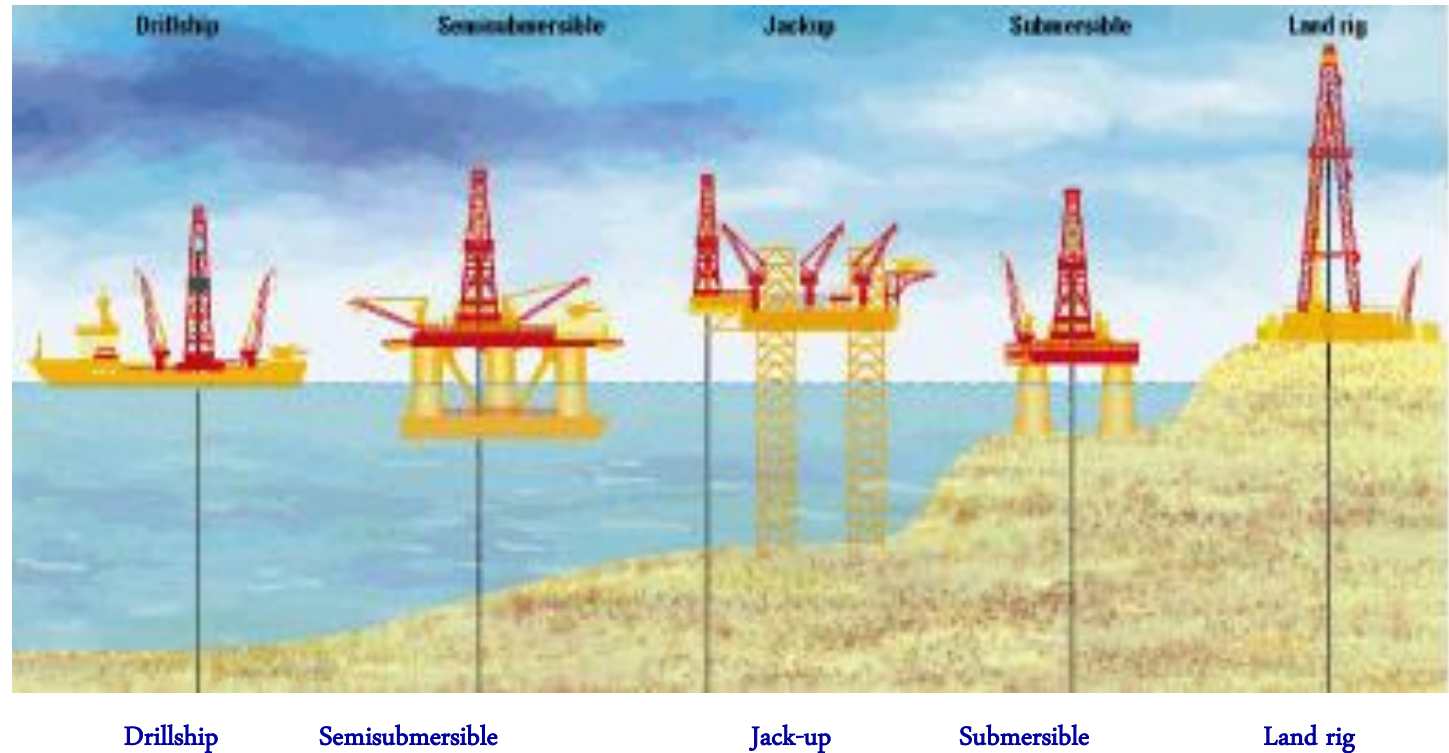
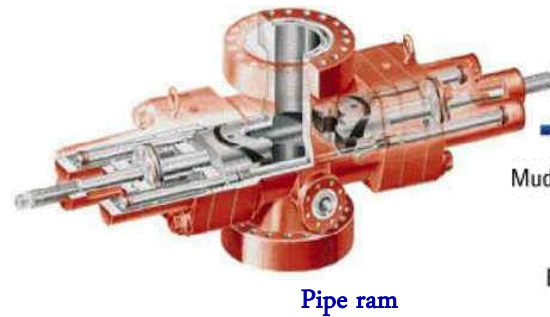


