

DESIGN OF A 5 1/8" 10K COILED TUBING INTERVENTION RISER SYSTEM FOR THE WELL ENHANCER



BACKGROUND

In 2009 the oil and gas industry's first monohull vessel designed for subsea Coiled Tubing Intervention was brought into service by Helix Well Ops UK Limited. AS Mosley were contracted to perform global riser analysis in support of the design of the Intervention system. The Well Enhancer was custom designed with a dynamically positioned well intervention and saturation diving system. The vessel includes provision for Wireline operations through a 7 3/8" 10K Subsea Intervention Lubricator (SIL) and for coiled tubing operations through a 5 1/8" 10K Intervention Riser System (IRS).

CHALLENGE

The 5 1/8" 10K IRS was required for a range of water depths covering all operations in the Central and Northern North Sea extending from 80m to 200m. The design of the riser system was to be in accordance with ISO 13628-7 which specifically includes for accidental loading. For a monohull dynamically positioned vessel the worst conditions occur in the shallowest water depth. The reason for this is that during an accidental vessel excursions (i.e. drift off) the resulting distance covered before the riser system can be disconnected, represents a larger ratio in shallow water compared to deeper water. This puts higher bending loads in the subsea equipment for operations performed in shallow water. Therefore, it was important to design the system to minimise the loading on the subsea equipment during accidental vessel excursions. Furthermore, it was necessary to ensure that the IRS was intrinsically weaker than the connectors and equipment below the critical subsea well barriers.

The 5 1/8" 10K Intervention Riser System also had to interface with the 7 3/8" 10K Subsea Intervention Lubricator. This meant that the subsea stress joint for the IRS would also be used as the SIL riser (i.e. to house the tool string) when configured for Wireline operations. Therefore the stress joint had a dual role to play and this made the design even more complicated particularly as the stress joint section properties had to be larger than the 5 1/8" riser in order to interface with the 7 3/8" SIL.

Large accidental vessel offsets during drift off also cause high bending loads in the riser at surface around the point of centralisation. The bending loads at surface are also higher for shallow water and it was important to ensure sufficient flexibility to accommodate the accidental vessel excursions.

DESIGN OF A 5 1/8" 10K COILED TUBING INTERVENTION RISER SYSTEM FOR THE WELL ENHANCER

5 1/8" 10K Intervention Riser System.



SOLUTION

In order to meet the high vessel offset requirements for an accidental drift off, special joints were designed at the top and bottom of the riser after selection of the 5 1/8" riser pipe. The special joints had to be very flexible in order to meet the high accidental offset requirements and it was essential to ensure that the 5 1/8" riser pipe was not overloaded during extreme vessel excursions. Furthermore, it was important to minimise the loading on the stiff subsea pressure control equipment.

The special joints comprised a subsea stress joint and a moonpool joint assembly incorporating a surface joint and a surface joint adapter. The subsea tapered stress joint was designed as a transition between the stiff subsea control equipment and the more flexible riser pipe. However, the stress joint had to have a larger bore than the riser pipe (i.e. 7 3/8") to meet the SIL requirements and this meant that the upper section had to be as flexible as possible with sufficient capacity even with 10K internal pressure. Furthermore, the top section of the stress joint was designed to be the weakest section ensuring that the stress joint would be the first point of failure in the event of bending overload.

The moonpool joint assembly was designed for

strength and flexibility. This was very challenging during accidental offsets in 80m water depth. The high offset during an accidental vessel excursion caused very large bending moment in the riser at the centraliser 2m below the deck. As a result of this an extremely innovative solution to the problem was found to increase flexibility in the moonpool joint assembly. As part of the Emergency Quick Disconnect (EQD) sequence the riser centraliser was designed to disengage with the riser at a predetermined extreme offset limit. This greatly increased the flexibility of the riser for all accidental vessel offsets outside the extreme limit.



RESULTS

The Well Enhancer was first mobilised in 2009 with full subsea wireline and coiled tubing intervention capabilities. To date the vessel has been used in many wireline intervention campaigns in the Central and Northern North Sea and off the coast of West Africa. Most recently in the summer of 2016, a major operator conducted a campaign with riser-based coiled tubing intervention using this vessel in a Central North Sea subsea development. This is the first coiled tubing development of its kind within the oil and gas industry and is a significant step in

the continued development of the intervention industry. Already there is more interest from other operators to follow on from this campaign with riser-based coiled tubing intervention. AS Mosley provided site specific global riser analysis in support of the Central North Sea coiled tubing operations for the operator and for a number of other prospective fields which may follow on after the initial campaign. Looking forward, there is great potential for riser-based coiled tubing intervention to be a growth area within the industry.



AS MOSLEY

ENGINEERING ANALYSIS AND DESIGN CONSULTANTS

Petmathen Laundry Cottage | Oyne | Insh | Aberdeenshire | AB52 6RU

T +44 (0)1464 851 144 | E info@asmosley.com | W www.asmosley.com

