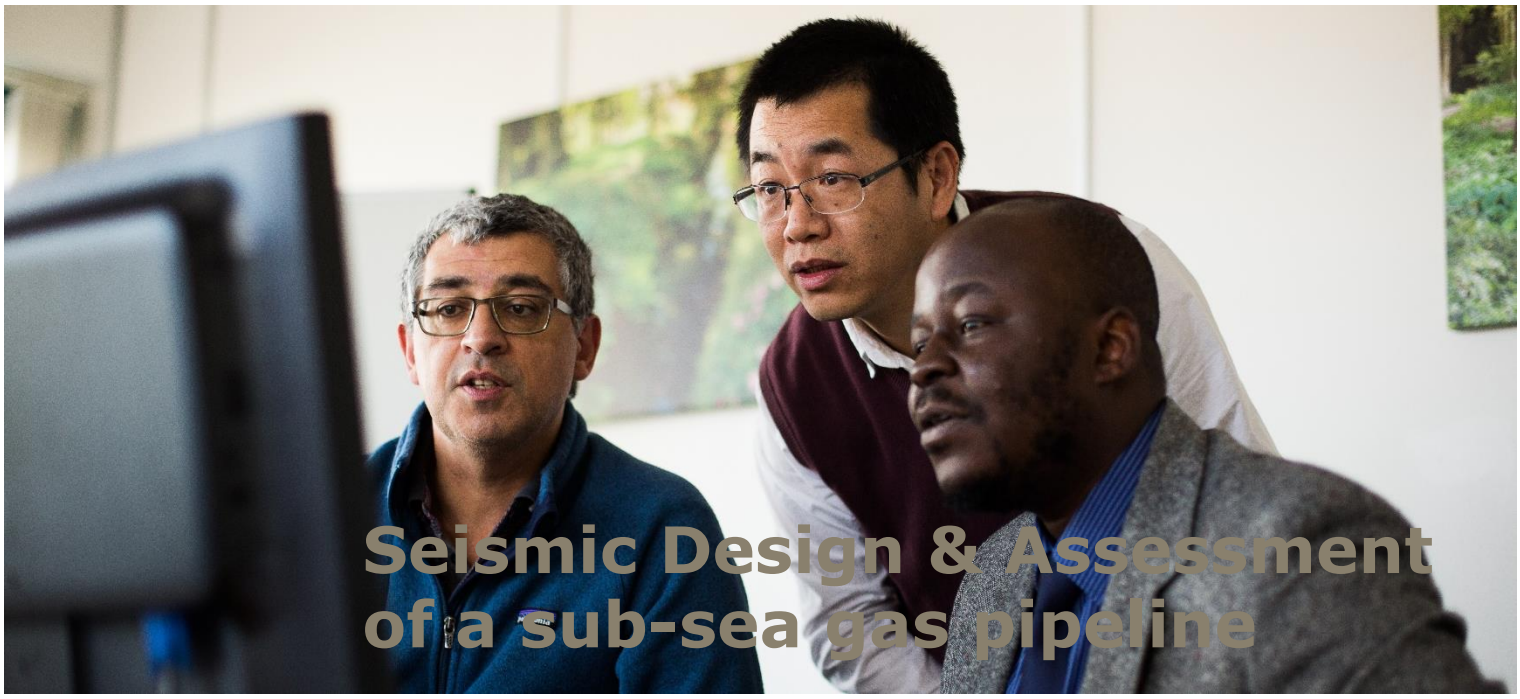


Seismic Design & Assessment of a sub-sea gas pipeline

Case study

As a specialist sub-contractor to Advantica, EASL were selected to provide seismic analysis, providing expertise to fill in identified knowledge gaps within the organisation. This skill within EASL has been developed from staff working practically with UK Civil Nuclear sites from the 1980s to the present day, experience that is transferrable to a number of different projects.

Expert design & assessment advice

EASL assisted Advantica Technologies to provide expert design and assessment advice to the piping contractors to assure the integrity of the pipeline for seismic loading and its consequences.

A hazard study was carried out for the proposed pipeline route and the 500-year return earthquake chosen as the design event.

Various seismic studies were carried out to determine the potential for seismically-induced soil liquefaction, slope instability and reduction in fatigue life of the pipeline from span vibration or fault movement.