Rigs and platforms



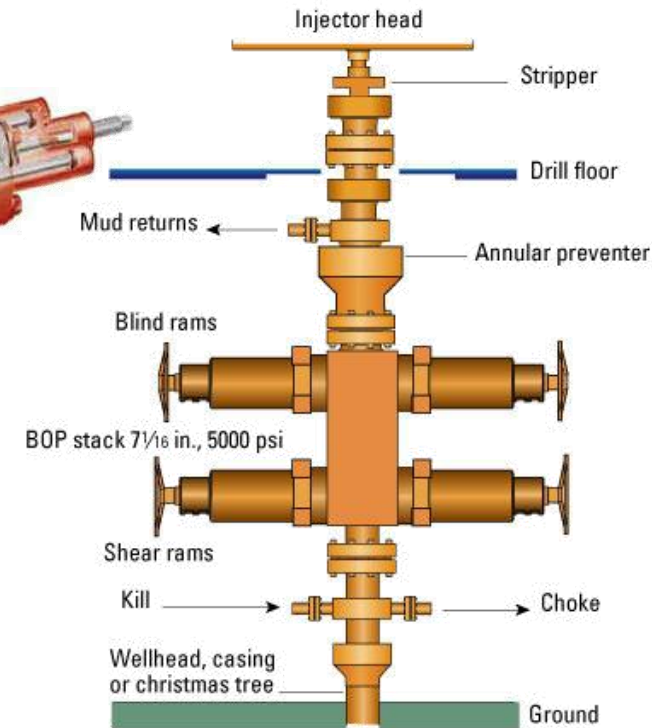
There are onshore and offshore rigs and there are platforms. The latter ones are usually fixed installations. All the others can be removed after their task has been completed. These installations are only used for drilling and workover or maintenance, not for production.

BOP stuck



Pipe ram

BOP stack on a Jack-up
normal pressure rating
10 000 - 15 000 psi
(750 - 1000 bar)



Blow Out Preventer

Each wellhead is connected to a BOP to keep the well pressure under control and if necessary to kill the well. They are operated by HP hydraulics and manually.

There can be a stack of 4 rams.

Pipe rams close around the drill pipe and require the right size.

Blind rams close the well completely, shear rams cut off any obstruction, e.g. drill pipe.

Below the rams is the kill line to pump heavy mud and cement into the well to kill it.

Rig site

Rigs are used to drill, test and workover wells - they don't produce petroleum.

Rigs are independently operating installations combining several units, e.g.: winches, pumps, power plants (some over 40 MW), water treatment plants, mud treatment plants, accommodation for crew (easily 150 men), communication facilities, medical facilities, transportation units, workshops, storage of water, cement, fuel, chemicals, food and pipes, air traffic control and helicopter port, fire fighting and survival facilities, etc.

