

## **VESSEL DESCRIPTION**



*Odin*

**Vessel Name** : **MST Odin (Ex. Navion Odin, and MST-4)**

**Current Status** : **Trading as tanker for Statoil**

## 1 Concept Description

The multipurpose shuttle tanker concept (MST) combines well proven ships construction practice and standardised submerged turret technology to yield low-cost construction and high utilisation over the vessel lifetime. The vessel has been designed for operation in harsh environment, and special attention has been paid to structural details in order to achieve a fatigue life of 20 years, based on West of Shetland (Foinaven) scatter diagram.

The Odin facilities consist of a vessel prepared for installation of a topside process plant or well intervention plant. As an FPSO, Odin is prepared for installation of APL's Submerged Turret Production system (STP) and a standardised oil export system. However, other systems may also be adapted. The final components will be selected and be field specific, when a contract is awarded. However, the total facility will be constructed, commissioned and operated as a single unit.

The STL/STP (Submerged Turret Loading / Submerged Turret Production), process and hull solution maximise the benefits of standardisation and flexibility. The result is a combination of production vessel (FPSO), intervention vessel, storage tanker (FSO), shuttle tanker and conventional tanker. This flexibility enables the MST to operate in several "liquid" markets thereby securing high utilisation over its lifetime.

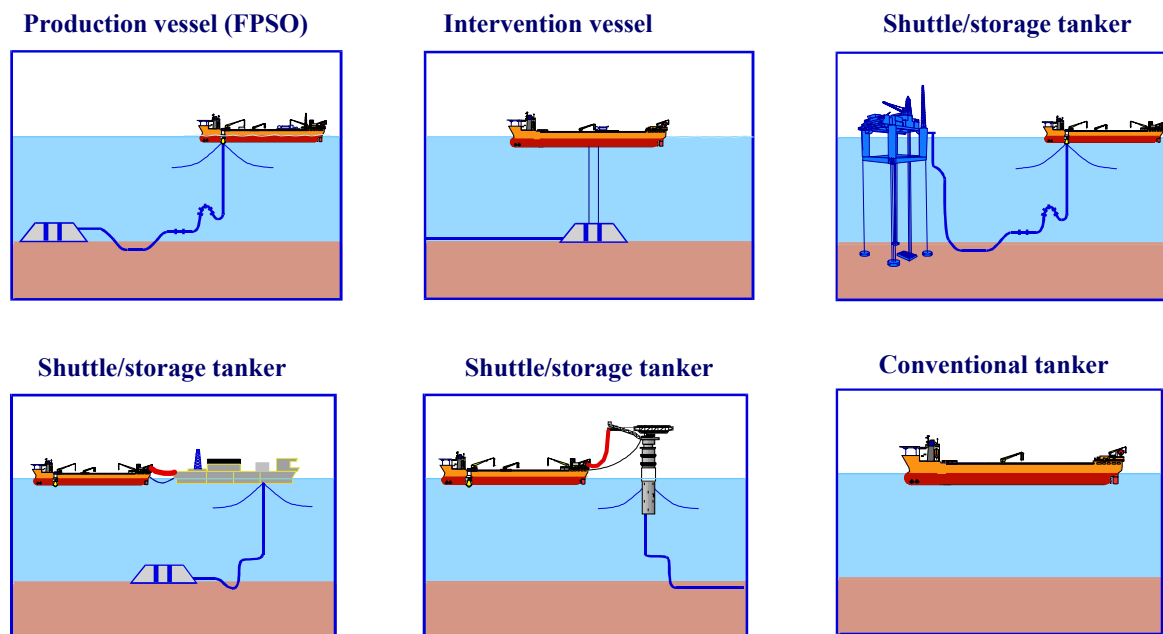


Figure 1.1 – MST: Multipurpose Shuttle Tanker

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The Odin concept is based on the assumption that the vessel will be utilised as an FPSO or a drillship, and is built on the previous experience of MST FPSO projects *Lufeng* and *Pierce*. In principle these well proven solutions combine the following three independent components, which together constitute a complete FPSO:

- MST vessel with oil export facility (stern discharge system)
- STP system
- Topside process

In addition, field specific facilities, such as the subsea systems, risers and flowlines have to be installed to make a complete FPSO production system. Figure 1.2 illustrates a typical layout as FPSO.

