

PETROJARL VARG





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THE **PETROJARL VARG** IS A SHIP-SHAPED, TURRET MOORED, FLOATING PRODUCTION, STORAGE AND OFFLOADING VESSEL (FPSO). THE MAIN DESIGN OBJECTIVES HAVE BEEN TO PROVIDE RELIABLE, EFFICIENT PROCESS AND UTILITY SYSTEMS. THE VESSEL IS EQUIPPED WITH PROCESSING FACILITIES FOR OIL PRODUCTION, GAS INJECTION AND WATER INJECTION.

The **PETROJARL VARG** is based on a Tentech 700 design, delivered by Keppel FELS Limited, Singapore.

There are a total of nine storage tanks, total capacity (100% filling) approximately 75,000 m³. Seven of the storage tanks are arranged aft to the turret and two forward of turret. Double bottom tanks, wing tanks and peak tanks provide ample capacity to maintain a sufficient draught in a light ballast condition.

The turret and mooring systems are designed to allow the **PETROJARL VARG** to rotate according to the waves, wind and sea current directions +/- 270° from a neutral position. The turret accommodates 10 anchor lines, and provides hang-off capacity of 10 risers and umbilical through guide tubes.

With a production capacity of 57,000 bopd and storage for 470,000 bbls, the vessel is adaptable to almost any offshore production requirements.



Petrojarl Varg - Location of the Field



OPERATING EXPERIENCE

PETROJARL VARG is currently in production for Talisman Energy Norge AS on the Varg Field, and has been on location since September 1998. The Varg Field is located in the Norwegian Sector of the North Sea.

MAIN PARTICULARS

Type: Floating Production, Storage and Offloading vessel (FPSO)

Length overall:	214.0 m
Breadth:	38.0 m
Draught:	16.0 m
Depth:	22.0 m
Displacement:	100,021 tonnes
Oil storage:	470,000 bbls
Slop tank:	3,800 m ²

PRODUCTION CAPACITIES

The FPSO has one separator train consisting of two stage gas, oil and water separation and one electrostatic coalescer and has the following throughput capacities:

Total liquid:	82,000 bfpd
Crude:	57,000 bopd
Produced water:	57,000 bopd
Water injection:	100,000 bwpd
Gas compression:	53 mmscfd
Flare capacity HP/LP:	110/15 mmscfd
Risers/umbilicals:	10

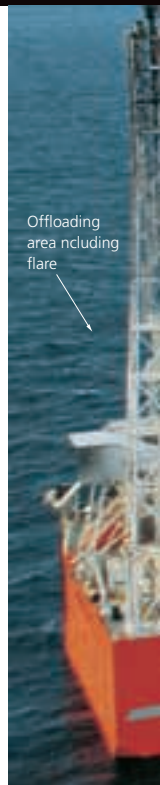
The given capacities are nominal and based on typical North Sea crude. The actual capacities will depend on specific gravity, GOR, pressure etc. Furthermore the process plant is designed with flexibility for modifications. Increased throughput and improved product specification can be achieved to meet the specific field requirements.

LAYOUT

The ship is arranged, from forward to aft, in the following sequential order:

- Helicopter deck
- Accommodation area
- Turret area including crane
- Process area including two cranes
- General facilities including power generation
- Offloading area and flare





CLASSIFICATION

The **PETROJARL VARG** including its hull, machinery and equipment is designed, built and operated in accordance with the rules for classification of ships issued by Det Norske Veritas (DNV) for assignment of the following class notations:

+ 1A1 Oil Production and Storage Vessel (N), POSMOOR ATA, CRANE, HELDK, ECO

REGULATIONS

The FPSO complies with the following rules and regulations in force Jan. 1996:

- Acts, regulations and provisions for the petroleum activity (PSA, Petroleum Safety Authority Norway)
- NMD Regulations for mobile offshore units
- IMO Code for construction and equipment of mobile offshore drilling units (Modu Code), Resolution A.649 (16)
- International Convention for the Safety of Life at Sea of 1974 (SOLAS) including all Amendments
- NORSOK Standards (Selection)
- DNV Rules for Classification of Ships

DNV has issued a Statement of Compliance with NMD regulations.

TURRET AND FLEXIBLE RISERS

The turret on the **PETROJARL VARG** is located approximately 30 meters forward of midship.

The turret diameter is approximately 16 meters. It includes ballast tanks for adjustment of mean bearing loads and free flooding tanks around waterline elevations for minimizing variations in the vertical loads.

The turret transfer system is of a dragchain type. A dragchain system is very flexible with regard to number of piperuns to be accommodated, as a new set can be accommodated by mounting a new one at the top of the existing and so on. This system allows +/- 270° rotation of the FPSO around the turret. If the FPSO is operating at the end of the heading limitation of the transfer system, the FPSO is turned through the weather and to the desired position supported by thrusters.

The turret provides pull-in and hang-off capacity of 10 risers and umbilicals through guide tubes. The guide tubes have an internal diameter of 1 m and extend from bottom of turret to the riser connector deck. The flexible risers are connected to the turret piping by flanged connections. The turret moonpool is open to water, and may accommodate additional riser pull-ins.

The risers are connected to the unmanned wellhead platform, Varg A, located approximately 1200 m away from the FPSO.



Picture showing main layout of the FPSO.

PROCESS SYSTEM

The main process consists of the following system:

- Crude Separation
- Gas Compressor System
- Water Injection System
- Flare System
- Produced Water System
- Heating Medium System
- Cooling Medium System
- Fuel Gas System
- Chemical Injection System
- Sea Water System

The **PETROJARL VARG** has one separator train consisting of two stage gas, oil and water separation and one electrostatic coalescer. In addition, there is one test separator in parallel with the 1st stage separator. Both the 1st stage separator and the test separator have an inlet heat exchanger and an interstage heater is installed upstream of the 2nd stage separator. To meet the water in oil specification of 0.5% water in oil, the oil from the 2nd stage separator is routed through an electrostatic coalescer. The oil is further cooled and routed to storage in the ship cargo tanks. The produced water is treated before it is discharged to sea.

