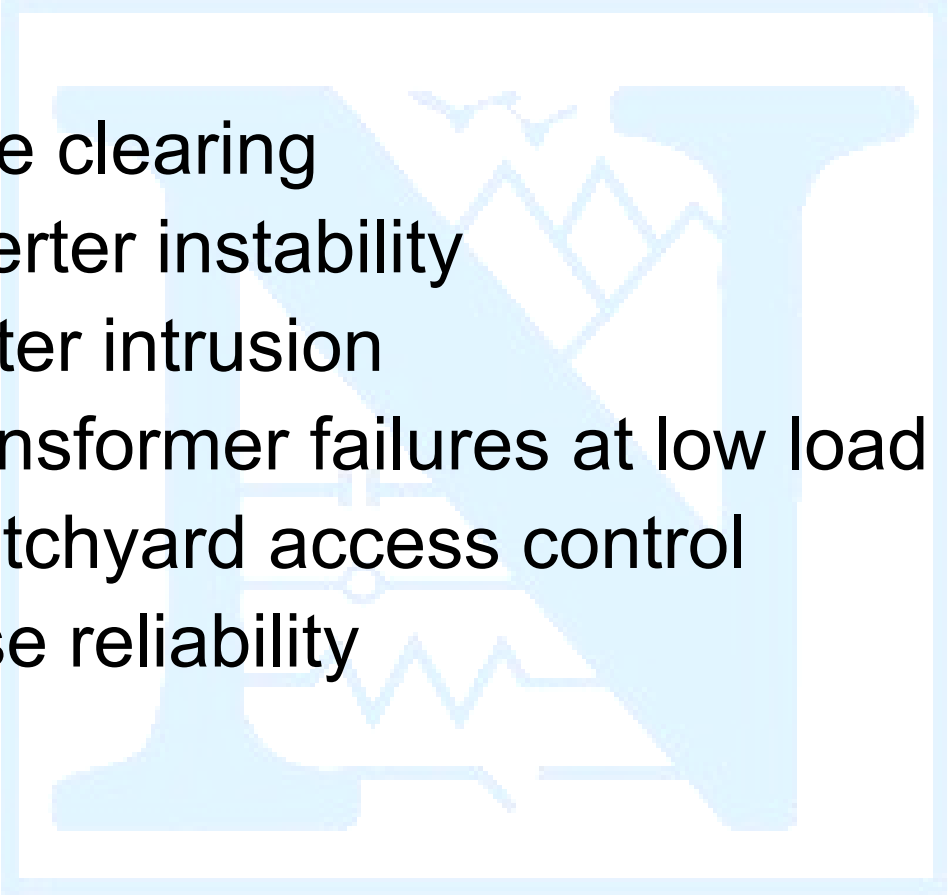
NRC Operating Experience Gateway

<http://nrr10.nrc.gov/ope-info-gateway/index.html>

Operating Experience Gateway

- 
- 
- Electrical power system issues
 - Emergency diesel generator issues
 - I&C systems issues

Electrical Power System Issues

- 
- 
- Tree clearing
 - Inverter instability
 - Water intrusion
 - Transformer failures at low load
 - Switchyard access control
 - Fuse reliability

