Quality Assurance Codes and Standards for Mechanical Structures and Components

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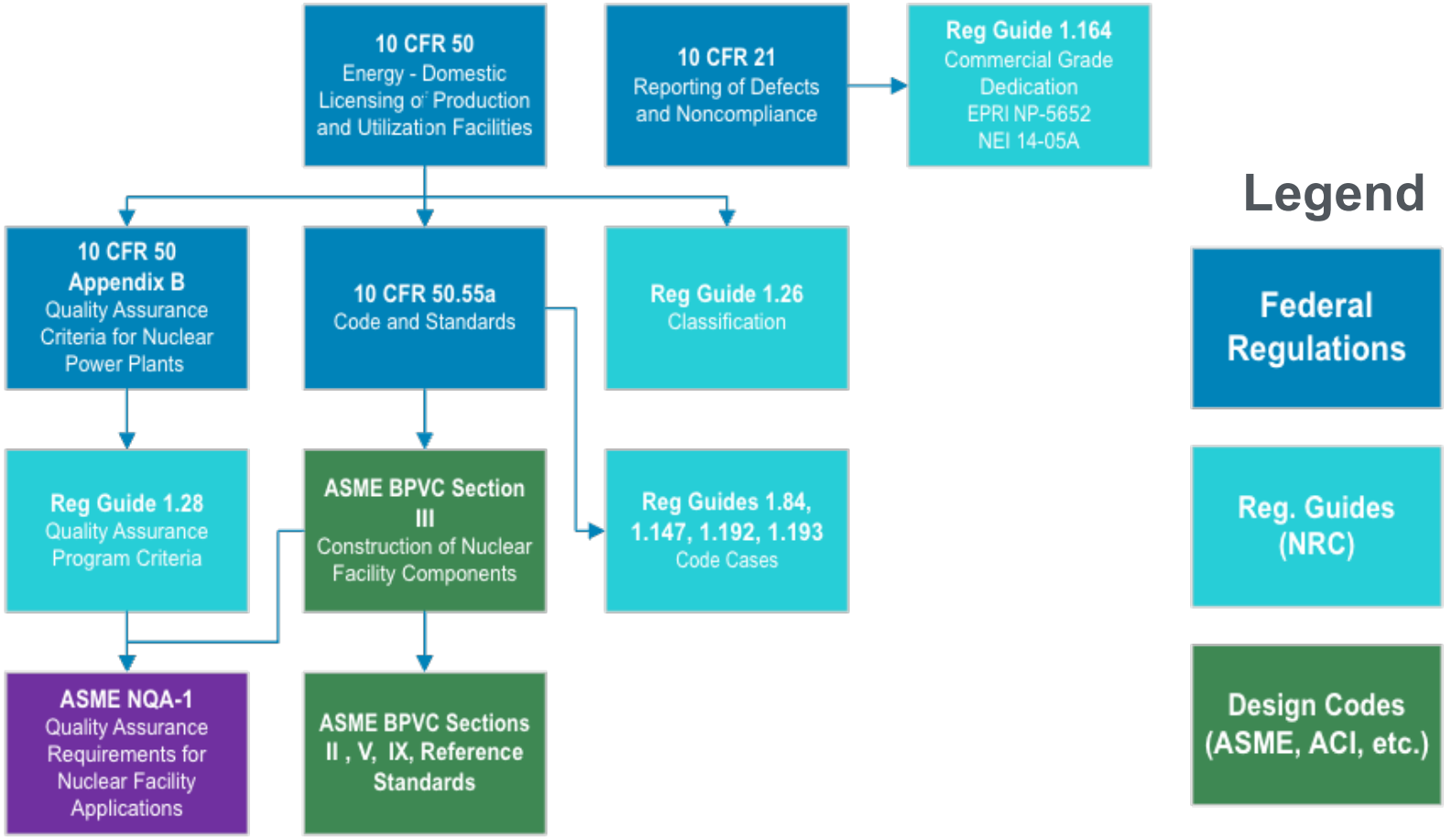
Objectives

