DECOMMISSIONING OFFSHORE PLATFORMS WITH A CIRCULAR ECONOMY IN MIND

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Abstract - Decommissioning offshore oil and gas platforms is an inevitable process that many companies will have to carry out in the coming years or decades because their service life is approaching the end. Decommissioning the platform is an expensive process and amounts to billions of dollars a year, so oil companies are forced to find and implement the most technically, economically, and environmentally advantageous decommissioning process. The decommissioning process itself depends on several parameters including platform characteristics (e.g., size, weight, and structural integrity), water depth, legislation (global, regional, and national) and environmental protection. The principles of circular economy should be incorporated into the decommissioning process and as much material as possible should be reused instead of disposing of it in the environment.

The paper elaborates offshore platform removal possibilities, by analysing their pros and cons. It considers application of the circular economy principles in the late stages of a platform's lifetime. In addition, the issue of decommissioning of offshore platforms in the Adriatic Sea, Croatia, is presented.

Keywords - Decommissioning, Offshore Platforms, Circular Economy, Environmental Impacts, Adriatic Sea

I. INTRODUCTION

Eventually, each hydrocarbon field will reach the end of its economic lifetime, so decommissioning of oil and gas facilities is becoming a major issue facing oil companies. It is about a complex and expensive operation, aiming at returning the site to its original state. For that purpose, different removal procedures are available and used and related costs are not the only parameter that must be considered. Comprehensive legal requirements, health and safety standards, or environmental effect, are crucial for decision making (Edalat & Bagherinia, 2018). According to Antony et al (2000), there was about 10,000 offshore facilities installed worldwide in the past 50 years. Majority of number refers to steel jacket platforms, under 45,000 t weight that are installed at depths over 400 m.

Decommissioning of 5,335 platforms installed in the Gulf of Mexico began in 1967. By 2000 about 30% of them had been decommissioned (one-third were monopods and two-thirds were jackets with 4 and 6 legs). In the North Sea (UK North Sea, Norway, Denmark, the Netherlands, and Ireland) 30 (5.4%) platforms were decommissioned, and in Australia 4 (7.5%) platforms. A considerable decommissioning activity have been performed in the Gulf of Mexico, but generally only for small jacket and caisson structures, while in the North Sea, complete removal is preferred.

The global offshore decommissioning market is estimated at $ 5.2 billion in 2021 and is projected to reach $ 8.0 billion by 2027 (URL 1). The growth of the offshore decommissioning market is driven by aging offshore infrastructure, growing number of abandoned wells and the presence of large mature oil fields around the world, and low international oil prices.

Well plugging & abandonment accounts for up to 49% of the total decommissioning cost of a project (URL 1). According to Oil & Gas UK, in Decommissioning insight 2019, overall, 2,436 wells are expected to be decommissioned in the North Sea during 2020–2029 (OGUK, 2020). Europe is expected to be the largest, by value, offshore decommissioning market driven mainly by activities in the UK, Norway, and Netherlands (URL 2). Offshore decommissioning projects are expected to cost the industry billions of dollars in the next two decades (Eke et al., 2021). Due to the huge costs of decommissioning, the oil industry is rapidly looking for techniques to improve efficiency planning and execution of such projects and ensuring the use of optimal decommissioning options (complete removal, partial removal, or artificial reefing) (Genuine & Olaide, 2019; Eke et al., 2021).

II. OFFSHORE PLATFORM CONSTRUCTION

Offshore platform construction can be bottom-supported or floating (Figure 1). Bottom supported platforms are divided into fixed (jackets and gravity base structures) and compliant (guyed tower and the compliant tower). Floating structures can be semi-submersible-based Floating production storage and offloading objects (FPSO), ship-shaped FPSOs, monocolumn Spars, or Tension leg platforms.
Different offshore seabed environment requires different production platforms (Chakrabarti, 2005). Small installations are under 200 t weight, and large topsides can exceed 50,000 t, gravity based structures

can reach hundreds of thousands of tons (Leporini et al., 2019). The fatigue loads on fixed legs is so great, that non-floating platforms can only be used in shallow, coastal waters.

