Fitness-for-Service: Brittle Fracture Screening

Preventing Catastrophic Failures

Brittle fracture is the sudden, rapid propagation of a crack-like flaw under stress (residual or applied) where the material exhibits little or no evidence of ductility or plastic deformation. Conducting proactive brittle fracture screening on pressure vessels and piping will lead to safer facilities and protect personnel and the environment.

Our Mechanical and Structural Engineering team has completed thousands of brittle fracture screening assessments using the latest fitness-for-service (FFS) technology (API 579-1/ASME FFS-1). For high-risk components, we supplement traditional assessments with fracture mechanics screening to provide a better understanding of the true propensity for fracture and help develop inspection plans to mitigate any concerns. We are at the forefront in developing new processes and technologies to address concerns for brittle fracture.

Equity's Brittle Fracture Assessment Workflow

At Equity Engineering, our team works with you to identify the highest-risk equipment and piping systems, set safe operating limits, and develop long-term risk management plans. We use industry-leading procedures and technology to conduct a comprehensive brittle fracture screening program for pressure vessels, piping, and storage tanks.

- Minimum allowable temperature (MAT) assessments
- Screening for brittle fracture susceptibility (Levels 1 & 2)
- Detailed assessment using fracture mechanics (Level 3)

All brittle fracture assessments meet the 2021 edition of API 579/ASME FFS-1, OSHA 1910.119 process safety management, and RAGAGEP requirements.

Fracture Mechanics

Our fracture mechanics-based brittle fracture screening will help you improve the reliability and safety of heavy-wall, high-pressure reactors. We apply the latest API 579 guidance to adjust material fracture toughness for hydrogen and aging effects, enabling safe operating limits that are often less conservative than traditional industry practices. We will help you optimize performance while mitigating risks from damage mechanisms like temper and hydrogen embrittlement.

Case Study

Large-Scale Brittle Fracture Screening

Industry:
Pipeline

Type of Asset:
Ethylene & Propylene Pipeline Storage Facility

Location:
USA

Issue:
Due to low operating temperatures, a pipeline storage facility had identified several pressure vessels with a potential risk for brittle fracture.

Solution:
We completed several Level 3 FFS assessments to determine the permissible safe operating limits for all equipment items. When necessary, a finite element analysis (FEA) was performed to quantify through-wall stress distributions at critical locations. In addition, fracture mechanics calculations were performed on the equipment to determine the MAT limits, as a function of pressure, for each critical location.

Result:
All equipment was qualified for continued operation at the current target operating and upset conditions. Our team provided guidance to assist the owner-operator in establishing an appropriate inspection plan for each pressure vessel.

Benefits

- **Set safe operational limits**
- **Develop long-term risk management plans**

"HIGHLY PROFESSIONAL GROUP OF ENGINEERS. **EXCELLENT SERVICE PROVIDED BY EVERYONE ON THE MECHANICAL ENGINEERING TEAM.**"

North American LNG company, October 2023

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