

The Problem

During inspection of a crude oil tank header at an onshore terminal, a number of areas were identified in which corrosion of the pipe material had occurred. In total, there were 8 areas of degradation reported. The client requested MMI to undertake an API 579 Level 3 based assessment of the oil tank bridle pipework and interconnection line to demonstrate continued fitness-for-service of these locations.

Our Approach

The fitness-for-service evaluation was carried out in accordance with the procedure defined in ASME FFS / API 579 for Level 3 assessments. This requires a detailed FE analysis of the pressure part with defect details explicitly included in the FE model. The analysis was carried out sequentially in two steps as follows:

- (1) Pipe stress analysis using CAESARII to determine the forces and moments in the corroded pipe sections due to thermal expansion and pressure loading.
- (2) The loads and moments obtained from the model were applied to the localised finite element models incorporating the areas of metal loss, and incremental collapse analysis using Riks method was carried out to predict limit collapse load for each defect.

Outcome

The results showed that the limiting location had a minimum collapse pressure of 2.3 MPa (23 barg), compared to a design pressure for the system of 15 barg, a margin of 1.53 x design against yield stress. Compared to the nominal pressure vessel code margin where the allowable stress is taken as 2/3 yield stress (i.e. a factor of 1.5x) it was considered that the crude oil tank header at the terminal remained fit for continued service at 15 barg. For all other locations of metal loss, the margins against local collapse were higher than at Area 1, with the next lowest collapse pressure being 37 barg associated with Location 8.8 (6 o'clock position around circumference of weld). The areas of metal loss were therefore considered to remain acceptable for operation with a design pressure of 15 barg in accordance with the guidance of API 579.