- **Review flow down of quality and technical requirements.**
- **Discuss Section III Quality Requirements.**
  - History
  - Use of NQA-1
  - Differences to industrial codes
  - Design control
  - Divisions 1-5
- **Highlight differences between Division 1 and Division 5.**
- **Future efforts at Section III.**

Flow Down of QA Requirements



Section III QA History

- Section III contained all quality assurance requirements until the 1983 Edition and its incorporation of NQA-1 1979 Edition.
- NCA and NQA-1 evolved together and are generally aligned.
- Section III is specific to pressure-retaining items and provides specifics for those applications.

Division 1 Components

- NCA-4100 follows 18-point criteria.
- Requires NQA-1 Part 1 and specific Subparts of Part 2.
- Modifies and supplements for specifics of pressure-retaining items.
- Takes exception to CGD except for software.

Material

- NCA-4200/4300/4400 provide quality requirements for suppliers of material.
- Self-contained requirements use the methodology of NQA-1.
- Provides specific requirements for how to approve suppliers of material and services.

Divisions 2, 3, 4, and 5

- Concrete and Storage/Transportation Containers follow NCA.
- Fusion does not have requirements, yet.
- Division 5 follows NCA for low-temperature items. Nearly identical requirements in HAB-4100 for high-temperature.
- Division 5 nonmetallic items have unique requirements in HAB-3800/4500.

Section III Requirements

- Controls for special processes: manufacturing material, material testing, heat treating, bending, forming, NDE, welding, pressure testing.

- Controlled procedures, documented personnel, qualification, completed reports.

- Identification and traceability from finished items to materials used and their certifications.

Section III vs Section VIII

- **Most QA processes in Section III are required for Section VIII pressure vessels.**

- **Section III/NQA-1 are more prescriptive on:**
  - Personnel indoctrination/training/qualification for inspection/test/certifying engineers
  - Design control
  - Design software control
  - Supplier control/approval
  - Record retention times.

Design Control

- **Section III provides specific methods for design analysis.**
- **Requires NQA-1 design control and design verification requirements.**
- **Incorporates software quality requirements from NQA-1.**
- **Certifying Engineer qualification requirements from Appendix XXIII.**
  - Challenging for Division 5 due to experience requirements.

Standard Items

- Design requirements are reduced for many items manufactured to industry standards, B16.5 flanges, B16.34 valves.

- Exceptions exist for material for items 2 inch and under, small products exclusion.

- No exceptions for manufacturing those small products.

Division 5

- **High Temperature Reactors**
  - Gas cooled
  - Molten salt
  - Liquid metal

- **Endorsed in Regulatory Guide 1.87**

- **Need for alternate requirements based on risk.**
  - Reg Guide 1.201 and NEI 18-04
  - Code Case N-940
  - Proposed alternative quality requirements based on safety significance.

Metallic Components

- **Same QA requirements as Division 1.**

- **Unique design, fabrication, and examination requirements based on temperature service.**
  - Low temperature service ≤ 700F – 800F depending on material. Use Class 1 and 2 rules for construction.
  - Elevated temperature service = creep effects are significant. Temperatures up to 1,650F.

- **Elevated temperature services requires:**
  - Additional design analysis.
  - Assessment of cold forming on material properties.
  - Multiple volumetric exams for welded joints.

Nonmetallic Components

- **Graphite and ceramic composite materials used for core components and core assemblies.**

- **GC Certificate Holder quality requirements similar to N Certificate Holder requirements.**

- **Significant differences for nonmetallic material suppliers.**
  - Material manufacturing and machining are Code activities that require GC Certificate or Material Organization quality program.
  - Only a GC Certificate Holder can qualify a Material Organization.
  - Significant supply chain challenges.

Future

- Adopt NQA-1-2022. To be published in 2023 Edition.
- Alternative quality requirements for safety related items with low safety significance.
- Advanced manufacturing in Divisions 1 and 5.