As the vessel is a full IMO DP class 3 vessel, it is also well suited to be the basis for a well intervention vessel. A well intervention rig and equipment can be installed on deck in order to provide the FPSO with intervention capabilities through the midship moonpool.

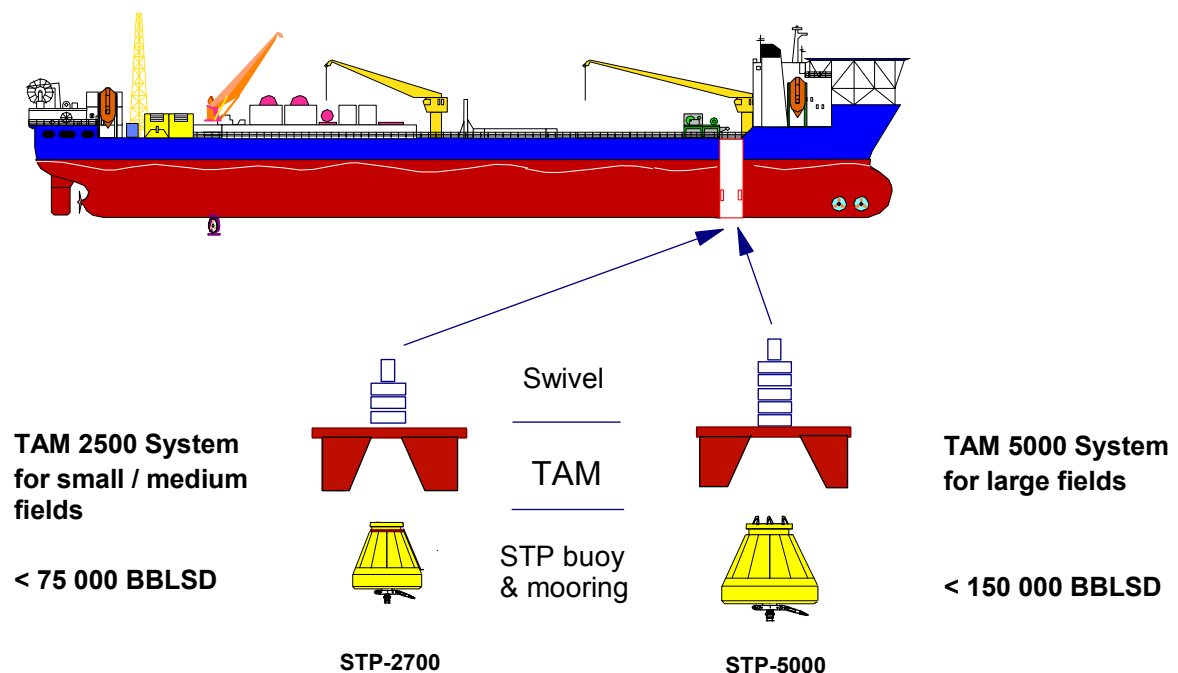


Figure 1.2 – Odin Typical layout as FPSO

## 2 Design Basis

### 2.1 Authority Regulations and Codes

The MST-vessel has in principle been designed and built to fulfil the requirements for design, operation and demobilisation in accordance with the applicable requirements of the Norwegian Petroleum Directorate (NPD) regulations for fixed installations. However, as no process facility has been installed, the vessel is presently having the class notation as a storage vessel only.

The vessel is presently carrying a Bahamas flag as a Tanker for Oil. The vessel is however built according the Norwegian Maritime Directorate regulations for 'Mobile Offshore Units' (MOU), which also satisfy the applicable requirements of the IMO MODU code.

As the vessel is fulfilling the above requirements, it is assumed that the vessel will comply with other relevant national and international regulations applicable for this type of vessel for worldwide operation, both as a FPSO and a tanker for oil.

The philosophy used to comply with the above mentioned authority requirements might be summarised as follows:

#### 1. NPD Regulations for fixed production installations:

- Partly covered by the DNV "Oil Storage (N)" class notation
- Additional requirements when operating as an FPSO are incorporated in the vessel according to Owner's interpretation the regulations.