A consortium of oil companies, including British Gas Trinidad & Tobago Limited, were planning the construction of a 107km long, 24” diameter steel gas pipeline, located between Hibiscus platform in the North Coast Marine Area and the Atlantic LNG plant in Trinidad. This pipeline would allow for the efficient delivery of gas from one platform to the other.

However, following studies of regional geology, seismicity and tectonic activity, results indicated the area was a region of high seismic potential, with a risk of earthquakes in the area.

With this threat, it was crucial that the pipeline be expertly designed and assessed to advise contractors regarding the pipeline integrity for any potential seismic loading, and the consequences of such events.

The approach

A hazard study was carried out for the proposed pipeline route, with a 500-year return earthquake selected as design event.

From here, various seismic studies were carried out to determine a range of potential risks.

Seismically induced soil liquefaction, where an earthquake may alter the sea bed supporting the pipe, and slope instability associated with this were considered. In addition, pipeline fatigue life being reduced from span vibration and movement where buried pipe crossed the fault line, were also examined as initiating events.

Our solution

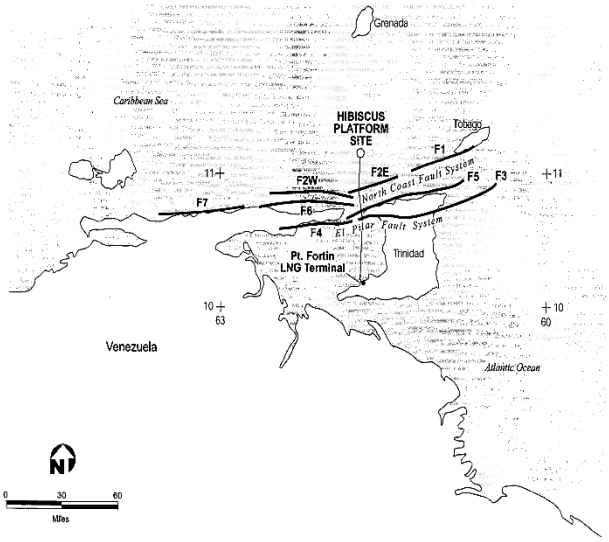
Two approaches were adopted to reduce the risk to pipeline integrity posed by seismic effects. Conventional design checks were made to ensure that the pipeline meets the requirements of modern codes; and the potential impact of other failure modes, e.g. slope failure, was reduced by the judicious route selection.

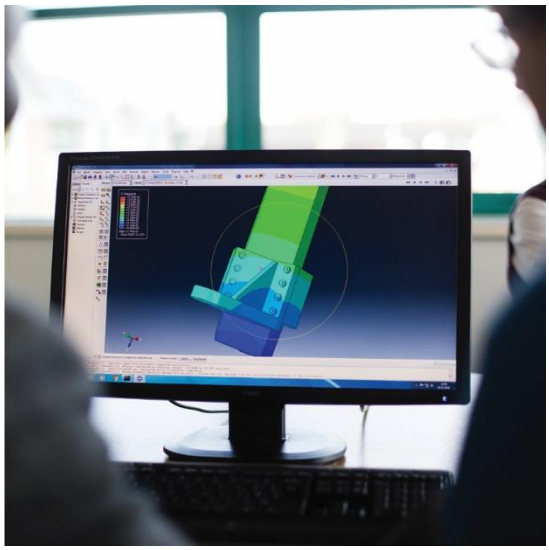
EASL provided an independent peer review of all seismic aspects of the design calculations and in addition carried out a detailed assessment of slope instability and a soil column analysis.

Various initiating events, arising from an earthquake, each with the potential to fail the pipeline, have been considered. For each initiating event, the limiting seismic strength, or trigger level, has been calculated for each of associated potential failure mode. This equates to a level above which post-event investigation is prudent because of the high likelihood of pipe distress.

It was recognised that despite the design measures, there remained a small risk that a severe seismic event could significantly reduce the structural reliability of the pipeline during the economic life of the structure.

EASL assisted in the preparation of the Seismic Risk Management System for the pipeline. This system enables the operator to evaluate what, if any, actions need to be taken after any significant seismic event to minimise risk to the structural integrity of the pipeline.





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