

Shuttles forged in the crucible

From their nurturing grounds in the unforgiving waters of the North Sea, shuttle tankers are spreading to all corners of the globe. The Gulf of Mexico, Brazil, west Africa and Canada are all benefitting from the technology

Shuttle tankers have been growing in importance in tandem with the expansion of the offshore oil industry. In the North Sea, for example, offshore loading systems were used to transport 36 per cent of the crude oil lifted in 1995. Today, offshore loading into shuttle tankers accounts for 47 per cent of the North Sea's total production. This trend is being repeated globally, not least in the waters off Brazil, West Africa and in various locations in Asia. More recently, shuttle tankers have been employed on Canadian fields, while the US stands poised to put such vessels into service to assist with the development of deepwater reserves in the Gulf of Mexico.

More difficult waters

Offshore oil now accounts for one-third of total world production and is growing at a faster rate than the onshore output. Success in developing offshore oil fields has come as a result of the rapid evolution of floating production technologies.

In the early days of offshore production, oil fields were close to shore and needed to be of a certain size to justify the high cost of the rig that would be fixed to the same spot on the seabed over its working life. New technologies are enabling the economic development of more marginal reserves and those in deeper waters.

Modern floating production systems (FPSs), or "floaters", enable oil companies to exploit offshore oil reserves much more quickly and more cost-effectively than ever before. The FPS mix includes floating production, storage and offloading vessels (FPSOs), semi-submersibles, tension leg platforms and spar buoys. The first ship-shaped FPSO was commissioned in 1976 and today FPSOs account for two-thirds of the floaters currently in service.

According to figures compiled by the UK-based oil industry analysts Douglas-Westwood Ltd, there are currently 74 FPSOs operating worldwide, while 24 such units are on order and a further 17 FPSO projects are "probable".

Shuttle tankers, which enable the safe and rapid delivery of offshore oil to nearby terminals, are an essential element of the offshore oil success story.

Teekay tops

The most important development in the shuttle tanker operator sector over the past year was the sale by Statoil of its Navion tanker business to Teekay in December 2002 for \$800 million. The transaction enables Statoil to focus on oil and gas production and exploration and on downstream activities in the Nordic markets. It also combines the fleets of two of the largest shuttle tanker operators in the world. Prior to the acquisition Teekay already operated one of the world's largest shuttle tanker fleets. The Vancouver-based shipowner established a foothold in March 2001 when it paid \$123 million for a 56 per cent stake in Ugland Nordic Shipping, the largest publicly traded shuttle tanker operator.

Now, the Navion purchase has more than doubled the group's shuttle tanker transport capacity and given Teekay a dominant position in the North Sea shuttle market. Navion has added some 40 shuttle contracts with oil producers, and a fleet of nine owned and 17 chartered tankers dedicated to this business, to the 18 vessels acquired with Ugland.

Teekay also operates the world's largest fleet of medium-size tankers, with 54 Aframax ships. Shuttle operations are based more on long-term contracts than traditional tanker shipping activities. This ensures that shuttle tankers provide a more

stable income flow than tankers serving the broader tanker market which is characterised by wide fluctuations in freight rates.

Tanker attributes

Looking at the attributes of a representative, recently built vessel, it can be seen that for shuttle tankers reliability and a high degree of manoeuvrability are key features. As shuttle tankers are part of the oil production train and downtime must be kept to a minimum, the ships are provided with propulsion system redundancy.

In addition, the ships are provided with a dynamic positioning (DP) capability in order to maintain a high degree of control when manoeuvring in the vicinity of floating structures to hook up to the loading connection.

DP systems allow vessels to remain in a specified position by engine power alone, without the need for anchors. Such systems also increase operational safety while reducing bunker consumption and atmospheric emissions, in comparison to manual vessel manoeuvring techniques.

Shuttle tanker loading systems are designed to enable connections and crude oil transfers even in rough seas, up to a certain agreed limit.

Sample shuttle

The 120,000 dwt Navion Britannia is one of a series of three sisterships built at the Sestao yard of Izar in recent years. It is a good example of a particularly flexible, modern, double-hull shuttle tankers in that it features not only bow loading (BL) and submerged turret loading (STL) systems but also fitted with a submerged turret production (STP) system. The latter system enables the ship to produce oil offshore as well as load it.

