

# Case study

## Pipework fitness for purpose assessment

### THE CHALLENGE

Safety is a major concern within the civil nuclear industry, with structural assessments forming a key element of the necessary safety case. The integrity of these components needs to be managed through life, particularly when new systems are introduced.

Our major energy client had retrospectively introduced a key system which required additional load scenarios to be assessed (*including the bottom line plant seismic hazard*). As a result, their safety case needed to be amended to incorporate these assessments. Frazer-Nash was appointed to provide independent verification that the gas pipework within the new system was 'fit for purpose' and that the new load conditions would not lead to plastic collapse, ratchetting or structural fatigue.

### OUR SOLUTION

Frazer-Nash worked jointly with our client, utilising their significant plant experience and safety case knowledge, to develop a suitable 'fitness for purpose' assessment of this new system.

After conducting a comprehensive review of the pipework architecture, we identified 'non-standard components' that could not be assessed using the basic piping design code within British Standard BS806. These components were a trunnion, an elbow with a branch attachment (*Figure 1*) and bellows (*Figure 2*). We then assessed the remainder of the pipework against the limiting criteria defined within BS806 for all of the new load scenarios (*using the pipestress analysis software PSA5*), and found it to be acceptable.

We then conducted separate tests to assess the trunnion and elbow attachment, focusing in particular on the possibility and likelihood of plastic collapse. To provide limiting rupture reference stresses we used a series of global collapse reference solutions, and to demonstrate the avoidance of ratchetting, we used the local loads calculation route defined in the pressure vessel code PD5500, Annex G. We then assessed the bellows structural components (*hinge pin/arms and endplates*) against the structural design code BS5950 and found them also to be acceptable, with the exception of the hinge pin which needed subsequent calculation of reference stress solutions before it could demonstrate acceptance.

Finally, we compiled a 'fitness for purpose' argument by blending standard pipework and pressure vessel code techniques, with more detailed reference stress solutions. This provided our client with evidence to support a robust fitness for purpose argument with which to complete their safety case. However, should our client require more detailed analysis of the stresses placed on the components of their equipment, Frazer-Nash has the capability and expertise to develop sophisticated finite element analysis modelling to simulate these types of loading.

### BENEFITS

The pipework assessment undertaken by Frazer-Nash resulted in an acceptable solution which would not have been achievable through standard pipework code assessments alone. This enabled our client to provide sufficient evidence in support of the structural integrity aspects of the safety case for continued operation of the plant under the new load regimes.

### Client

Major energy client

### Business need

Provide evidence in support of structural integrity safety case argument

### Why Frazer-Nash?

Our ability to work closely with the client in providing fitness for purpose solutions, beyond the limitations of the design codes.

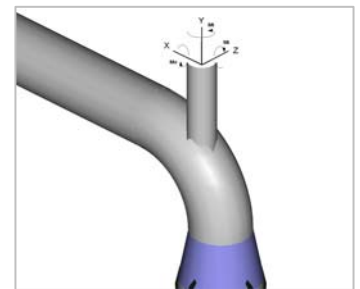


Figure 1: Branch on Elbow Fitting

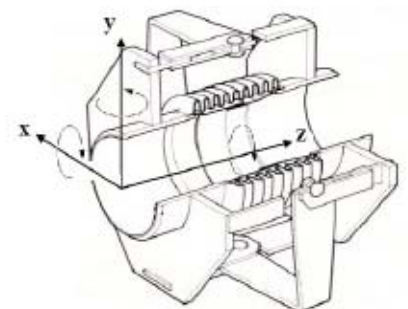


Figure 2: Bellows Unit

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