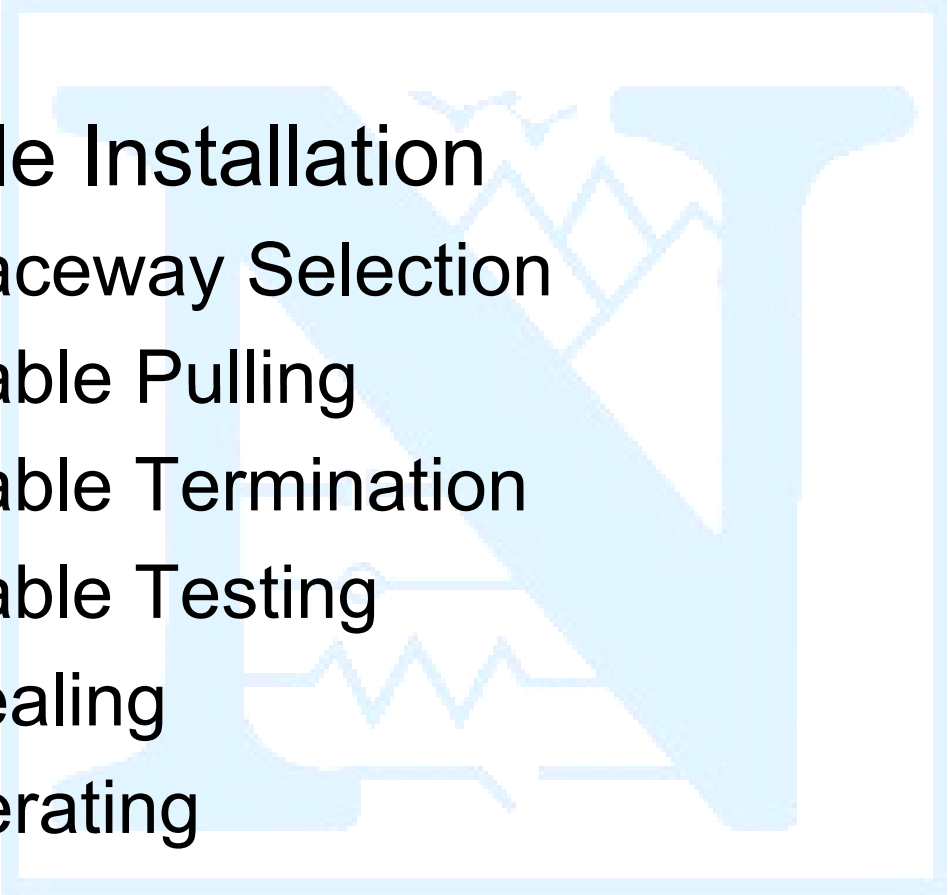
Emergency Diesel Generator Issues

- Starting problems
- Vibration
- Flange connection
- Mechanical binding
- Tornado vulnerabilities
- Snubber failures

I&C Systems Issues

- Software malfunctions
- Digital hardware malfunctions
- Auto-start failure
- Incore detectors software malfunction
- 7300 board malfunction
- Fuse reliability
- Counterfeit parts

Case Studies of Construction Related Issues

- 
- Cable Installation
 - Raceway Selection
 - Cable Pulling
 - Cable Termination
 - Cable Testing
 - Sealing
 - Derating
- 

Case Studies of Construction Related Issues

- Electrical Equipment Installation
 - Switchgear Floor Mounting
 - Battery Installation on Battery Rack
 - Pump-Motor Alignment
 - Containment Penetration Weld Access
 - Cable Tray Supports
 - Terminations

Case Studies of Construction Related Issues

- I&C Equipment Installation
 - High internal rack temperatures
 - Separation of input/output wiring to isolator
 - Inadequate grounding
 - Slope of instrument lines
 - Instrument line routing, supports, protection
 - Unused conduit connections to instrument not sealed

Case Studies of Construction Related Issues

- I&C Equipment Installation
 - Effects of vortexing on level measurement
 - Effects of thermal stratification on temperature measurement
 - Effects of upstream/downstream piping configurations on flow measurement
 - Orifice installed backwards

Case Studies of Construction Related Issues

- Calibration and Testing
 - Static head correction unsat
 - Scaling incorrect
 - No density correction for DP flow measurement at much higher temperatures (e.g., RHR flow)
 - Not all logic circuit failures detectable
 - Not all failure modes considered

Case Studies of Construction Related Issues

- Environmental Concerns
 - Room Ventilation and Fire Dampers
 - Temperature Extremes
 - Potential Flooding from Drains and Conduits
 - Maximum Flood Level