#### 2. NMD MOU Regulations:

- NMD's Regulations of 20 December 1991 concerning stability, watertight subdivision.....
- NMD's Regulations of 4 September 1987 concerning potable water systems.....
- NMD's Regulations of 22 December 1993 concerning helicopter decks on offshore units.
- Other requirements from the NMD Regulations are incorporated in the vessel.

#### 3. IMO MODU Code

- Partly covered by the NMD rules.
- The requirements from the IMO MODU Code are incorporated in the vessel.

The vessel has been evaluated/inspected by NMD, and certificates as a Mobile Offshore Unit (MOU) can be issued MND, subject that the vessel is operating under Norwegian flag, and that minor remarks from the evaluation/inspection are dealt with.

#### 4. International Codes

- International Maritime Organisation (IMO)-codes as applicable.
- Other relevant international codes

(Ref. to list of applicable IMO-codes and other relevant international codes specified in the Quality Plans of the Project Groups)

## 2.2 Vessel Classification

The vessel is classed by Det Norske Veritas, designed and certified to comply with the following DNV class notation:

+1A1 Tanker for Oil ESP, E0, OPP-F, ICS, W1\*, F-AMC, DYNPOS AUTRO, HELDK (SH), ISM, TMON, Oil Storage Vessel (N), CRANE (when installed)

\* *except layout and field of vision*

### Description of notations

ESP	: Enhanced survey program
E0	: Unattended machinery space
OPP-F	: Oil pollution prevention - fuel systems
ICS	: Integrated computer systems
W1	: Extended req. for one-man workstation, instrumentation, automation level etc. Information on manoeuvring. Operational safety.
F-AMC	: Additional fire protection for accommodation, machinery space, and for cargo space.
DYNPOS AUTRO	: Automatic position keeping system with redundancy in technical design and physical arrangement. (DP class 3)
HELDK(SH)	: Helicopter deck incl. additional shipboard safety requirements and helicopter safe operation requirements.
(N)	: Vessel also complying with applicable requirements of the Norwegian Petroleum Directorate.
CRANE	: Shipboard crane
ISM	: International Safety Management Code
TMON	: Tail Shaft Monitoring

## 2.3 CE-directives

If, and when required in Norwegian legislation, applicable requirements in CE-directives will be implemented in the Odin project.

## 3 Vessel description

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### Vessel Description

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The vessel is a single screw, diesel-electric driven ocean going double hulled, dynamically positioned, Bahamas registered vessel, specially designed for meeting the requirements of a Multipurpose Shuttle Tanker for offshore operation.

The vessel is designed to operate as an FPSO under harsh weather conditions similar to the North Sea (Foinaven field).

The hull has necessary strength and stability and is arranged for installation of an oil production plant, submerged turret production (STP) system and an oil discharge system to shuttle tankers.

The vessel is designed to accommodate 120 persons on a permanent basis. However, in 30 of the double cabins it is prepared for future installation of a Pullman type bed. The lifesaving equipment for the vessel is already dimensioned for a compliment of 150 persons and is complying with relevant Rules and Regulations.

The implemented design philosophy for the dynamic positioning (DP) system is according to IMO DP class 3 requirements, i.e. automatic position keeping system with redundancy in technical design and physical arrangement.

The STP compartment is of cylindrical shape and is designed to withstand an over pressure of 8 barg.

The storage capacity is approximately 89.000 cbm incl. Slop tanks (100 %). An offloading system is prepared for in the stern for export to shuttle tankers (tandem operation).

### 3.1 Basic Vessel Layouts

The vessel is arranged with the accommodation and helideck forward.

The main engine rooms are located as follow:

- two (2) forward below the accommodation
- two (2) aft,

An engine control room is arranged in each forward engine room. The cargo pumps are operated from the Central Control Room (CCR) on the bridge. Main propulsion motors are located in a separate engine room aft.

As a FPSO the vessel is planned to be moored with a turret system located in the STL compartment. This will enable the vessel to feely weather vane without thrusters/propulsion assistance.

