Title: Nuclear Piping System ASME B31.1 and ASME III Class 1-2-3 Design-Qualification-Analysis and Piping Operability Assessment

Potential PDH: 24 **Code:** BTT035

Description:

The first part of this course covers the fundamental design rules, regulations, and practices for ASME III and ASME B31 piping systems in nuclear power plants. The second part of the course provides a guide for the evaluation of degraded and non-conforming conditions through case studies, using ASME XI and the corresponding NRC regulations and precedent. The course concludes with a review of repair options for safety-related and non-safety piping systems and components.

Outline:

1. OVERVIEW
    - Brief historical progression from B31.1 to B31.7 to ASME III
    - Key technical developments in the historical progression
    - Scope of B31.1 and ASME III
    - Outline of B31.1 contents
    - Outline of ASME III
    - What B31.1 and ASME III cover and what they do not cover
    - Regulatory requirements related to nuclear piping systems
    - Overview of the B31.1 and ASME III piping analysis process
    - The 11 criteria for qualification of a piping system
    - Piping analysis by span or detailed methods
    - Analysis differences between B31.1, ASME III Class 1-2-32.
2. PRESSURE DESIGN
    - Straight pipe equation and its basis and margins
    - Weld joint efficiency factors
    - Allowable stresses
    - Pipe fittings
    - Flanges
    - Valves
    - Plant-specific Pipe Spec.
3. THERMAL EFFECTS ANALYSIS
    - Global effects flexibility analysis
    - Markl's technical basis flexibility analysis Eq.(10)
    - Flexibility stress equation margins
    - Flexibility stress analysis: Key decisions
    - Fatigue analysis using Eq.(10)
    - Local Effects
    - Through-wall stress transients
    - Differences between Class 1 analysis and B31.1, Class 2-3
    - Overview of Class 1 equations and analysis
4. SUSTAINED AND OCCASIONAL LOADS
    - Service levels and load combinations

- Deadweight analysis
- Seismic input and analysis
- Waterhammer causes, analysis, and prevention
- Flow-induced vibration causes, analysis, and prevention
- Pipe break principles, locations and effects
- Leak-before-break overview
- Tornado loading on outdoor piping
- Buried pipe, key design equations

5. EVALUATION OF WALL THINNING CASE STUDIES
   - ASME XI CC N-513 and N-597 technical basis
   - Case Study – cavitation in piping
   - Case Study – wall thinning N-597
   - Challenges in crack assessment
6. EVALUATION OF CRACK-LIKE FLAWS
   - Introduction to fracture mechanics
   - ASME XI Ap.H Simple Case
   - Real-Life Challenges
7. OPERABILITY ASSESSMENT
   - ASME Code and NRC perspectives
   - Over-pressure transient
   - Abnormal vibration in piping
   - Locked snubber thermal overstress
   - Beyond-design thermal transient
8. REPAIRS OF PIPING SYSTEMS CASE STUDIES
   - ASME XI and PCC-2 repair options
   - Welded repairs
   - Mechanical repairs
   - Non-metallic repairs

Instructor:

George Antaki, PE, Fellow ASME,is chairman of ASME III Working Group Piping Design, chairman of ASME B31 Mechanical Design Committee, and member of ASME O&M Subgroup Piping. He started his career at Westinghouse in 1975 and has been involved in the design, analysis, qualification, start-up, and operational trouble-shooting of mechanical equipment throughout the industry. He is the author of three textbooks on the subject of mechanical integrity and fitness-for-service, and is an instructor for ASME.