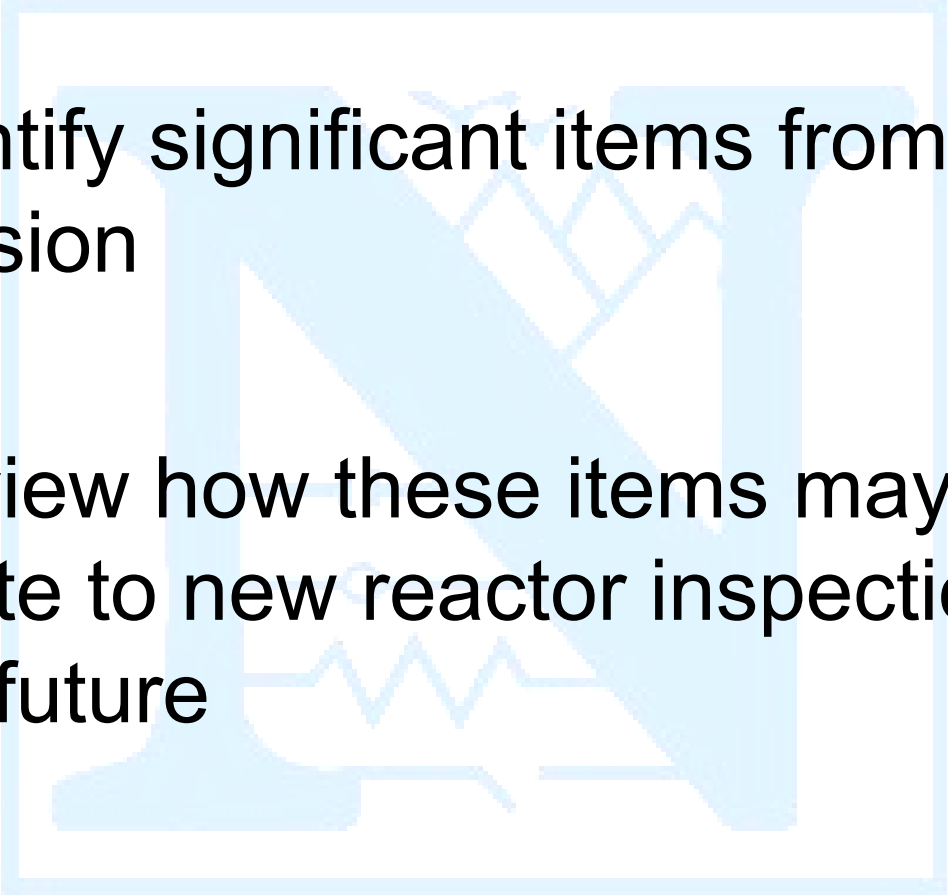
Case Studies of Construction Related Issues

- Environmental Concerns
 - Seismic Category 2 over 1
 - High Energy Lines Breaks
 - Pipe Whip

25. Course Summary Review



25. Course Summary Review Objectives

- 
- 
- Identify significant items from each session
 - Review how these items may relate to new reactor inspection in the future

1. Introduction and Overview of the NRC Web Site

- Reviewed the access to the NRC website
- Reviewed the location of NRC Regulations, Generic Communication, Regulatory Guidance, and the Technical Library

2. Quality Assurance Requirements

- Reviewed the regulatory requirement for a Quality Assurance program
- Reviewed the industry documents that implement those requirements

3. Code Requirements in 10 CFR 50 and Appendix A

- Highlighted those design criteria that invoke requirements on the design of the electrical power system and the I&C systems

4. Standard Review Plan and Generic Guides

- Reviewed the guidance available in the Standard Review Plan
 - Chapter 7, I&C
 - Chapter 8, Electric Power Systems
 - Chapter 9, Supporting Auxiliary systems