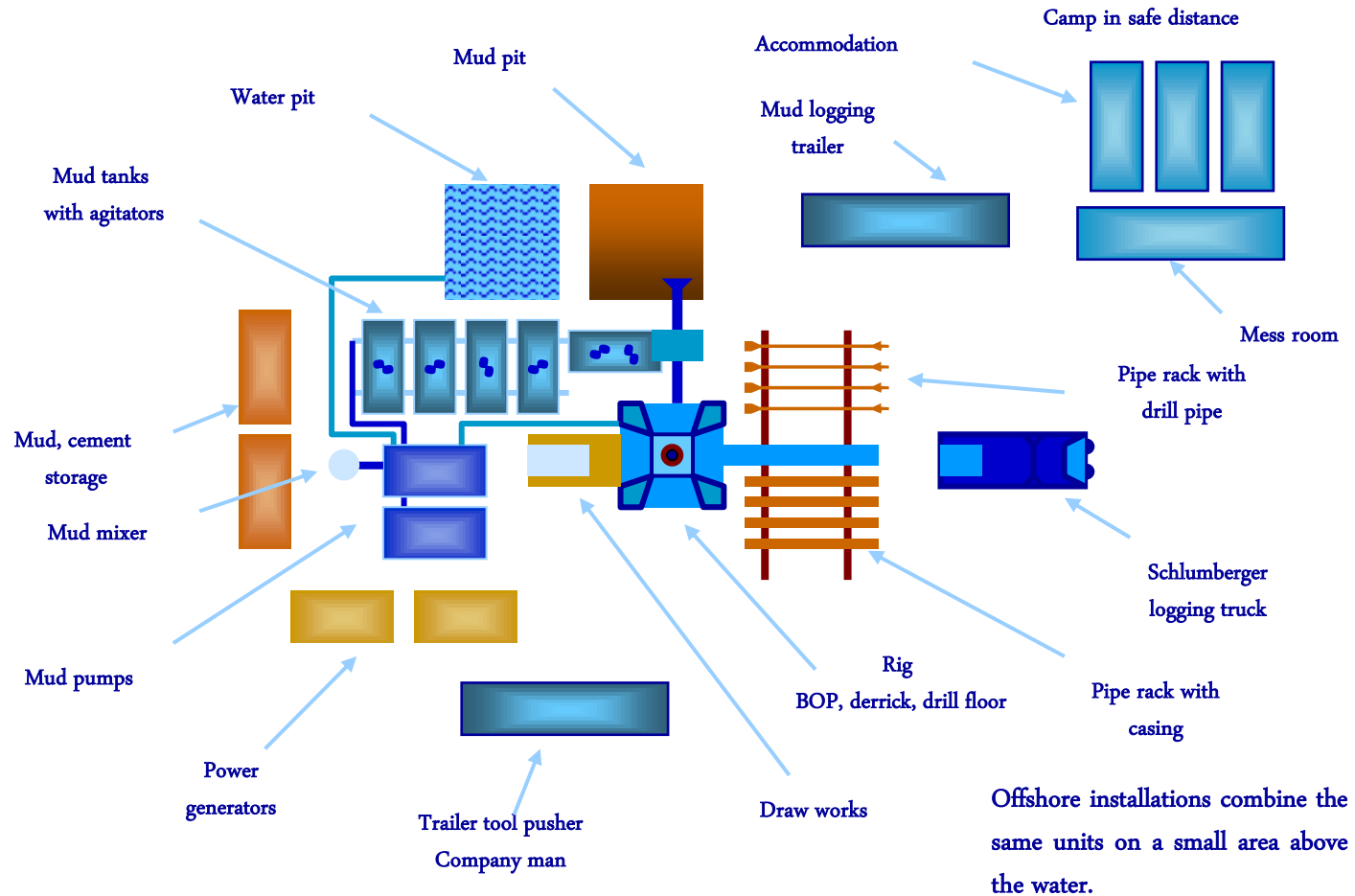
Land rigs, associated units and camps are built on skids to be transported on big trucks to the site and can require over 100 loads.



Courtesy of ÖMV, Austria
Söhlingen Z10 World record

If large distances are to be covered, just the utilisation can cost several hundred thousand USD. Rig charges are several ten thousand USD per day.

Onshore drilling rig site set-up



Land rig

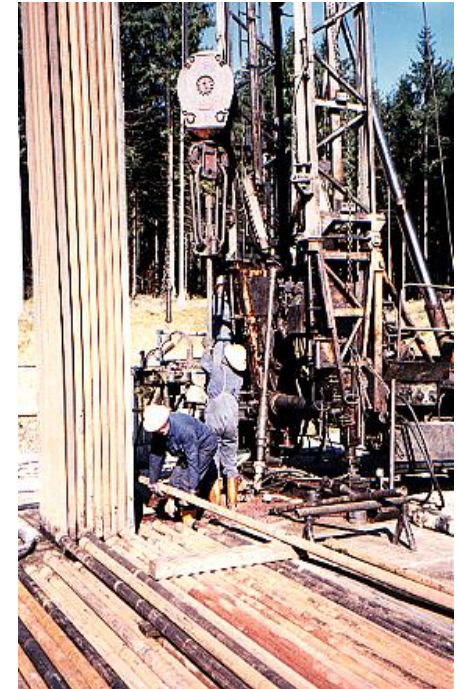
There are many types of land rigs, however they are basically all the same and are only segmented into smaller and bigger drilling rigs for more or less deep wells.

