

SUMMARY

At this moment oil and gas are the most important energy resources in our world. Many of the oil and gas reservoirs are located beneath the ocean and to make it possible to produce {recover} these resources, offshore installations are built. After their useful life these installations should be removed from the sea.

There are many kinds of Offshore installations, varying in architecture and construction. Most of the short term activities (construction, survey) are performed by mobile installations which are easy to remove and transport from the field. In favour of the real oil and gas recovery activities (*production drilling, production, processing, storage and transport*) normally permanent platforms are installed. These platforms differ in topside layout that depends on their task. Another difference in installation can be made when looking to the way the environmental forces (wind and waves) are transferred to the foundation. Doing so, six different types of sub-structures can be distinguished: *Rigidly Fixed Structures (Towers, Jackets), Guyed towers, Compliant towers, Gravity based structures, Catenary anchored floaters and Tension Leg Platforms*. At the North West European Continental Shelf the most common platform type is the Rigidly fixed structure. Their severe foundation in the sea floor and their massive weight and size make these platforms an interesting subject for a removal study.

Oil companies, Governments and other users of the sea made some *international treaties* about the result of a removal operation. At this moment platforms in less than 75 meter water shall be *removed entirely*. Platforms in deeper water may be *removed partially* if at least 55 meter water remains above the remnants to secure safe navigation.

Although, because the great diversity of structure type, size and weight, no uniform receipt for platform removal can be given, some activities will be necessary for all installations.

The first operation after the production stopped is the *decommissioning* of the installation. This can be seen as a reverse Hook-up. All the installations on board are cleaned and disconnected. In this stage the oil company also removes installation that can be useful at other locations. The method used to remove the Topside declares more or less how much work shall be done cleaning en dismantling the topsides.

After the decommissioning and partial removal of installations, still periodic inspection and maintenance are necessary. It may be possible to regain the cost of these activities partially by other (oil or gas related) use of the platform.

Finally, according to the international treaties the entire installations shall be removed. Mostly, two separate removal operations are carried out: *Removal of the Topsides* and *Removal of the Substructure*.

To remove the topside two principles are possible. By *Lifting* with a floating Lifting vessel or *Heaving* with some kind of Heaf-vessel. The latter is a new not yet applied method.

The Topside removal of small integrated topsides is no problem. They can be removed in one single Lift. The heavier, mostly modular constructed, decks shall be removed in more lifts. One of the problems than is the connection of the slings. *Stiffness, strength, integrity, weight and point of gravity* play an important role in the lift operation. Because of bad registered modifications during the production period it may be difficult to determine these features.

For substructure removal are several concepts mentioned in the literature. According to the international treaties platform remnants may stay on the sea floor if the water depth is more than 75 meter. Removal methods which result in partial removal are: *Truncation* and *Toppling*. By toppling a platform the structure finally will lie horizontally on the sea floor. Truncation is a method where the upper part of the structure will be removed and the foundation and lower part of the structure will be left in situ.

To remove the truncated part or the whole structure completely, two main concepts can be used. The first is *Lifting or Heaving* the structure. Like the removal of topsides it may be difficult to predict the exact weight and point of gravity of the structure or parts of it.

The second method to remove structures is *Refloating* by using their own buoyancy of the structure or using additional buoyancy tanks.

Closely related to the removal of offshore installations is the *Disposal* of the old structures and installations. In the literature mentioned options are: *Dumping, Scrapping, Re-use*. Another problem after or during removal is the *disposal of the Drill cuttings*. To prevent pollution by the toxic elements of the cutting piles under a platform, these piles shall be removed.

During the whole removal process the pre-engineering phase as well as during the operation several engineering areas have to co-operate. The knowledge in each engineering area has to match with other disciplines. Doing this may result in successful removal of the huge platforms which at this moment are seen as hard to handle.