



Nuclear Piping System ASME B31.1 and ASME III Class 1-2-3

Design-Qualification-Analysis and Piping Operability

Assessment under NRC Rules and Section XI and Repair per ASME PCC-2 and ASME XI

Potential PDH: 24

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

Subject Matter Expert (SME):

George Antaki, Fellow ASME, has over 40 years of experience in nuclear power plants and process facilities, in the areas of design, safety analysis, startup, operation support, inspection, fitness for services and integrity analysis, retrofits and repairs. George has held engineering and management positions at Westinghouse and Washington Group International, where he has performed work at power and process plants, and consulted for the Department of Energy (DOE), the Nuclear Regulatory Commission (NRC) and the Electric Power Research Institute (EPRI). He also is an instructor of failure prevention, inspection and equipment integrity courses for ASME, and has done teaching assignments for the Department of Energy as well as many other private organizations. Mr. Antaki has authored several articles, publications and two textbooks on design and mechanical integrity of plant systems and components. George serves as a member of several committees including:

- ASME/API Joint Committee on Fitness for Service Member
- B31 Mechanical Design Technical Committee Vice Chair
- Post Construction Subcommittee on Repair and Testing (PCC) Member
- Pressure Technology Post Construction Committee Member
- Pressure Technology Post Construction Executive Committee Member
- Subgroup on Dynamic Qualification Member
- Task Group on Impulsively Loaded Vessels (SC VIII) Member
- Working Group on Piping (SG-D) (SC III) Chairman