Very small derricks on trucks are available to carry out maintenance work on older wells.



Libya, 1985, RB

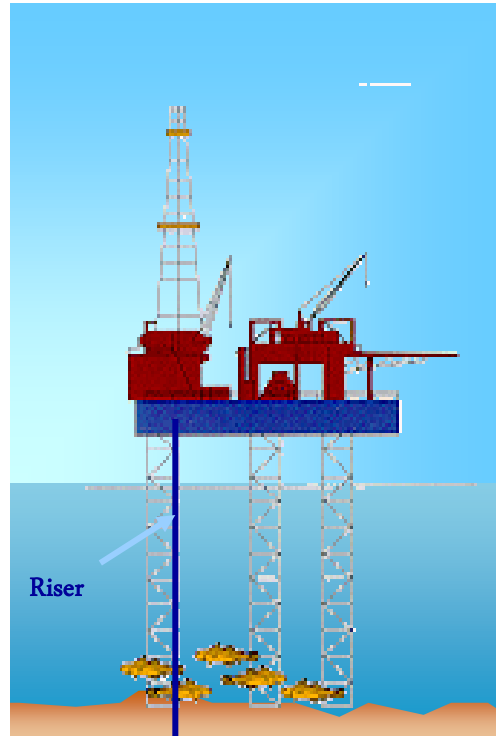
At this small workover rig, the pipes and all activities happen on the ground. They can only carry out limited and simple operations in shallow wells up to 2500 m.



Austria, courtesy RAG 1987, RB

This bigger land rig with a logging sheave wheel in the derrick is capable of drilling down to approx. 3500 m. At this moment RB is logging the well with measuring instruments at the end of the cable, wireline.

Jack-up



Jack-ups are installations resting on usually three extendable legs and can operate in water depth of up to 150 m. Standing on legs makes the rig operation independent of waves. For relocating they pull up the legs, lower the hull and float. They have no propelling engine and require tug boats.

The BOP is above sea level and the riser goes straight into the well. The derrick reaches over the site of the deck and is movable to position the rig over fixed platforms to drill several wells from one position.

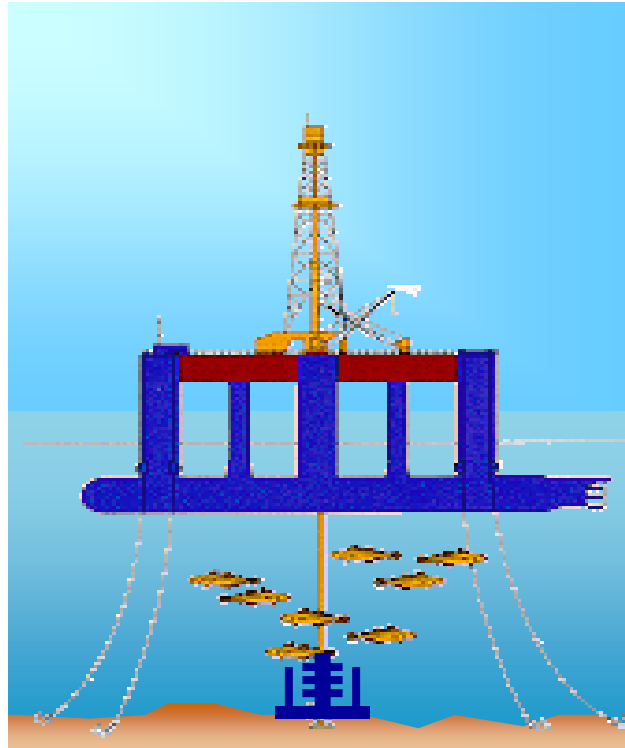
The basket to hang lazy men over board



BOP and riser

The well is being tested for e.g. 24 hrs and produced gas is being flared off.