The process plant is planned to be installed on a topside deck located approx. 3.7 m above the ship deck. The major part of the process equipment will be installed aft of the mid ship. The vessel is prepared for a process with total weight of 12.000 tonnes. The vessel is further prepared for installation of up to 152 support pillars, each with a capacity of 3.500 kN.

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Off loading equipment is arranged aft, providing facilities for normal tandem off loading operations. A cargo/ballast pump room is also located aft.

For intervention equipment, space is allocated between the forward part of the moon-pool and the STP compartment.

### 3.2 Vessel Particulars

Main characteristics: ref. drwg. NAV-FPS-XD-0001 enclosed.

- Length overall :252,16 m
- Length b.p. :233.00 m
- Breadth mld :42.00 m
- Depth mld. :23.20 m
- Draft, design :15.00 m
- Draft, scantling :15.85 m
- Deadweight, design :85,300 mt
- Deadweight, scantling:92,500 mt
- Hull :Double hull
- Ballast arrangement :Segregated

#### Design capacities

- Cargo capacity (100 %-incl.slop tk.): 89,000 m<sup>3</sup> /approx. 560,000 bbl
- Slop tanks: 3,300 m<sup>3</sup> /approx. 21,000 bbl
- Discharge capacity: 10.000 m<sup>3</sup> /hour approx. 79.000 bbl per hour

#### Cargo tank area

The tank arrangement with one (1) centre tank and two (2) wing tanks. The ballast tanks are of L - type enclosing the cargo tanks.

- Cargo tanks:18 tanks including slop tanks
- Ballast tanks:25 tanks + fore and aft peak tank
- Moon pool:12.48 x 19.2 m (breadth x length)
- STP cylinder:15 m (diameter)

#### Power plant

The main diesel electric power plant consists of two (2) completely independent plants forward and two (2) completely independent plants aft. Totally 7 diesel generators are installed as follows:

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- Forward engine room port  
Number: 2 x MAN-B&W 8L 48/60.  
Power: 2 x 8.400 kW at 514 RPM (electric output 2 x 8.130 kW)
- Forward engine room starboard  
Number: 2 x MAN-B&W 8L 48/60.  
1 x MAN-B&W 7L23/30H (harbour generator)  
Power: 2 x 8.400 kW at 514 RPM (electric output 2 x 8.130 kW)  
1 x 1.120 kW at 900 RPM (harbour generator) (electric output 1 x 1.075 kW)
- Aft engine room port  
Number: 1 x MAN-B&W 12v 32/40  
Power 1 x 5.280 kW at 720 RPM (electric output 1 x 5.100 kW)
- Aft engine room starboard  
Number: 1 x MAN-B&W 12v 32/40  
Power 1 x 5.280 kW at 720 RPM (electric output 1 x 5.100 kW)

The machinery spaces are separated in watertight and fire class A-60 divisions. The six main diesel generators with associated switchboards and auxiliaries are split in two main systems and otherwise arranged in line with the split system philosophy according to IMO DP class 3 requirements.

- Totally installed generator capacity (electric output): 43.795 kW

Power is available for:

- Propulsion
- Domestic
- Future topside

#### Electricity

Total electric power capacity connected to the 11 kV system: 42.720 kW

Total electric power capacity connected to the 440V system: 1.075 kW

The following voltages are applied:

- 11 kV, 3Ph, 60 HZ for power generation and high-voltage systems such as propulsion motors, fire pumps, cargo pumps, ballast pumps and thrusters.
- 440 V A.C., 3Ph, 60 Hz for medium voltage systems
- 230 V A.C., 3Ph, 60 Hz for normal supply



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- D.C. supply system: 24 V

The main propulsion unit consists of two electric motors on the same shaft, each developing 6,000 kW. The main propeller range is +/- 113 rpm.