5. Standards Overview

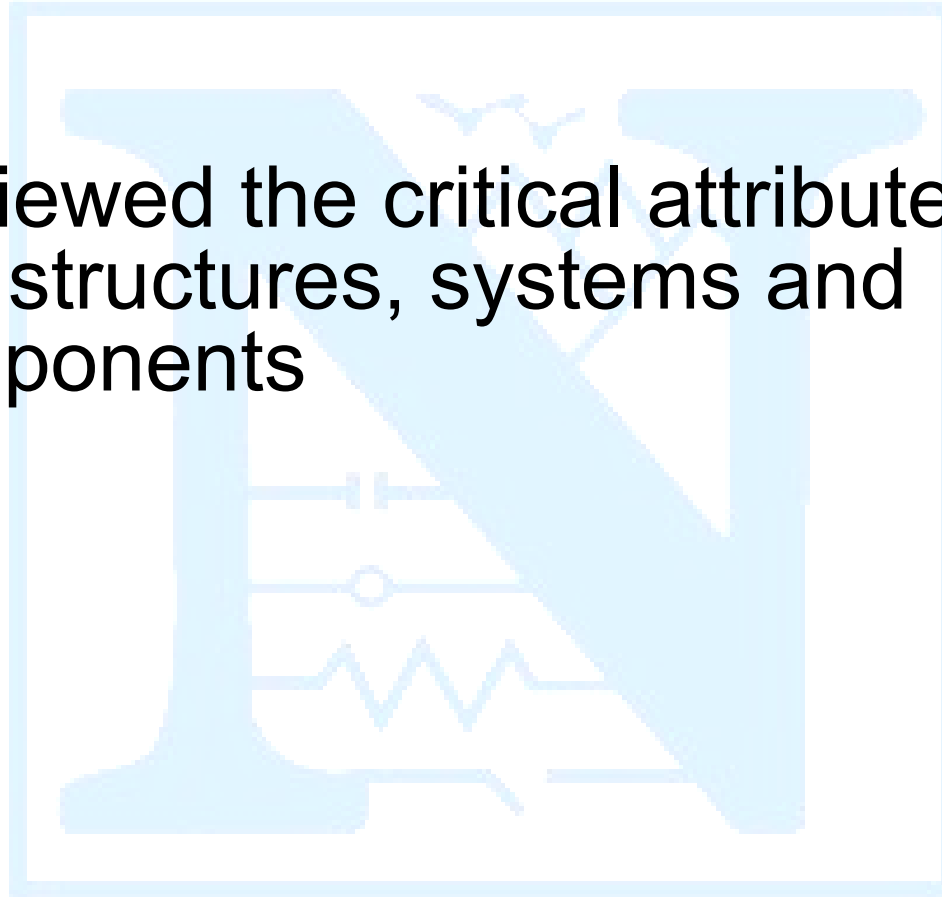
- Consensus Standards Organizations
- Overview of the Color Book Series

6. Electrical SSCs Critical Attributes

- Reviewed the critical attributes for electrical power structures, systems, and components

7. I&C SSCs Critical Attributes

- Reviewed the critical attributes for I&C structures, systems and components



8. IEEE Generic Criteria for Nuclear Power Plants

- Discussed IEEE standards that apply to both electrical and I&C systems and components

9. IEEE Design Standards for Nuclear Power Plants

- Discussed IEEE standards that apply to the design of electrical and I&C systems and components

10. IEEE Qualification Standards for Nuclear Power Plants

- Discussed IEEE standards that apply to the qualification of electrical and I&C components

11. Handling, Shipping and Storage Standards

- Discussed IEEE standards that apply to the handling, shipping or storage of electrical and I&C components

12. IEEE Installation Standards

- Discussed IEEE standards that apply to the installation of electrical and I&C systems and components

13. IEEE Inspection and Testing Standards

- Discussed IEEE standards that apply to the testing of electrical and I&C systems and components

14. IEEE Operation, Maintenance and Surveillance Standards

- Discussed IEEE standards that apply to the operation of electrical and I&C systems and components

15. IEEE Digital Standards and Software Life Cycle Standards

- Discussed IEEE standards that apply to
 - Digital components
 - Software life cycle

16. Instrument Setpoints

- Discussed instrument setpoint development



17. IEEE Standards on Fiber Optics

- Discussed fiber optics cables

18. Selected Non-IEEE Industry Standards

- Discussed non-IEEE standards that may also be applied to electrical and I&C systems and components in nuclear power plants

