



Project Summary

Axiom were approached by a client whose Fired Heater was suffering from widespread internal pitting. This was due to water condensing on the internal shell wall, and corrosion barrier originally applied had since been washed away due to the wet environment.

The Challenge

The client previously commissioned two fitness for service assessments. These were based on design by formula approaches considering a uniform shell thickness based on the most severe pit depth. They both had shown the unit to be unfit for continued use.

The heater operates under a small partial vacuum, and is subjected to further compression due to wind and self-weight loading. The failure mode to be investigated was therefore that of buckling.

Key Achievements

- Phased Array Ultrasonic Thickness (PAUT) inspection data was post-processed in accordance with API 579 Level 2 methodology to calculate an equivalent plate thickness for each strake of the Fired Heater.
- A series of non-linear buckling analyses were performed within ANSYS finite element analysis (FEA) software. Analyses were conducted against API 579 requirements.
- A shell element model was built, as can be seen in Figure 2. The use of shell elements allowed the model size to be reduced, and the analysis efficiency increased.
- A series of initial linear buckling analyses were performed to obtain the first buckling mode shape for each load case. This mode shape, i.e. a model inclusive of an imperfection, was then used as the base model for any subsequent non-linear buckling analysis so as to meet the codal requirements.
- Calculations were also performed to investigate the effects of increased pit size and density on the integrity of the Fired Heater.

Why Axiom Engineering Associates?

Axiom were able to reference fitness for service design code API 579 and process pit dimension and spacing data to calculate an equivalent plate thickness for pitted shell plates. We could combine this with a non-linear computational analysis and perform a Level 3 fitness for service assessment on the Fired Heater in accordance with API 579 code. This methodology would provide a more accurate and less conservative assessment compared with the previous studies undertaken on the heater.

The Result

Axiom's more accurate and less conservative assessment approach was able to show the unit remains fit for continued service, where other assessment methods had deemed the item to require repair. It was probable that our client would have also had to install further external bolted stiffeners whilst on line to maintain integrity until a scheduled TAR.

Referencing historical inspection data, we were also able to calculate a predicted remnant life for the heater, which the client could then use to set future inspection frequencies accordingly.

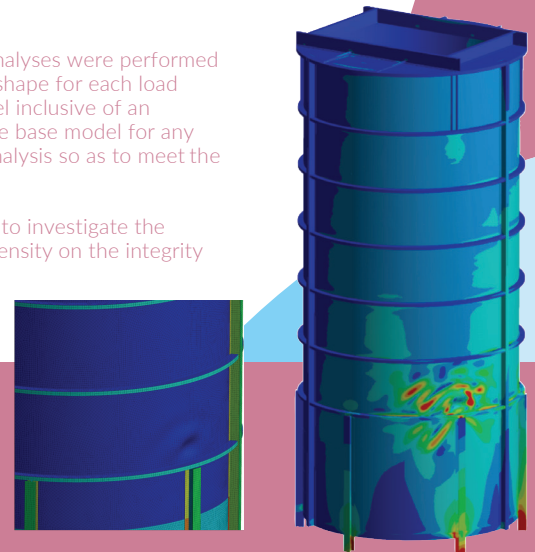


FIG 2: Finite Element Model

FIG 3: Stress Contour