FSO Conquering Offshore Oil Fields

A giant seaborne crude-oil terminal that taps into offshore oil fields around the world: IHI presents the "ERAWAN 2" floating storage and offloading (FSO) system

The increased demand for crude oil accompanying industrialization in emerging economies is pushing up the price of crude oil. In response to this increased demand, the development of offshore oil and gas fields in the open sea and deep waters is moving forward, where until recently extraction was not economically feasible. Offshore energy plants are advancing the development of offshore oil and gas fields that are attracting a growing interest worldwide.

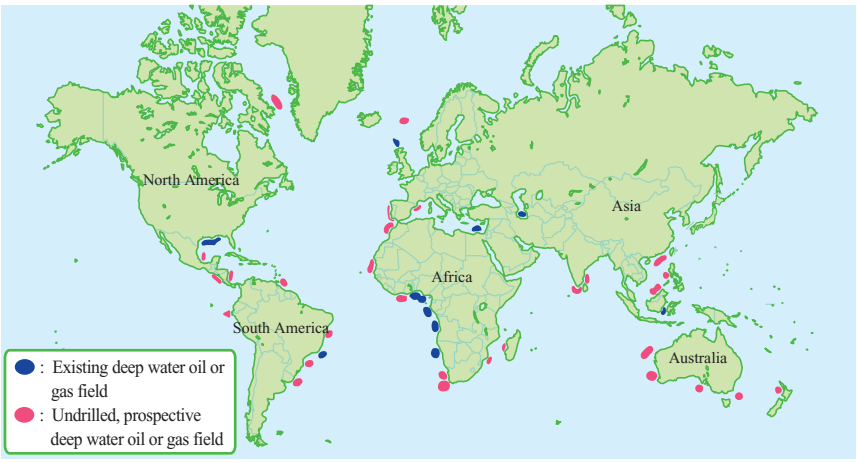
"ERAWAN 2" a floating storage and offloading system

Today, 40% of the world's crude oil is extracted from offshore oil fields

Increased oil consumption is pushing up the price of crude oil. This has encouraged the development of oil fields deep underground and offshore, which had been difficult due to the associated high costs.

More specifically, extraction from offshore oil fields has become economically viable not only in coastal waters, but also in the open sea and waters deeper than 300 meters. In recent years, the development of offshore gas fields has been underway since natural gas has attracted increasing attention as a source of clean energy. The earliest recorded development of an offshore oil field is said to be the one off the coast of California in the United States in 1890. Since then, the number of offshore oil fields has grown to account for reportedly around 40% of the world's total extraction of crude oil.

Development of offshore oil fields utilizes special systems called "offshore structures." Various types of offshore structures are selected according to the conditions of the oil field, such as its scale and distance from the coast. An offshore structure used in relatively shallow water consists of a base structure that reaches the seabed and equipment built atop. But an offshore structure with floating equipment secured by mooring cables, such as wires fixed to the seabed, is suited for offshore oil fields in deep water (1 000 m or more). Such structures can be used in a wide range of water depths. There are about 240 units currently in operation in the world's oceans. These offshore structures are divided into: 1) Floating Storage and Offloading



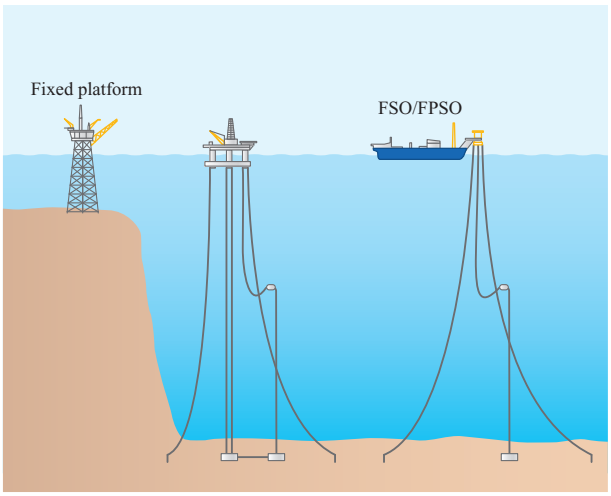
Oil and gas fields throughout the world

system (FSO) exclusively for storing and offloading crude oil without any production equipment; and 2) Floating Production, Storage, and Offloading system (FPSO) with production equipment.

Having the appearance of a ship

In the case of offshore oil fields near the coast, the extracted crude oil is transported to onshore refineries by pipeline. If such pipeline transportation is difficult, crude oil is first stored and refined at sea, then transported every five to ten days by transport ships called shuttle tankers. FSO and FPSO are the offshore structures used in such circumstances. The appearance of FSO and FPSO resembles ships such as bulk carriers and tankers. But they do not have engines to propel themselves. They are towed by tug boats when they need to be moved elsewhere. FSO and FPSO are not ships, but rather they are seaborne plants. For this reason, they must be constructed to satisfy the required standards for both ships and plants. Tankers are docked once every few years to be checked and repaired. In contrast, FSO and FPSO continue operation in the same waters for more than 10 years once they are moored offshore. Naturally, they are subject to tighter safety and reliability requirements compared to ordinary ships.

Moreover, their design and construction work must meet the stringent health, safety, and environmental management standards that each oil developer has put in place for its own operation.



Offshore systems involved in crude oil extraction

"ERAWAN 2"

In April 2012, IHI Aichi Works completed an FSO called "ERAWAN 2" and delivered it to Erawan 2 FSO Bahamas Ltd. This system was towed to the Gulf of Thailand and installed there for commercial production of condensate — a type of crude oil. This enormous FSO, having a length of 262 m, a width of 46 m, a depth of 24 m, and storage capacity of approximately 1 million barrels, also serves as a hotel for people who are visiting other offshore structures located in nearby waters.

It was extremely challenging to provide a design that would satisfy construction standards for FSO under such a tight construction deadline. But IHI gained a high level of confidence from its achievement — one made under rigorous safety standards in a short period of time. The IHI Group will intensify its efforts to provide offshore LNG production equipment, utilizing its own SPB tank technology.

Mini commentary

Although the majority of Thailand's population claims to be Buddhist, some worship Brahmanic (Vedic) or Hindu gods. Thus, the FSO ERAWAN 2 also has a designated prayer room—evidence of the deep faith held by the Thai people.

By the way, did you know that Erawan is the Thai name for the "three-headed elephant" who carries a god in Brahmanism and Hinduism? According to their beliefs, the god of thunderstorms, Indra, rides Erawan when he descends from the heavens to Earth to bring rain and to fight with the evil gods, the Asuras, etc. Meanwhile, in Japan, Indra is worshipped as *Taishakuten*, while Asuras are venerated as Buddhist guardians called *Ashura*.

Erawan, the elephant god

Inquiries:
Marketing & Project Development Department,
Offshore Project & Steel Structures Operations,
IHI Corporation
Phone: +81-3-6204-7165
Website: www.ihi.co.jp/en/