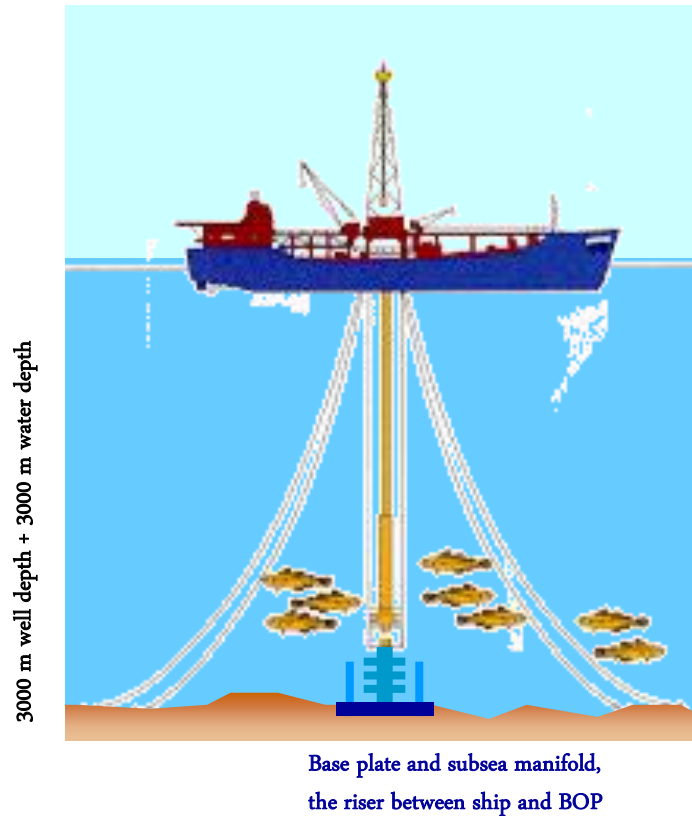
Semisubmersible



Semisubs, as they are usually called are for deeper water depth of up to over 1000 m. They always float and the rig moves up and down during drilling! Compensators can handle vertical rig movements (waves) of up to 5 m.

Semisubs have only limited thrust power and are kept on their position by eight or more automatic mooring winches and huge anchors. A baseplate on the sea floor with the BOP controls the well pressure and even allows a quick disconnection and release of the riser for the rig to move away. Rig cost are now in the range of several hundred thousand USD/day.

