Aasta Hansteen

Northern Norwegian Sea Spar Heads
High-Latitude Spars Development

T.EN TECHNIP ENERGIES

Overview

Equinor's 2012 award of the first spar platform for its Aasta Hansteen field development in the northern Norwegian Sea provided the first opportunity to build a floating platform with steel catenary risers and a large volume hull condensate storage in this area. The contract, awarded to a consortium composed of Technip Energies and Hyundai Heavy Industries (HHI), covers engineering, procurement, construction and transportation of the spar hull and its mooring systems at a depth of about 1,300 m (4,250 ft). Project management, engineering and procurement were based in Houston, Texas, USA and fabrication in HHI's Ulsan fabrication yard in South Korea. After the heavy lift vessel transport to Norway, the spar was offloaded, upended, ballasted and then installed in a temporary mooring for the final commissioning scope of work.

- **Contract:** EPC
- **Award:** 2012
- **Delivery:** 2018
- **Client:** Equinor
- **Location:** Norway

Project executed on three continents

45,000 tonnes of hull

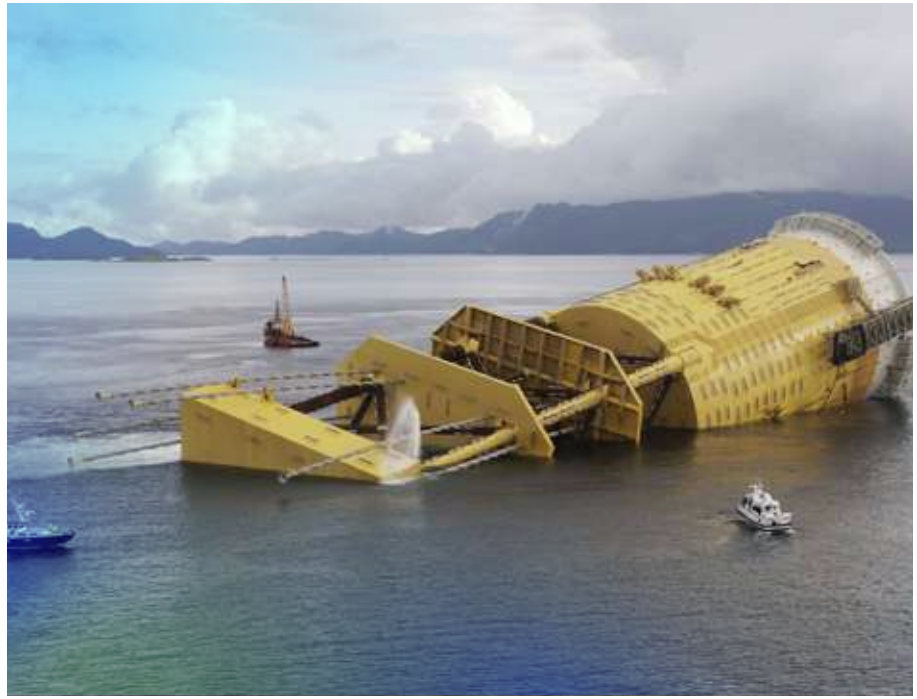
26 vessels used through the entire marine scope

Extensive marine operation involving a flotilla of vessels, including a 30,000-ton iron ore carrier for the spars fixed ballast

Challenge

It was the first time a spar hull was designed and built to NORSOK and other specific Norwegian requirements. The platform had to be built to survive 10,000-year storm conditions and continue producing during 100-year storms without evacuation. The design also had to accommodate more extreme conditions and higher fatigue utilization than those found in the Gulf of Mexico (GoM).

The smaller motions of the spar helped make steel catenary risers and the riser support system feasible in the harsh environment. While the absence of strong ocean currents like the Loop Current in the GoM eliminated the need for strakes on the hull to control vortex-induced motions, the design needed to incorporate new technical solutions such as an elevator in the moonpool access shaft and condensate storage in the hull.



Technologies

The spar platform provided 25,000 cubic meters of storage for condensate in the hull and an offloading system to dynamically position tankers, making it a floating production storage offloading (FPSO) system — another first for a spar. The space required for the segregated storage, along with a 31,500 tons topside, made Aasta Hansteen the largest truss spar hull at 50m in diameter and 198m in length with total displacement of 146,000 tons. Pull tubes were used to support the steel catenary risers, which enabled continuous welded import and export risers from seafloor to topsides without leak prone mechanical connections.

The hull was built in South Korea by the consortium partner HHI and was transported to Norway on the Vanguard heavy transportation vessel. In Norway, the topsides were installed by floatover in a fjord before being towed vertically about 500 nautical miles to the offshore site.

Solutions

The customer had very challenging specifications and requirements that had never before been employed in a spar design. After a period of engineering and design assessment, Technip Energies developed and implemented a series of unique solutions that became industry firsts, including:

- World's largest spar (50m diameter, 198m long).
- First spar with large storage (condensate) in the hull.
- First use of pull tubes to support all import and export SCRs for a truss spar.
- First spar designed to NORSOK, PSA, NMA and other Norwegian requirements, more stringent than other areas of the world.
- First use of elevator in the hull and between topsides and hull on a spar.
- First use of permanent HVAC, permanent bilge system and pumps, hydraulic control of valves, electrical and equipment rooms with topsides controls replicated in the hull, permanent utilities piping (water, hot water, instrument air, compressed air and nitrogen) with multiple utility stations, permanent fire water system with multiple fire cabinets in the hull, fire and gas detection and CCTV and PA system in the hull.
- First spar hull to be mated to its topsides in a fjord and then towed vertically to site.
- First use of nonlinear-coupled analysis for Global Performance included the true effects of hull, mooring and risers.
- First use of computational fluid dynamics (CFD) to compute green water and wave impact loads on hull and topsides
- First use of noise insulation inside the hull.
- First use of rope access to inspect the hull compartments.
- First use of castings in the truss and hard tank/truss connections due to high-fatigue demand.

Results

In addition to the northern Norwegian Sea, spar hulls with and without storage may find favor in the high-latitude deeper waters of the Barents Sea due to their ability to support all types of risers to withstand harsh extreme and fatigue environments without the need to disconnect and to the presence of fjords for floatover installation of precommissioned topside facilities. The fjords also allow the spars to be fabricated vertically from concrete using a constant cross-section slip form, making them attractive for use off Norway and eastern Canada with the latter area's challenges of ice and icebergs.

From an execution standpoint, Aasta Hansteen represented one of the most complex and challenging construction projects of its type ever conceived.

It involved major coordination of people, equipment and information across the globe and required many millions of man-hours. The project demonstrated the capability and capacity of our project management systems to cope with multicenter megaprojects even when faced with technologically challenging first-of-a-kind engineering requirements.

This spar is the 17th executed worldwide by Technip Energies, a world leader in spar design and delivery.