19. I&C and Electrical ITAACs

- Discussed ITAACs for electrical and I&C structures, systems and components

20. Overview of Industry Guidance

- Discussion on other industry guidance
- Reviewed different sources of nuclear industry guidance

21. Regulatory Guides

- Discussed Regulatory Guides applicable to electrical and I&C systems and components
- By discipline and by regulation

22. NRC Construction Procedures

- NRC Manual Chapter 2503
- Construction Inspection Procedure IP65001
- Attachments related to electrical and I&C systems and components

23. Overview of International Standards

- Provided an overview of international standards that are used in foreign nuclear plants
- IEC and IAEA

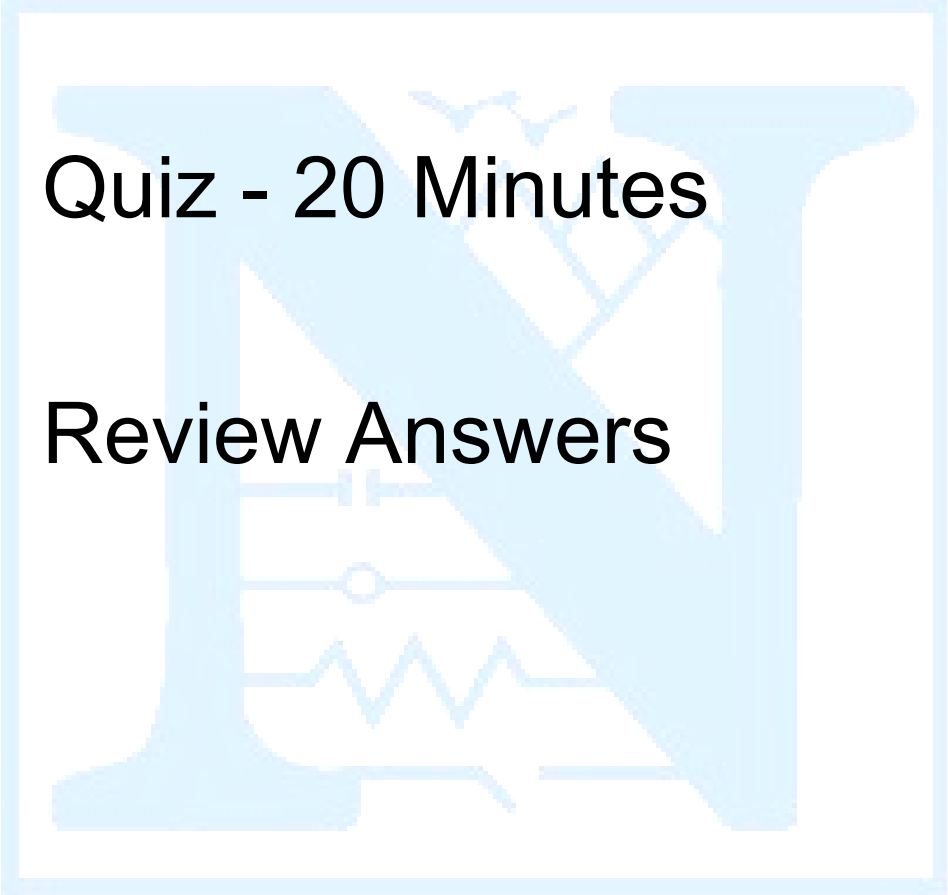
24. Construction Related Issues

- Discussion on NRC Operating Experience Gateway
- Provided examples of construction problems associated with electrical power and I&C systems and components

