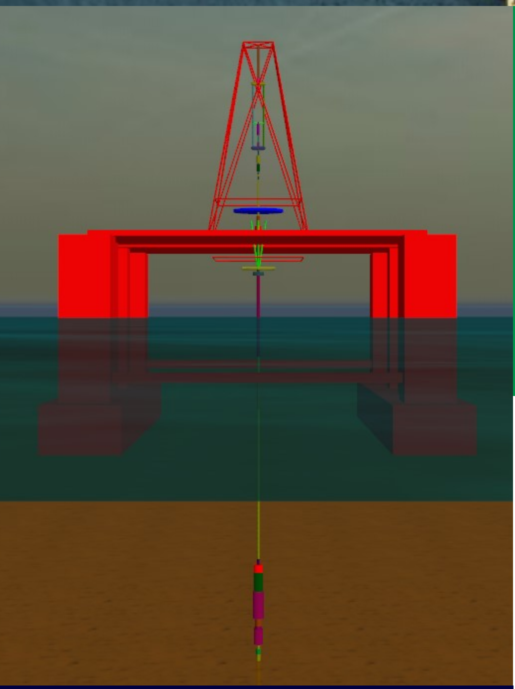
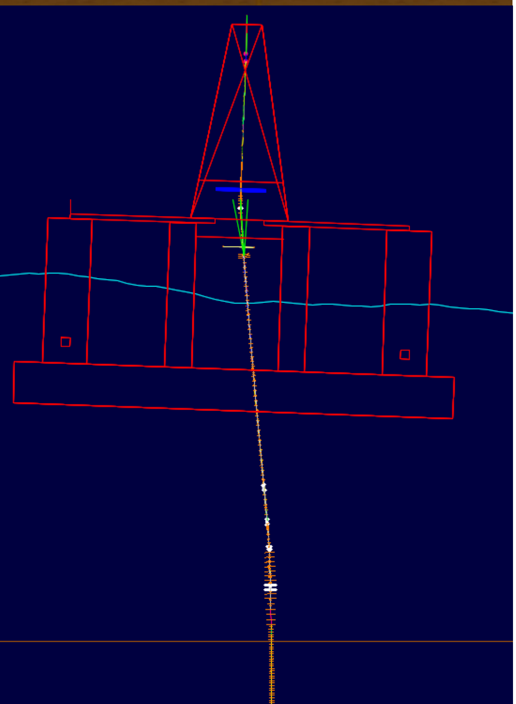
AS | MOSLEY

CASE STUDY

LANDING STRING SELECTION AND GLOBAL RISER ANALYSIS FOR SHAH DENIZ STAGE 2





BACKGROUND

The Shah Deniz field in the Caspian Sea is BP's largest ever gas discovery and one of the biggest gas-condensate fields in the world. Shah Deniz Stage 2 is a $45 bn project that will supply Caspian gas to Europe for the first time via the Southern Gas Corridor.

AS Mosley was contracted to specify 7 5/8" Landing String and perform global riser analysis for the proposed completion operations over a range of water depths from 70m to 580m from the Istiglal semi-submersible vessel.

CHALLENGE

During completion operations, the tubing hanger and Subsea Test Tree (SSTT) are run and landed through the marine riser.

Running operations impose very tight limits as the large diameter control equipment passes through the restrictive upper and lower flex joints. Furthermore, it is important to ensure for all landed and latched (L&L) operations that the landing string can be safely unlatched and pulled clear of the lower flex joint during emergency conditions in readiness for disconnecting the lower marine riser package (LMRP).

Accommodating landing string unlatch for all L&L operations restricts the lower flex joint angle. This means that the permissible flex joint angle limits with the landing string and SSTT are much lower than for normal marine riser drilling operations. Optimising the angle limits for all operations is critical to minimise the cost of completing each well.

While the Caspian Sea has calm environmental conditions, other challenges existed. Shah Deniz has high pressure (12000 psi) sour service wells covering a wide range of water depths (70m to 580m).

Shallow water is challenging as small vessel offsets can impose high loads in the subsea equipment. Furthermore, fatigue damage of the SSTT resulting from waves and vessel motions is much more significant in shallow water conditions.

However, in deep water the landing string tensions are substantially higher which utilises more structural capacity with a negative impact on operability, particularly at high pressure.

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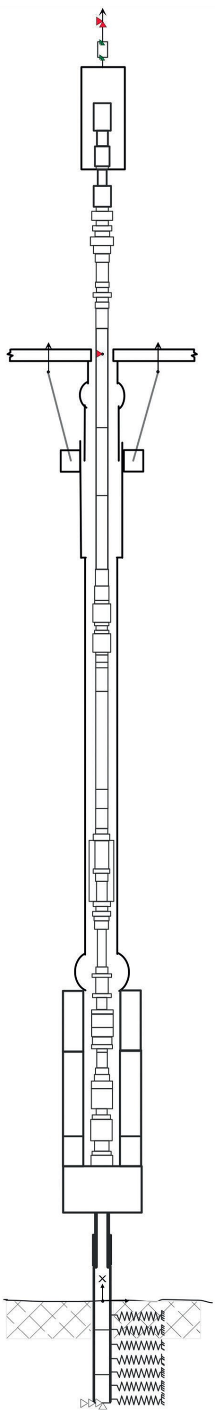

SOLUTION

To meet the long lead time for the landing string joints, the order had to be made well in advance of the detailed design of the system. AS Mosley could draw on many years of experience to conservatively estimate the bending requirements prior to global riser analysis being carried out.

The Landing string pipe selection was carried out in accordance with ISO 13628-7 to meet the pressure, tension and bending requirements.

It was established that Q125 grade would offer high strength resistance, but did not meet the NACE requirements for sour service.

However, it was determined that with careful material selection C110 grade could meet the NACE requirements and would also have sufficient strength resistance for the worst-case loads.

AS Mosley identified two suppliers of threaded and coupled pipe who could meet the material specification. Further review of strength and fatigue properties highlighted the best option.

AS Mosley performed a global riser analysis of the 7 5/8” landing string system inside the 21” marine riser using OrcaFlex.

The analysis determined the operability, established the limits for all operations and predicted the fatigue life of the system. In order to optimise the safe limits and maximise operability a detailed analysis of flex joint angle limits using ANSYS was performed.

This was carried out to determine the accurate limits for running the TH and SSTT through the upper and lower flex joints as well as establishing the limit for unlatch which governs all L&L operations.

RESULTS

AS Mosley provided design support throughout the project from the landing string selection to the final well completions.

Early selection of landing string pipe prior to global riser analysis meant that timely deliveries were achieved. This provided the opportunity to perform additional strength and fatigue qualification tests fully supported by AS Mosley.

Good operability with enhanced confidence was established for all the completion operating conditions through accurate determination of the flex joint angle limits during running and L&L operations.

Further support was provided to the design of the shear sub to ensure that the first point of failure during overload was always above the critical barriers. Nevertheless, the system had sufficient strength to sustain the worst-case loads even during accidental vessel excursions from a mooring line failure.

The limiting fatigue life of the most critical component in the system was greatly improved by incorporating advanced analytical techniques supported by AS Mosley. This involved applying a full operational stress histogram to detailed non-linear Stress Transfer Functions for the critical hot spots.

The improvements in accuracy resulted in a significant increase in fatigue life sufficient for the duration of the campaign.

AS MOSLEY

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