TU Delft

Offshore & Dredging Engineering

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Conceptual Design & Feasibility Study: Conversion of a Jack-up Drilling Rig to a Production Platform

Overall depletion of reserves in the North Sea has freed processing capacity on many offshore platforms. To avoid building more infrastructure than required, these platforms are often used as hubs for nearby satellite fields. Oranje-Nassau Energie (ONE) has developed and successfully employs a standard low cost design for satellite platforms in the Dutch North Sea, the Oranje-Nassau Standard Satellite (ONSS). For production of fields with no nearby existing infrastructure, however, a new central gas processing and exporting platform is needed. Because the ONSS is not suited to this requirement, an alternative concept must be developed.

Due to low oil and gas prices since 2015 the occupation of jack-up drilling rigs has declined. Some of these idle rigs are in line to be scrapped and could be potentially acquired for a low price. The idea was suggested within ONE to convert an idle drilling rig into a production platform.

Worldwide there are various examples of the conversion of a jack-up unit into a Processing Platform. Weather conditions and regulation in the North Sea however are not comparable to those where these developments are most commonly found, such as West Africa and Southeast Asia. Case studies show that in the North Sea either new high specification jack-ups are used for drilling and production simultaneously or bespoke self-elevating units are employed. The concept of converting a used jack-up drilling rig into a production platform suitable for operation in the Dutch North Sea (30-50 meters water depth) must therefore first be assessed for feasibility.

In this thesis, the key challenges of the concept are identified and addressed. Following this a conceptual design for the conversion is made. What was found to be the main challenge, the design and technical assessment of the conductor support structure for use with the Mobile Offshore Production Platform (MOPU), has formed the bulk of the analyse. Finally, the capability of the MOPU to remain on location for 20 years is assessed.

ONE has identified the GEms prospect in the N blocks as a potential target for the concept. Topside design has been dimensioned for the expected size of the prospect. The assessment of the conductor support and jack-up integrity is based on conceptual data that is applicable for the entire Dutch North Sea. Market analysis resulted in the MSC designed CJ46 jack-up being selected for the concept. Design and assessment work was carried-out with support of the rig designers GustoMSC.

It has been found that with minor modifications to the preload capacity of the jack-up unit, the concept using the jack-up supported conductors is feasible up to 30 meters' water depth. Beyond 30 meters the initial constraints are: risk of vortex induced vibrations (VIV) of the conductors, the bearing capacity of the jack-up and jack-up fatigue. Initially mitigation of these issues is straightforward. Detailed studies will need to be done to verify the effectiveness of the VIV mitigation measures. Further study on fatigue sensitive areas could increase the design fatigue factor achievable by reducing conservatisms or prompt local joint reinforcement as solution. Between 30 and 50 meters' water depth mitigation of the constraints becomes increasing costly and technically challenging. Beyond 50 meters' water depth jack-up and conductor stability all become critical constraints and major design changes are required. Site-specific parameters will also affect the feasibility and the findings above must be validated in a site-specific study.

The conclusion of the research has verified the conductor support design as a feasible concept to be used with jack-ups that have been converted to production platforms. It will also allow ONE to confidently utilize the designed MOPU concept as a field development option for suitable sites. The body of the work can form a basis to initiate detailed engineering and design if the concept is selected.

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