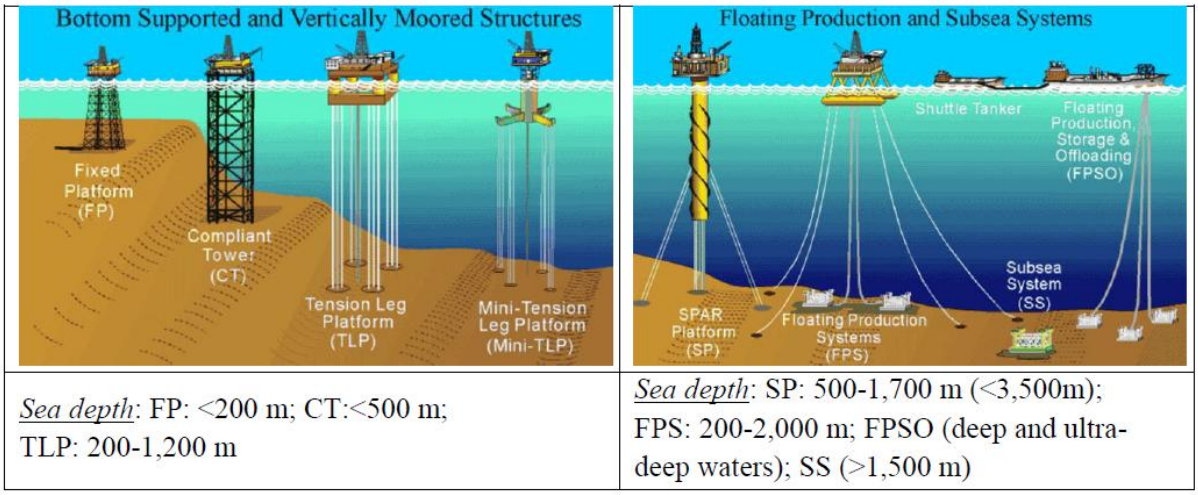


Figure 1. Common types of offshore production facilities (URL 3)

III. DECOMMISSIONING PROCEDURE

Common phases in the conventional process of platform abandonment and removal are shown in Figure 2. During decommissioning, topside facilities are completely removed and taken to shore for partial reuse or recycling. The substructure supporting jacket is generally severed 4.57 m (15 feet) below the mudline, then pulled out of the seafloor, and removed for reuse or recycling. Partial decommission refers to cutting at different reference depths, as referenced in literature and several decommissioning regulatory documents (Bernstein et al.; 2010; IOGP 2017; OGUK 2020,).

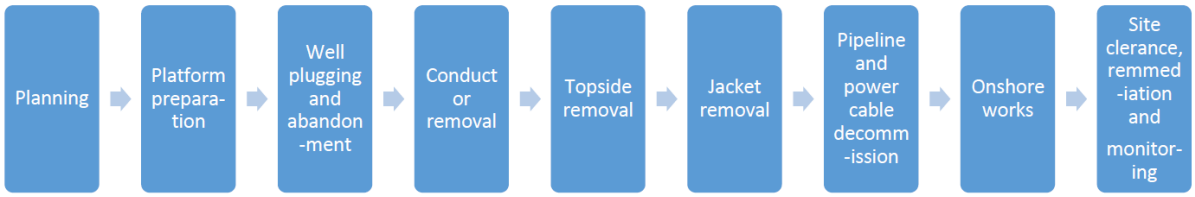


Figure 2. Common phases in the process of platform abandonment and removal

3.1. Regulation acts concerning decommissioning

There is a variety of international, regional and national acts dealing with decommissioning. Many countries have minimal national decommissioning related legislation, and such requirements are usually incorporated into operating agreements between Operators and the Concessionaire. Nevertheless, national legislation shortage is compensated by either regional protocols or international regulations/guidelines (IOGP, 2017). When it comes to international guidelines, the United Nations Convention on the Law of the Sea (UNCLOS III) 1982, and the International Maritime Organization's (IMO) Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone (EEZ) adopted in 1989, represent common practice (IOGP, 2017). The UNCLOS III retains the standard of complete removal with possible exceptions for technically very demanding and quite impossible removal of large platforms. The IMO Guidelines require removal of all structures in <75 m of water (or in <100 m of water for all platforms installed after 1/1/1998) and <4,000 tonnes in air excluding deck and superstructure, as well as those located in navigation important areas. The platforms installed after 1998 must be designed in a way possible to be removed. In case of partial decommission, the jackets must be cut at least 55 m from the sea surface.

Regional conventions are supplemented to international conventions around the world. In the North Sea, there are Oslo Convention, OSCOM Guidelines and OSPAR Convention. Barcelona Convention is applied in the Mediterranean, while Kuwait Convention in the Persian Gulf. Among the EU directives, Marine Strategy Framework Directive aimed at reaching Good Environmental Status (GES) of the marine waters can be singled out when it comes to decommissioning issue.

3.2. Platform decommissioning options, circular economy and reuse

Decommissioning procedures applied for the removal and disposal of offshore facilities depend on different

technological parameters, including (Della Greca, 1996): platform size and weight, water depth, structural integrity, lifting capacity, disposal destination, weather conditions. There are two possible destinies for offshore facilities: decommissioning, or leaving the platform/jacket structure in place for alternative applications (Figure 3).

The conventional approach considers decommissioning of platforms located at shallow or moderate waters and disposal of the topside and/or the jacket ashore, or in case of deep water, partial removal of jacket platforms and its conversion to artificial reefs. More recent solutions can refer to LNG terminal, wind or solar power generation, military uses, etc. For the well, potential reuses include CO2 storage (URL 4).