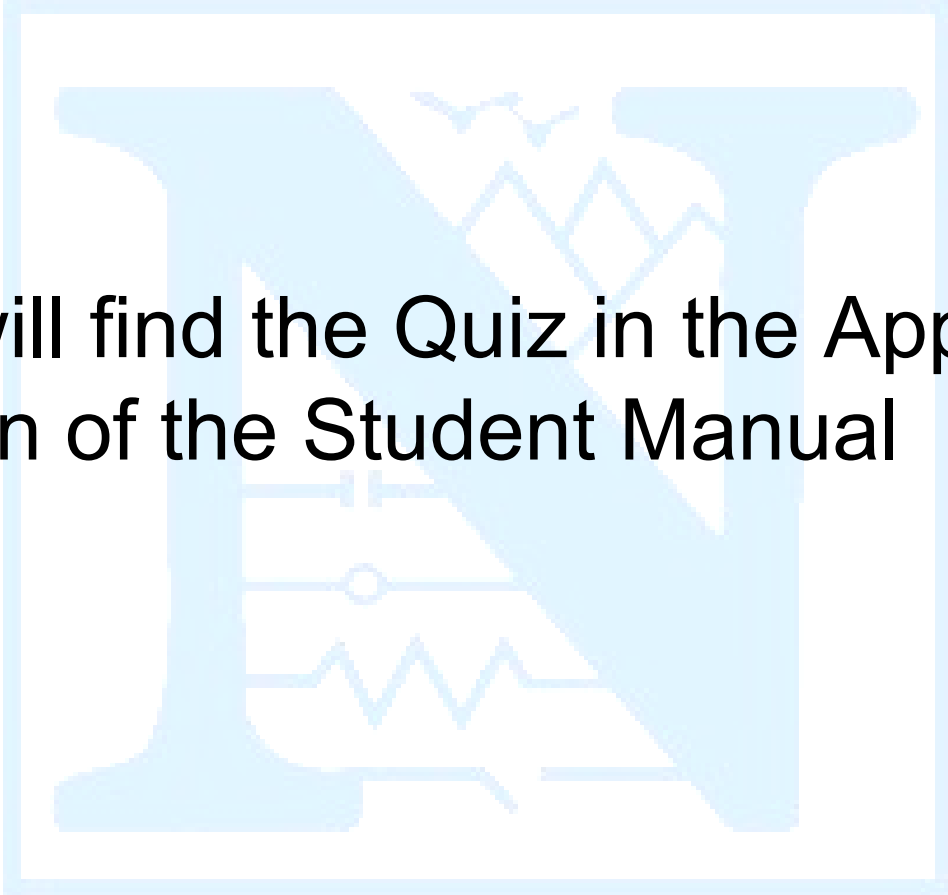
25. Course Summary Review

- Open Questions and Answers from the Parking Lot

26. Quiz

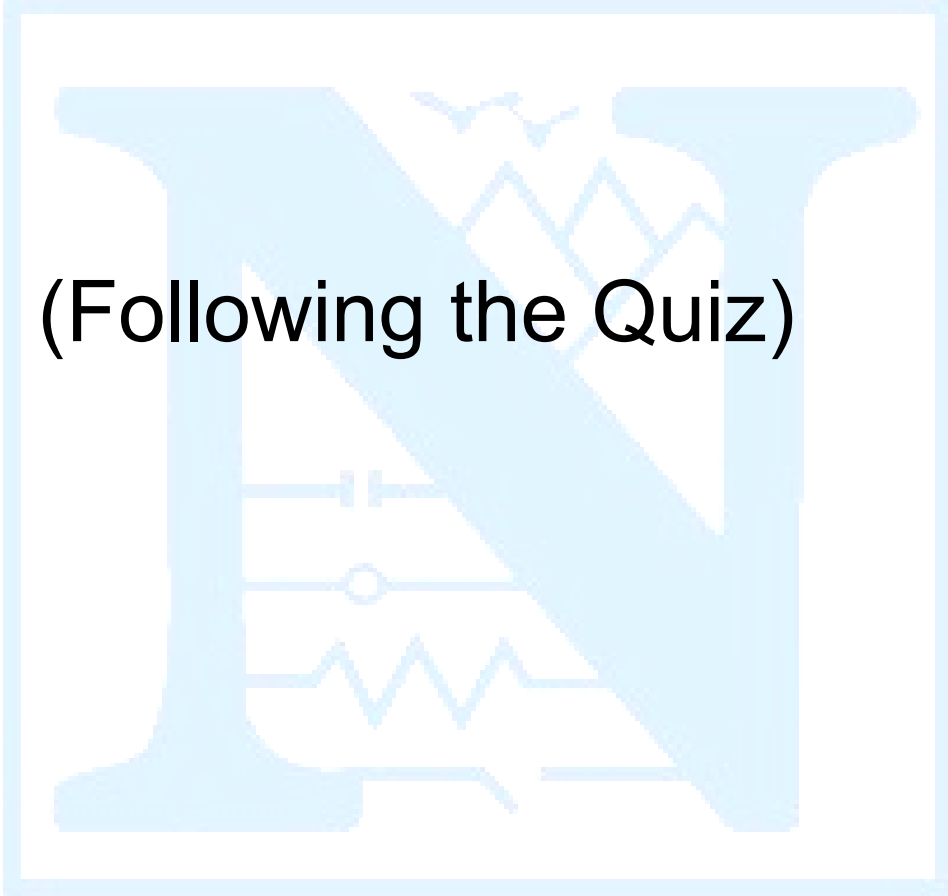
- 
- 
- Quiz - 20 Minutes
 - Review Answers