STL, which was first used on the Fulmar field in the UK North Sea in 1993, is recognised as the new standard in offshore loading. The technology allows loading operations to continue in rougher seas than is possible with earlier systems.

With STL a submerged, catenary-anchored buoy is pulled into a recess in the bottom of the tanker near the bow to provide an effective mooring. The loading hose runs through the buoy to a rotating connector, or swivel, which allows the ship to weathervane freely so that it remains positioned bows-on to the wind and waves.

Cargo capabilities

Navion Britannia is arranged with two longitudinal bulkheads and a series of transverse bulkheads which divide the cargo space into 18 cargo tanks and two slop tanks. This high degree of subdivision helps to reduce the release of cargo vapour volatile organic compounds (VOCs) during loading. Two segregated cargo grades can be accommodated simultaneously.

Navion Britannia is able to load crude oil from a variety of offshore facilities or from a conventional oil terminal through the midship manifold. The vessel can be moored at offshore facilities in seas with a significant wave height of up to 4.5 metres and in winds of up to 25/30 knots. The ship is capable of transfer rates of 8,000 m³/hour through its BL and STL systems and 12,000 m³/hour through the midship manifold.

Fingertip control

The ship's main propulsion system is comprised of twin two-stroke, slow-speed diesel engines, each driving a controllable-pitch propeller. Two symmetrical engine rooms, divided by a fire-resistant, watertight longitudinal bulkhead, house the engines. In addition, Navion Britannia is provided with four generators and an emergency engine.

Manoeuvrability is provided by two schilling-type rudders, driven by two rotary-vane, electro-hydraulic steering gears, and the dynamic positioning system. Controlled and monitored from the bridge, the DP system is based on two tunnel/retractable, controllable pitch bow thrusters and one retractable, controllable pitch stern thruster.

The loading of the shuttle tanker is automated, with use made of several independent, integrated control and monitoring systems. These include the cargo control system (CCS), the main engines remote control system (MERCs), the DP system, the thrusters control system (TC) and the integrated navigation system, in addition to the BL and STL loading/discharge systems.

Technology crucible

The North Sea, and particularly the Norwegian sector of the North Sea, has provided a rigorous nurturing ground for shuttle tanker technology. Navion and the other Norwegian shuttle tanker operators have pioneered the technology and concepts that have established the pivotal role now provided by these ships. Shuttle tanker operations that function safely and efficiently in the harsh climate of the North Sea can be easily transferred to other waters.

Another type of loading technology developed in the North Sea is the single anchor loading (SAL) system. Such systems are unable to function in weather as extreme as that with which STL systems can cope, but they allow offshore fields to be developed at a reduced cost.

SAL systems comprise a single or double mooring line attached to a suction anchor or pile on the seabed. A swivel stands on top of the anchor. The oil flow is carried through a flexible hose up to the ship, which weathervanes freely. Placing the swivel function on the seabed means that less conversion work is needed to adapt a tanker for SAL.

Continuous loading

Recently, Advanced Production and Loading AS (APL) of Norway contracted with Uglund Nordic Shipping (UNS) for the supply of two SAL systems for use in Tuscan Energy's Ardmore field in the UK North Sea.

The systems will be used for direct shuttle loading at the field. Because Ardmore has no infield storage, the production from the process plant onboard the Gorilla VII platform will be pumped via one of the SAL systems into one of two dedicated UNS shuttle tankers.

To ensure continuous production, another shuttle tanker has to be connected to the second SAL system before the first shuttle tanker is full. The systems at Ardmore will be of similar type as the one installed at the Petro-Canada operated Hanze field on Dutch shelf. SAL systems have already been selected for five field or terminal applications and over 300 shuttle tanker loads have been exported.

Azimuthing

IMO specifies three classes of dynamic positioning (DP) systems, with Class 2 the most common for shuttle tankers. Class 2 (DP2) ships must remain in the specified position even after a single failure in active components or systems.