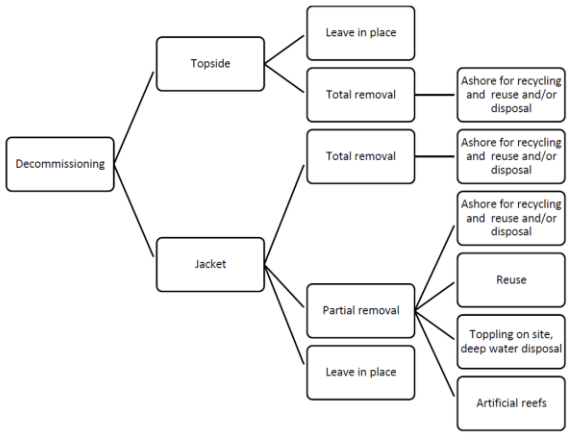


Figure 3. Decommissioning options (according to Edalat & Bagherinia, 2018)

Concern on fishes and invertebrates' survival beneath platforms has led to global reefing of offshore platforms jackets (mostly referred to USA, although some examples are present in Malaysia, Brunei, and Japan). North Sea region does not have comparable large-scale activities. Since the OSPAR regulation requires offshore structures to be removed and transported to shore for recovery and disposal, about 10% of the oil and gas installations in the North Sea have been decommissioned in this way. There is more than 95% of the recovered materials reused or recycled (EMB, 2017; Scarborough Bull & Love, 2019).

IV. DECOMMISSIONING ISSUE: NORTH ADRIATIC, CROATIA

To date, 128 exploration wells and 51 production wells have been drilled in the Northern Croatian part of the Adriatic Sea. There are three exploitation fields "Izabela", "Northern Adriatic" and "Marica" (Figure 4), producing less than 1 billion m3 of natural gas annually (www.azu.hr). Production wells are connected to 19 fixed production platforms and 1 compressor station platform (Table 2). A total of about 28,000 tonnes of iron was installed. Depending on leg number, platform jackets are monopod (50%), tripod (15%) and 4 –legged (35%). About 50 % of total weight (installed iron) belongs to deck, i.e., the process part of the platform (Farkaš-Višontai et al., 2019).

More than 270 km of pipelines of various diameters connect production platforms and form a unique gathering-transportation system with connected to Pula and the Garibaldi platform in Italy. In addition to gas pipelines, about 350 km of produced water pipelines and instrument air supply systems have been laid (Farkaš-Višontai et al., 2019). All offshore structures must function safely for at least 25 years – and fixed platforms are no exception.

During the decommissioning in the "North Adriatic", the following series of activities are planned: 1. plugging (3-4 cement plugs) and well abandonment; 2. removal (at the site of the well) and transport of the topside to the mainland; 3. disassembly of topside on land; 4. rinsing the pipeline and leaving it on the seabed (as an artificial reef); 5. removal (at the well site) and transport of the jacket structure on the shore.

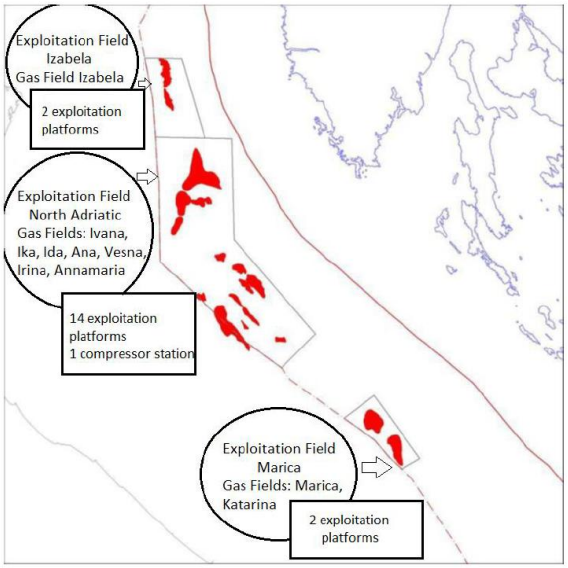


Figure 4. Overview of exploitation fields and production platforms in the Adriatic Sea, Croatia (according to URL 5)

V. CONCLUSION

Worldwide, the oil industry is already facing a major challenge due to the obligation to decommission many offshore platforms and seeking ways to reduce overall cost. Although each decommissioning project is unique in terms of platform characteristics and several other factors, the following general conclusions can be drawn:

- Several options exist for decommissioning an offshore platform such as complete removal, partial removal, and artificial reefing.

- Determining the best options is a complex decision-making problem which depends on the platform's attributes such as configuration, weight, material composition and location.
- Final decision requires a thorough evaluation of all the available options with reference to environmental impact, safety implications, financial costs, technical feasibility, and public perception.

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