Drilling ship

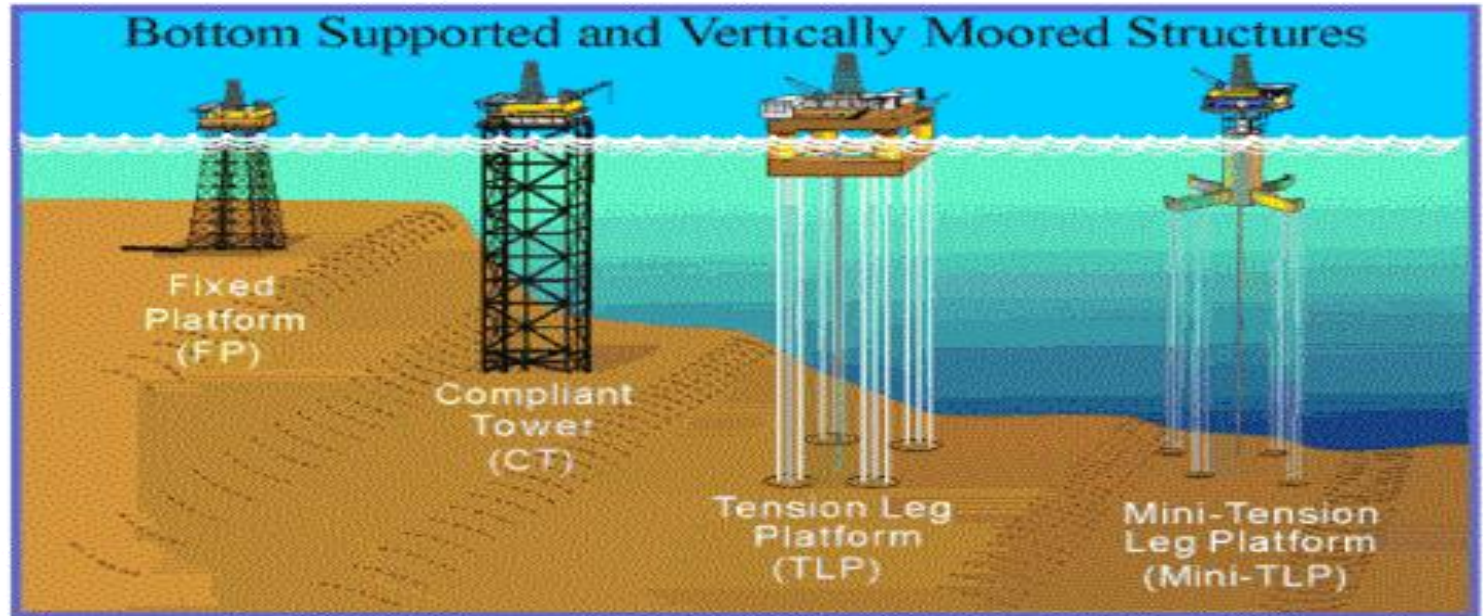


Drilling ship Ernest Shackleton -

Drill ships are very often converted oil tankers, i.e. big ships of >200 m length offering a lot of space on board. They are used to drill in very deep waters - 1000 - 3000 m - where anchors are difficult to be used. They are very mobile and can easily move to any offshore location.

To maintain the ship over the well head the ship's engine and thrusters are used. The pipe connecting the base plate and subsea manifold with the ship is called riser and keeps the sea water out. The manifold comprises the main BOP to shut off the well in case of trouble.

