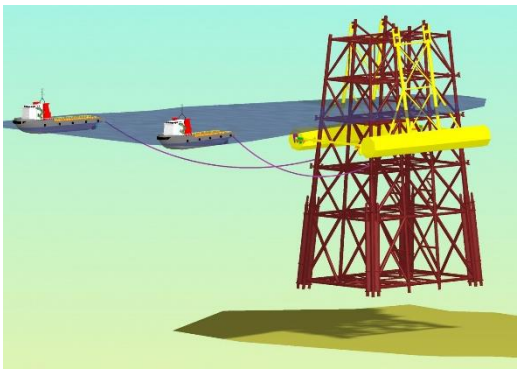
TU Delft

Offshore & Dredging Engineering

Technische Universiteit Delft

Jacket Buoyancy Lift System – Concept design and technical feasibility study

An increasing number of offshore platforms in the North Sea will have to be decommissioned in the near future, as they will reach the end of their operational lifetimes. Existing jacket removal methods are limited by currently available crane capacities of heavy-lift vessels, yet the weight of a large number of jackets exceed this capacity. With the Jacket Buoyancy Lift (JBL) system, a jacket can be re-floated as a single section in an upright orientation, after which it can be towed and moved to an inshore location for further demolition. The JBL consists of two large buoyancy tanks, both suspended from the top of a target jacket by means of a lift frame. In between the outer ends of the tanks, two tension rods are installed alongside the jacket to keep the tanks in position. This thesis aims to contribute to the further development of the JBL concept, such that it is compatible with a wide range of jackets, and to analyse its technical feasibility.



Jackets ranging from 10,000 to 25,000 t were selected as target group for removal with the JBL system. Dimensional jacket data and offshore regulations were taken into account to obtain a preliminary concept design for the JBL. The concept design was analysed for hydrostatic stability during the re-float of a reference jacket, as well as for intact and damaged conditions of the transport case. Critical for the technical feasibility of the concept is the structural integrity of the jacket upon interaction with the JBL. Of particular interest are the lateral loads that occur at the locations where the buoyancy tanks are in contact with the jacket legs, as strengthening of the jacket structure at this location is not desired. The structural integrity of the reference jacket was analysed for both in-place and floating conditions. Additionally, for the floating condition a motion response analysis was performed in the frequency domain in order to obtain an understanding of the system's hydrodynamic behaviour.

The final concept design was obtained after implementation of design modifications to the preliminary design, such that hydrostatic stability criteria were satisfied. Most notably, the legs of the lift frames were increased in diameter, thereby increasing the moment of inertia of the waterplane area. Hydrodynamic responses of the system were small, as natural periods were found outside the peak period range of the wave spectrum. For both in-place and floating conditions, the structural strength of the reference jacket was found to be sufficient to withstand the expected static and dynamic design loads.

The obtained concept design fits a large selection of jackets. As the geometry of the reference jacket is rather tall and narrow in comparison with other jackets, it is expected that the obtained design is able to provide for sufficient hydrostatic stability for the re-float operations of other jackets as well. Furthermore, the technical feasibility of the JBL is made plausible by the structural integrity analysis of the reference jacket.

For future research, it is recommended to extend the performed analyses to other jackets, as well as to implement structural degradation of a jacket in the structural integrity analyses. A damaged case for the lift frame has not been analysed, but it is expected that preventive measures, such as dividing the frame into compartments, are required to satisfy stability criteria. For further development of the tension rods and the interfaces between the buoyancy tanks and the jacket legs, impact loads between the tanks and jacket legs should be assessed and mitigated correctly.

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April 21st, 2016

Sponsor
Heerema Marine Contractors

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