Challenges in the Design of Large Marine Pipelay Structures & it has to last for 25 years!

Evening Meeting, Newcastle

Wednesday, 22 March 2017

By M. van Zwanenberg, Principal Engineer, SMD Curvetech

This eagerly awaited talk by local engineering industry stalwart IHC EB was well attended with over 50 people crammed into Newcastle University's lecture room. Martin Bingham (Engineering Director) started proceedings with a well illustrated and highly informative over-view of pipelay and associated vessels and tower infrastructure.

Starting from the basics of why do we need pipelines, Martin gave a brief over-view of the field infrastructure of the Ormen Lange including the large number of in-field and export cables (or elongated members) present. Following this when you consider the 21.6billion m^3 of exported gas product it's soon obvious that trying to export from the field by tanker is hugely onerous, especially if you have to factor in Norwegian weather. Moving swiftly on Martin ran through the wide variety of tower types within their market and the advantages and disadvantages of each. S-lay being slow, but ideal for larger diameter pipelines and shallow to medium water depths, J-lay for deeper water depths to such an extent in the extreme it is more limited by pipeline strength than lay infrastructure. Flex lay from on-ship carousels – only for flexibles, but much faster at 20km / day. And finally Reel lay from on-board reels where additional considerations are required to straighten the pipe prior to final over-boarding. The use of pictures to illustrate these systems and Martins intimate knowledge gave everyone in the audience a real insight into the wide variety of systems available each with its own speciality.

Martin then valiantly launched into the structural aspects of tower design, noting the large numbers of equipment required within each tower from hang-off clamps, A&R clamps, Top Reels, Tensioners, and Loader Arms. Coupling all of these loads with expected vessel motions, wind loads, green sea loads and pipe loads it becomes easy to see that that towers have inherent complexity which needs significant design and engineering know-how. Even lifting of these towers is a significant design task with dedicated lift points and towers weighing upto 960Te.

James Hoy (Senior Engineer) bravely followed Martins presentation providing significantly more depth behind how the IHC tower engineers assimilate and simplify this design data. Starting from the client's specification James illustrated how IHC manage to break down this specification into manageable chunks. The prescribed wave spectrum is used to construct a spectral diagram to quantify each scenario into operational windows. These are applied to vessel RAO's to determine tower RAO's for 12 vessel headings for each of the 6 vessel degrees of freedom. Now armed with over 18,000 tower motion responses the engineers simplify the data back via spectral analysis to 3 peak inertial load-cases – peak longitudinal, transverse and vertical. From these simplified loadings tower design can now begin, however it soon gets complicated when you consider the tower can operate over a wide variety of angles and the large number of equipment loadings that could be present during a normal day of pipe-lay. Simplified as far as possible tower structural design can require over 192 inputs operationally and a further additional inputs for emergency and survival cases.

Having determined load-cases IHC perform basic structural analysis of the tower to determine critical sections, followed by detailed analysis of highly stressed areas. Again IHC demonstrated that this requires significant knowledge to analysis global strength, local strength, buckling, panel buckling and fatigue of large structures.

If it hadn't been before it was soon obvious that the IHC team was highly knowledgeable and can explain highly complicated technical problems, disseminating them down to manageable work packages to arrive at the end solution. The session closed with an active Q&A session from the floor and reminder of the next event in May on Marine Renewables.