

PETROJARL I





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PETROJARL I, SPECIALLY DESIGNED FOR OIL PRODUCTION IN THE HARSH ENVIRONMENT OF THE NORTH SEA; IT IS DESIGNED TO STAY CONNECTED TO THE PRODUCTION WELLS IN THE 100 YEAR NORTH SEA ENVIRONMENTAL CONDITION (30 M MAX. WAVE HEIGHT AND 41 M/S WIND).

The ship's process and utility systems are designed to handle a large variety of well stream compositions and well flow rates.

The process system comprises crude separation and stabilization. The stabilized crude is temporarily stored in cargo tanks for subsequent offloading to shuttle tanker. Produced water is cleaned and reinjected. Produced gas is used for gas lift and power production, the excess gas is reinjected.

PETROJARL I is a Golar-Nor Offshore design, delivered by NKK of Japan in 1986. The ship is equipped with proprietary equipment securing high operational regularity.



PETROJARL I - Location of the Field



OPERATING EXPERIENCE

Since the delivery in 1986, various oil companies have contracted the ship for oil production. The field locations have been in the British and Norwegian sectors of the North Sea. The variety in field conditions (flow rates, flow composition, water depth etc.) illustrates the flexibility of the system. All contracts have been performed with a 96 - 99% mean production regularity.

The ship has successfully undertaken production contracts for the following operators:

NORSK HYDRO

Field:	Oseberg, Norwegian Sector
Period:	August 31, 1986 – June 6, 1988
Water depth:	105 m
Max. production rate:	26,000 BOPD
Production regularity:	98 %

Field:	Troll, Norwegian Sector
Period:	December 24, 1989 – May 6, 1991
Water depth:	330 m
Max. production rate:	30,200 BOPD
Production regularity:	97 %

CONOCO UK

Field:	Lyell, UK Sector
Period:	June 7, 1988 – August 28, 1988
Water depth:	125 m
Max. production rate:	6,400 BOPD
Production regularity:	98 %

SHELL UK

Field:	Fulmar, UK Sector
Period:	February 15, 1989 – November 9, 1989
Water depth:	85 m
Max. production rate:	230,000 BOPD ¹⁾
Regularity:	100 %

¹⁾ Operated as storage and loading unit, and the figures represent throughput per day.

ESSO NORWAY

Field:	Balder, Norwegian Sector
Period:	May 7, 1991 – October 7, 1991
Water depth:	125 m
Max. production rate:	9,400 BOPD
Production regularity:	99 %

AMERADA HESS LIMITED

Field:	Angus, UK Sector
Period:	December 31, 1991 – June 27, 1993
Water depth:	71 m
Max. production rate:	33,500 BOPD
Production regularity:	99 %

Field:	Hudson, UK Sector
Period:	July 19, 1993 – January 26, 1995
Water depth:	157 m
Max. production rate:	40,000 BOPD
Production regularity:	96 %

ARCO BRITISH LIMITED

Field:	Blenheim, UK Sector
Period:	March 15, 1995 – January 9, 1998
Water depth:	148 m
Production rate:	35,000 BOPD
Production regularity:	99 %

TALISMAN ENERGY (UK) LIMITED

Field:	Blenheim/Bladon, UK Sector
Period:	January 10, 1998 – May 1, 2000
Water depth:	148 m
Production rate:	13,000 BOPD
Production regularity:	99 %

RANGER OIL

Field:	Kyle, UK Sector
Period:	May 24, 2000 – Oct. 12, 2000
Water depth:	90 m
Production rate:	13,000 BOPD
Production regularity:	100 %

STATOIL

Field:	Glitne, Norwegian Sector
Period:	August 28, 2001 –
Water depth:	110 m
Max. production rate:	46,000 BOPD
Production regularity:	98 %

MAIN PARTICULARS

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

Length overall:	215 m
Breadth:	32 m
Draught:	12 m
Deadweight:	31,473 tons
Oil storage:	190,000 bbls
Slop tank:	7,000 bbls

PRODUCTION CAPACITIES

The process system is of flexible design and has typically experienced the following throughputs:

Crude:	46,000 bopd
Produced water:	47,000 bwpd
Total fluids:	55,000 bfpd
Gas lift:	20 mmscfd
Water injection:	52,000 bwpd

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 (see picture of main layout next page):

- Helicopter deck
- Accommodation area
- Lay-down and storage area
- Turret area including derrick
- Process area
- General facilities including power generation
- Offloading area including ground flare

The process plant is skid mounted on a single deck level. Valves and instrumentation are located on the skids with only interconnecting piping between skids. This facilitates simple modifications when required. Ample space is available for additional equipment.

The process plant is installed with natural ventilation. This has considerable safety advantages.

CLASSIFICATION

The ship with equipment is built for, and operating under the special survey and classification of Det Norske Veritas (DNV).

PETROJARL I complies with the following class and notations: + 1A1 MOBILE OFFSHORE UNIT Oil Production and Storage Vessel HELDK, PROD (N), EO, F-AC, POSMOOR ATA, DYNPOS AUT, ICE-C, BIS, COW, INERT, CRANE.

REGULATIONS

The ship complies with the following rules and regulations:

- Petroleum Safety Authority Norway (PSA)
- Norwegian Maritime Directorate (NMD)
- International convention for safety of life at sea (SOLAS)
- International convention for prevention of pollution from ship, MARPOL 73/78. Annex 1.
- British continental shelf regulations

SUBSEA SYSTEM

PETROJARL I is prepared with 10 stations for tying in flexible risers or riser systems either from individual production/injection wells or subsea manifolds.

Currently the subsea system comprises seven complete sets, six for production and one for combined water and gas injection.