#### Propulsion and thrusters

The vessel is equipped with one (1) main propeller with an associated high efficiency rudder of Schilling type, two (2) bow tunnel thrusters, two (2) stern azimuth thrusters and two (2) forward azimuth thrusters. All the above-mentioned propellers are integrated into the DP system. The four azimuth thrusters are non-retractable and in water dismountable. The design characteristics can be summarised as follows:

- Main propeller (electric propulsion motor) MCR of 12,000 kW at 103 rpm(output from alternator)
- Two (2) tunnel thrusters forward (FPP rpm controlled) 2,200 kW each, (FPP = Fixed Pitch Propeller)
- Two (2) azimuth thrusters forward (FPP rpm controlled) 4,500 kW each, (Nominal thrust not less than 80 tons thrust each.)
- Two (2) azimuth thrusters aft (FPP rpm controlled) 4,500 kW each, (Nominal thrust not less than 80 tons thrust each)

#### Cargo system

The vessel is equipped with a conventional pump room arranged aft. The pumping system consists of:

##### Cargo pumps

Number of cargo pumps: 4  
Drive: 4 electric high voltage motors  
Capacity: 4 x 2.500 cbm/h at 135 mWG

##### Ballast pumps

Number of cargo pumps: 2  
Drive: 2 electric high voltage motors  
Capacity: 2 x 2.500 cbm/h at 2,5 barg

#### DP capacity

The vessel is built according to DNV class notation DYNPOS AUTRO and IMO Class 3 dynamic positioning system. As a moored FPSO the DP system may be used in combination with the mooring system as thrusters assisted mooring or for heading control if necessary.

#### Helideck and helifuel

The helicopter deck is designed for handling a Sikorsky S-61 and EH 101 type or equivalent helicopter. Facilities for future installation of helicopter fuelling system are provided.

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#### Accommodation

The accommodation is equipped with cabins, offices, dining area, recreation area, etc. according to Norwegian offshore standard. The vessel is presently fitted with 123 beds as follows:

- Single cabins : 3
- Double cabins :30
- Triple cabins :30 (Presently double cabins that are prepared for future installation of a Pullman type bed).

By installing extra Pullman type beds in the triple cabins, the ship can be equipped with up to a total of 150 beds.

#### Lifeboats and lifesaving equipment

The vessel is equipped with 4 x 60 men enclosed free fall lifeboats located forward and 1 x 30 men enclosed free fall lifeboats located aft. The secondary lifesaving equipment is according to applicable rules and regulations. Also, one rescue boat for six persons with diesel driven water jet is installed forward.

#### Safety and Automation System

The vessel is provided with an integrated automation system (Kongsberg make), which is a network-based system connecting the different subsystems for propulsion, manoeuvring, cargo, ballast and auxiliary system control/ monitoring. The system is prepared for future expansion to integrate a separate process control system. Control for this system will be from the bridge (CCR).

A separate ESD/F&G system is installed on the vessel and will accommodate the future needs of a full FPSO.

This is achieved by selecting one supplier for the following systems;

- Vessel Control
- Process Control
- Emergency Shutdown
- Fire and Gas detection

#### Telecommunications

As with the Instrumentation a single system is required for the total facilities. Within the vessel specification space has been allocated for additional cabinets, and the system is expandable.

#### Fire fighting systems

The fire fighting system comprise mainly:

- Foam system.
- CO<sub>2</sub> system.
- Sprinkler/Deluge system
- Main water system

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The main fire water system consists of a main ring line and is supplied with water from 3 seawater fire pumps. Each pump has a capacity of 1,500 cbm/h (i.e. 3x 100 %). The system is arranged according to NPD requirements, i.e. one pump is located in aft engine room with separate power supply, while two are located in forward engine room.

#### Deck preparations for topside equipment

The moon pool area and the tank deck are reinforced for taking 12,000 tonnes of topside weight dependent on layout and operation to be carried out. Ship pipe systems will be arranged on deck to ease topside skid installation in the future.

#### Offshore Cranes

Four (4) offshore type crane foundations with design moment of 3,000 m x tonnes are prepared

#### Mooring

The vessel may be moored to a Submerged Turret Production Buoy (STP) or other turret system with no restrictions for weather vaning. The mooring system may be designed for thrusters assisted mooring.

The vessel is otherwise fully equipped with steering gear, anchors and mooring equipment as a normal tanker of this size. The mooring equipment is in line with OCIMF guidelines and recommendations.

#### **Drawings**

NAV-FPS-XD-0001