The compression package compresses gas from the 1st stage separator, test separator, and the 2nd stage separator, and recovered flare gas for use as either fuel gas or for gas reinjection. The overall gas compression package has been designed for a maximum gas rate of 53 mmscfd.

Low pressure gas is compressed through a single train (two stage) LP booster compressor and then combined with gas from the 1st stage separator/test separator which is further compressed in three identical trains of HP compression (3x33%). The three compression trains are designed such that all trains may work independently, with different discharge pressures, depending upon the destination of the gas (either fuel gas or gas reinjection).

FLARING SYSTEM

The flare system is designed to safely dispose of hydrocarbons released from the process plant in a closed system. All releases are collected in either LP or HP flare systems. The flare has an automatic ignition system that ignites the flare during significant gas releases and blow down.

The flare is designed to dispose of the following maximum flow rates:

HP flare gas:	110 mmscfd
LP flare gas:	15 mmscfd

OFFLOADING SYSTEM

The offloading system on the FPSO is a standard Pusnes offloading system with a flexible hose stored in its complete length along the top of the escape tunnel. The offloading hose is 130 m long and is protected by use of a 100 m mooring hawser during offloading. Interface as for 'Standard' North Sea bow loading tankers.

STATIONKEEPING SYSTEM

The **PETROJARL VARG** stationkeeping system consists of 10 mooring lines, assisted by thrusters for heading and position control. In addition to the top chain segment of 205 m length (160 m from fairlead), the mooring system consists of 135 mm R3 chain segment of 110 m length and 1,600 m spiral strand wire segments and a short chain segment continuing to the pile anchor.

The position control system includes redundant independent gyro systems, hydroacoustics and two independent satellite based Diffstar Absolute and Relative Positioning Systems (DARPS) for position reference in addition to line tension measurements. The thrusters consist of three 2,8 MW Azimuth thrusters, one bow and two aft thrusters, each of 2,8 MW. The thrusters are arranged with the aft thrusters located at Ap (Aft perpendicular) and one six meters forward of Ap and with bow thrusters 180 meters forward of Ap.

UTILITES

POWER GENERATION:

The entire power generation consists of five diesel engine driven generators having a total output of 33,750 kW. Each generator is rated 6,750 kW. Four of these fuel gas/diesel generators are located in two separate engine rooms aft and provide the normal power supply. The fifth generator provides the essential power and is located in the forward part of the vessel. The essential consumers are required to operate in 'survival in sea' condition. The generator will normally be in operation when the main aft generators are shut-down. All five generators may work in parallel operation.

Emergency power is provided by an independent 690 V generator, rated 2,000 kW, located in the forward part of the vessel. The generator supplies power to emergency consumers and other consumers required for personnel and vessel safety.

FIRE PROTECTION SYSTEM:

One firewater and one foam ring main is installed for distribution of firewater and foam to the relevant consumers. The ring main is located on the cargo tank deck level.

1 x 100% diesel-driven fire pump is located in the hull aft. Capacity: 2,000 m³/h at 13.5 bar. 2 x 50% electrical pumps driven by the emergency generator are located in the fore part of the hull. Capacity: 2 x 1,000 m³/h at 13.5 bar.

The process area is covered by six deluge skids. Passive fire protection is in accordance with classification rules including the escape tunnel located on the port side.

CRANES

Handling of all loads to and from the supply boats is achieved by using the three deck cranes. The capacities are 45 Te at 15 m radius and 15 Te at max radius of 45 m. Horizontal transportation of loads on the vessel is achieved by using fork lift trucks, wheeled trolleys and deck cranes as required. Vertical transportation is done through deck openings or hatches by using locally installed hoists or one of the deck cranes.

ACCOMMODATION

The living quarters is a steel structure located in the front part of the vessel. On the top of the accommodation module, the aluminium built helideck is located. The organization level onboard is 41 persons during normal operation including catering. The design has allowed for this in arrangement and location of all workshops, offices and recreation areas. The accommodation is designed to handle 77 persons located in 39 cabins.

The living quarters provides adequate comfort and safety during the stay on board.

SHUTTLE TANKERS

Teekay Petrojarl is currently operating two shuttle tankers specially equipped for operations with FPSOs. The shuttle tankers are PETRONORDIC (92.995 tdw) and PETROATLANTIC (92.995 tdw).

In addition, Teekay Petrojarl owns the shuttle tanker RITA KNUTSEN (124.472 tdw) which presently is on bareboat charter to Knutsen OAS Shipping.





COMPANY BACKGROUND

Teekay Petrojarl is the largest operator of Floating Production, Storage and Off-loading (FPSO) vessels in the North Sea. With a combined production capacity of 350,000 barrels of oil per day and a crude storage capacity of more than one million barrels, we have a long, proven track record in safely operating FPSO vessels in one of the harshest environments in the world.

Teekay Petrojarl owns and operates five FPSOs of which two are on each of the Norwegian and UK Continental shelves and one offshore Brazil. The company currently has another FPSO under construction in Singapore for the production of oil for Petrobras in 2012. All production units are under contracts producing for oil and gas companies. Our operating fleet also includes two shuttle tankers, one storage tanker and a 40% ownership in the FPSO Ikdam, operating offshore Tunisia.

With our head office in Trondheim Norway and operations offices in Aberdeen and Macaé, Brazil as well as a site office in Singapore, our 700 employees offshore and onshore possesses a unique blend of operational, engineering and professional expertise.



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