The six production sets consists of:

- Tubing hangers
- X-mas trees
- Lower riser packages (on three of the wells)
- Flexible riser systems (bundles of 6" production line, 2" or 2 1/2" gas lift line and control umbilical)
- Moonpool riser connectors
- Control system for direct control of and data acquisition from wells.

The combined water and gas injection system consist of:

- Tubing hanger
- X-mas tree
- Flexible risers (one individual 6" water injection line with clamped-on control umbilical, and one individual 4" gas injection line)
- Moonpool riser connectors
- Control system for direct control of well





Picture showing main layout of the FPSO.

MANIFOLD AND SWIVEL SYSTEMS

Production and injection manifolds are located on the turret.

A six-slot choke manifold commingles the individual flows from the production wells. The manifold also allows for individual well testing and well killing.

A gas lift/injection manifold distributes individual gas lift volumes to each production well and gas to the injection well.

A two slot water injection manifold, where at the moment one slot is blanked off, routes water to the injection well.

A multipath swivel stack provides fluid and utility interface between the turret and the ship.

PROCESS SYSTEM

The process plant comprises the crude separation and stabilization system, fuel gas treatment unit for turbine and dual fuel power engines supply, produced water treatment unit, gas compression system, water injection and crude and gas fiscal metering system.

The process is supplied with utilities such as sea water, steam, air and electric power from the machinery/utility section aft.

FLARING SYSTEM

Excess gas is flared in a ground flare stack located at the stern of the vessel. The system is designed to safely dispose up to 32 mmscfd. The existing flare can be enhanced to abt. 70 mmscfd capacity.

The gas is combusted completely within the flare drum. The risks of exposing the shuttle tanker to “burning rain” are therefore eliminated.

OFFLOADING SYSTEM

The produced crude is shipped to shore by shuttle tankers. The crude is transferred to the shuttle tankers by the offloading system.

The system is located at the stern of **PETROJARL I**.

The system comprises:

- Offloading hose
- Offloading crane. The hose is suspended in a catenary between the crane boom and the shuttle tanker.
- Control, communication and emergency shutdown system.
- Mooring hawser
- Fiscal metering station

The system can transfer 4,250 m³ crude per hour. Offloading can take place in weather conditions characterized by up to 5.5 m significant wave height.

STATIONKEEPING SYSTEM

PETROJARL I is moored to the seabed by the turret mooring system. The stationkeeping system of PETROJARL I is approved for the one hundred year storm condition. The passive element of the system, the chains, are dimensioned such that propulsive power is not required while producing crude. The ship has been moored in 330 m water depth, but can be moored in water depths up to 1600 m in harsh environment.

The turret is located in the forward part of the ship so as to allow for natural weather-venting. This means that the combined forces from wind and waves to be restrained by the mooring system are minimized, resulting in optimal safety against mooring line break. The mooring lines are terminated on the turret. The mooring winches located on the turret deck can individually adjust the tension in each mooring line.

The weathervaning capability is facilitated by the turret bearing system, allowing the ship to rotate around the turret. The turret bearing system is a Golar-Nor Offshore design. The design is made with the objective of long life continuous operation and maintenance while operating.

The ship is also equipped with DP (Dynamic Positioning) and APM (Anchor Position Mooring) systems for thruster/propeller controls. These systems are used to enhance position control and provide optimal mooring line loads.

UTILITIES

The main utilities for the process plant are supplied from the engine room. The main utility capacities are:

ELECTRIC POWER

- 2 x 6 MW (dual fuel Wärtsila 18V32DF engines)
- 4 x 2.8 MW (dual fuel gas turbine generators)
- 2 x 1.5 MW (diesel engine generators)
- 1 diesel emerg. gen. 500 kW, 450 VAC
- 1 diesel emerg. gen. in turret, 95 kW, 450 VAC

STEAM

2 x 7.5 ton/hour at 6 bars. The steam is generated by dual fuel (diesel/gas) boilers.

FRESH WATER:

2 x 40 tons/day. The evaporators are steam driven.

SERVICE AIR:

2 x 1000 m³/h, delivered by air cooled screw compressors.

COOLING WATER:

3 x 480 m³/h seawater and 3 x 275 m³/h freshwater is available.

FIRE WATER:

Fire water is delivered from two independent firepump rooms, one located forward and one aft. Each room can deliver:

Fire pump : 1 x 450 m³/h Deluge pump: 2 x 1300 m³/h

PROPULSION SYSTEM

The main propulsion system consists of 2 electrically driven ducted propellers, 5600 kW rating each.

In addition to the main propellers, 4 ducted sidethrusters, (2 forward and 2 aft, 1600 kW each) are included.

CRANES

Three main cranes are installed on the ship. One just aft of the accommodation and two aft serving the process area. The cranes are according to Norwegian and British offshore requirements.

The forward crane is mainly used for loading/offloading supply vessels. This crane is powered via the emergency switchboard and can be used for emergency evacuation.

The crane capacities are 15.5 tonnes at the extreme reach of 36.5 m. At 20 m reach the capacities are 30 tonnes.

ACCOMMODATION

The accommodation capacity is 68, while normal complement is 38 persons including catering.

The accommodation is located in the front part of the vessel. The main controls of the vessel are in the NCC room in the accommodation quarters. Emphasis laid on easy access to NCC room. Risk analyses have shown that the weathervaning feature, and the forward location of the accommodation, has reduced the risk to personnel on PETROJARL I to a minimum.

SHUTTLE TANKERS

Standard North Sea shuttle tankers can hook up to PETROJARL I. Tankers up to 135.000 tdw have been used for shuttling.

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.