Questions



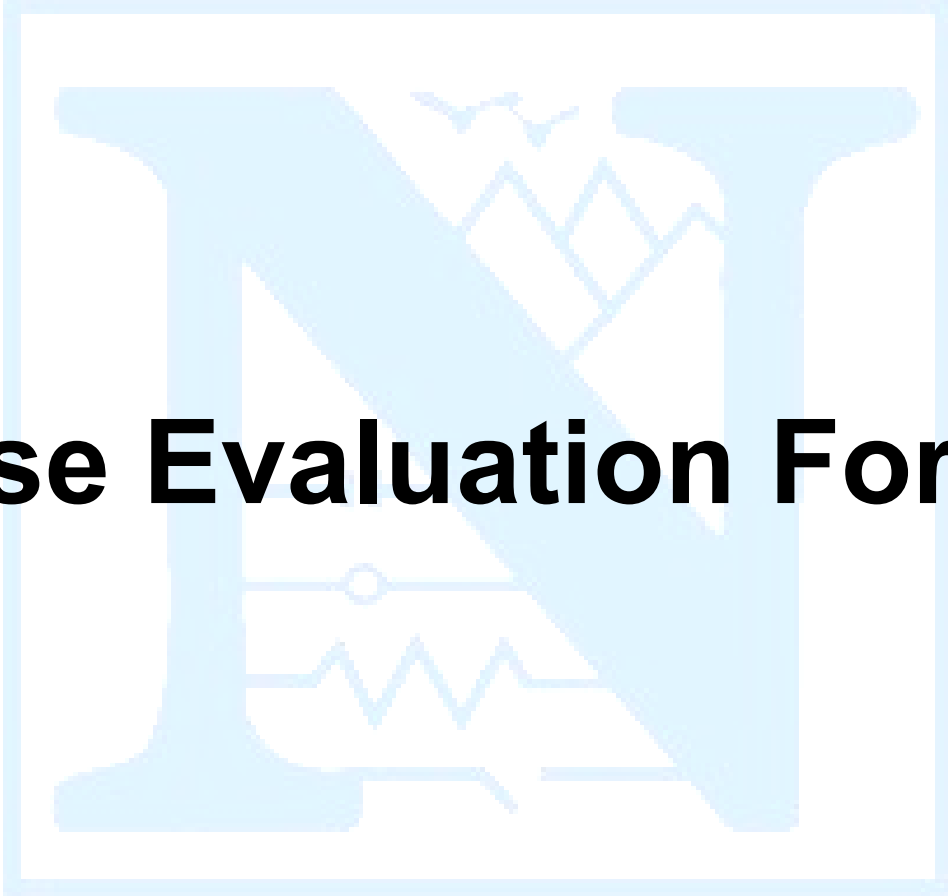
You will find the Quiz in the Appendix
section of the Student Manual

Answers



(Following the Quiz)





Course Evaluation Forms

27. Inspector Qualification Cards



ISA-CI-6 Industry Codes & Standards