Shuttle tankers have traditionally been provided with a DP2 capability through their two main engine rooms and dual propulsion and steering systems. However, some ship designers believe that with the new propulsion technologies becoming available, redundant engine rooms is a relatively expensive configuration.

Navion's new generation shuttle tanker concept meets the DP2 requirements but replaces one of the main engines with one or two azimuthing thrusters positioned on the bottom of the tanker. According to Navion, this arrangement provides substantial savings and improves operational safety. The concept also makes it possible to convert an existing shuttle tanker with only one engine room from a DP1 to a DP2 ship.

Navion took delivery of Bertora, the first ship of this type, from the Samsung yard in South Korea in January 2001. Two further such shuttle tankers are under construction for the owner at the same yard for delivery in 2003 and 2004.

Japan in Brazil

Most Brazilian oil production is located offshore and the country is committed to further developing its deepwater oil reserves. Considerable use is already made of shuttle tankers, all of which have been acquired from Petrobras, the state energy company, and all of which are now owned and operated by the Petrobras subsidiary Transpetro SA.

In recent months an agreement has been finalised which will bring the first non-Brazilian shuttle tankers into operation in the country's offshore waters. Marubeni Corporation and Itochu Corporation will each charter an \$80 million shuttle tanker newbuilding to Transpetro.

Upon delivery, the two shuttle tankers will be primarily used for the carriage of crude oil from the offshore Campos field to the coastal terminal in the port of Sao Sebastian.

Grand Banks oil flows

Production from the Hibernia and Terra Nova fields off the coasts of Newfoundland and Labrador, which is now running at 275,000 barrels per day, requires the services of three, purpose-built 127,000 dwt shuttle tankers for the delivery of the oil to the transshipment terminal at Whiffen Head on Placentia Bay.

The tankers - Mattea, Kometik and Vinland - are operated by Canship Ugland, a joint venture formed by Canship and J J Ugland of Norway. The ships are the first shuttle tankers to go into service in North America. Canship Ugland also manages two purpose-built Whiffen Head escort tugs, Placentia Hope and Placentia Pride, which are used to help ensure a safe passage for tankers entering and leaving the Newfoundland port.

The shuttle tankers complete their Whiffen Head round-trip voyage in four and one-half days. Because oil production levels are so high, it is most cost-effective to discharge the shuttle tankers at Whiffen Head rather than have them proceed to more distant US and Canadian East Coast refineries. Deliveries from Whiffen Head's storage tanks to refineries are best handled by so-called "second leg" tankers falling in the 35,000-155,000 dwt range, with each customer nominating a ship size best suited to their precise requirements.

New to the Gulf

A new potential area of operation for shuttle tankers is the Gulf of Mexico. Growing interest in the development of oil and gas in deeper waters and regulatory acceptance of the use of FPSO technology as a development option are heralding a new role for shuttle tankers.

Because the exploitation of deepwater reserves is regarded as a domestic operation, the use of Jones Act shuttle tanker tonnage will be required, i.e. US-built, US-flag ships manned by American crews. American Shuttle Tankers LLC (AST) of Houston has been established in recent years as a 50/50 joint venture by Navion and Skaugen PetroTrans Inc to participate in this new opportunity. AST is hoping to have its first Jones Act tankers converted to shuttle service by the end of 2003.

AST is promoting its Separate Storage Shuttling (SSS) technology to broaden the range of offshore Gulf production facilities that can be served by shuttle tankers beyond FPSOs. The SSS package also includes tension leg platforms (TLPs), semi-submersibles and spars.

The aim of the SSS package of options is to overcome the economic shortcomings of direct shuttle loading by dedicating a dynamically positioned tanker to receive and store oil from a nearby production facility. This crude oil is then offloaded from the storage vessel into a shuttle tanker for delivery to coastal refineries in the region. AST has signed an agreement with Seabulk Tankers, Inc of Fort Lauderdale whereby Seabulk will make certain of its double-hull Jones Act tankers available for conversion to enable deployment in the Gulf of Mexico within a matter of months.

The arrangement permits the use of shuttle tankers in the Gulf within a year, if need be, in contrast to the three years that would be required if the vessels were newbuildings.