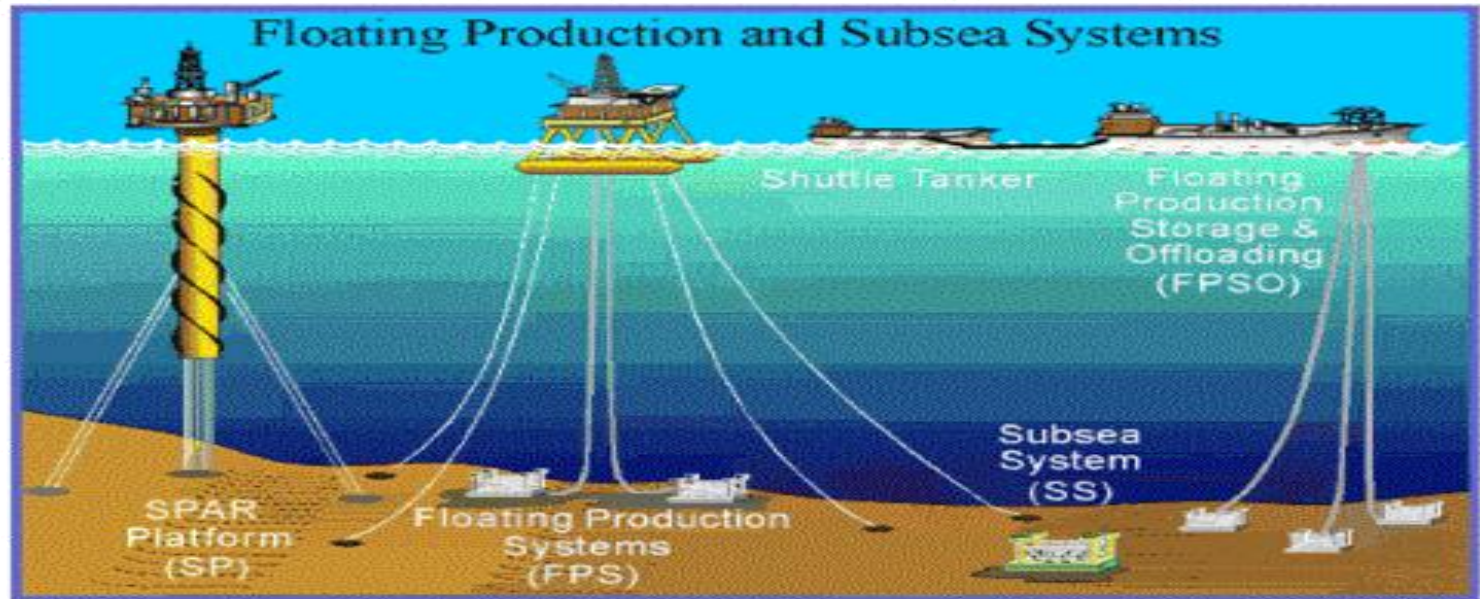
Deepwater development systems



Depending on the water depth and sea condition and to counteract possible strong winds and high waves or icebergs, various platforms were developed.

Most of them are standing on legs some however are floating and connected with tension legs to the sea floor to prevent most vertical movements by the sea.

Floating production systems



Graphic courtesy of Minerals Management Service

Floating production platforms are positioned by anchors and the wellstream enters the unit through flexible risers and hoses.

Modern production systems include storage facilities to buffer the production for some days before exporting it to tankers or pipelines.

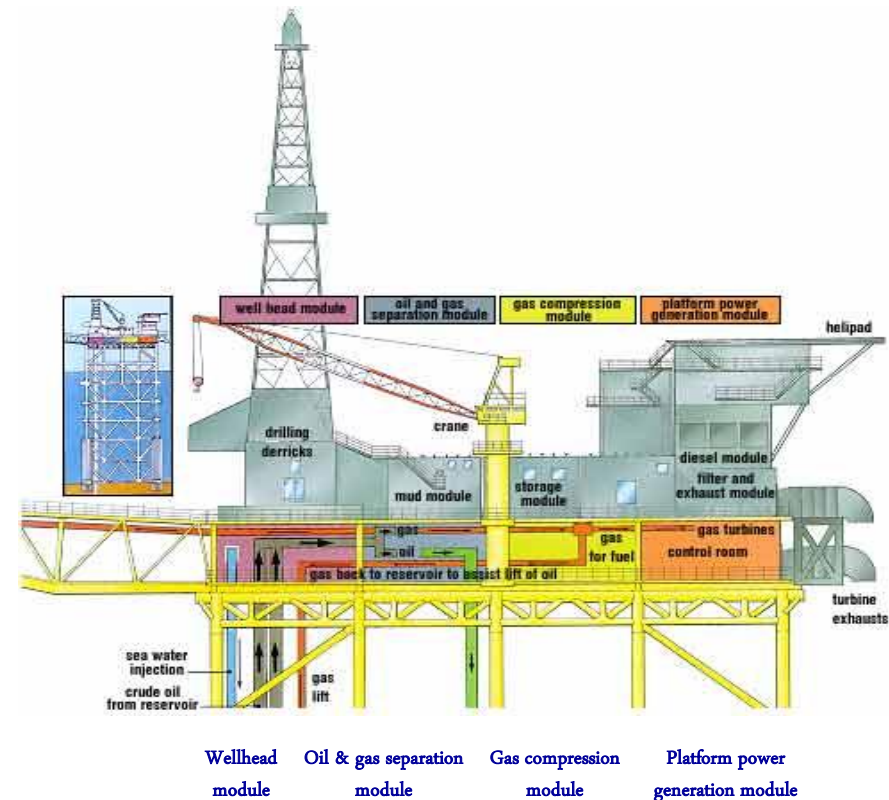
Production platform

Oil platforms offshore are like a town. They provide housing for many people, and all the required assets to separate petroleum into oil, gas, water and sand.

There are pumping and compressor stations to feed the pipelines.

Reinjection facilities allow the controlled reinjection of gas, water, cuttings and chemicals as well as the injection of sea water.

For gas lift, a part of the produced gas is used to help the petroleum to easily flow to the surface.



Jack-up operation



Since most platforms have no drilling facilities a drilling rig comes at an early stage to drill a cluster of wells. Here a jack-up is positioned close to the structure. The derrick is two directionally mobile, to descend wells offset every 2 m. After the wells are drilled the rig is tugged away to a new location.

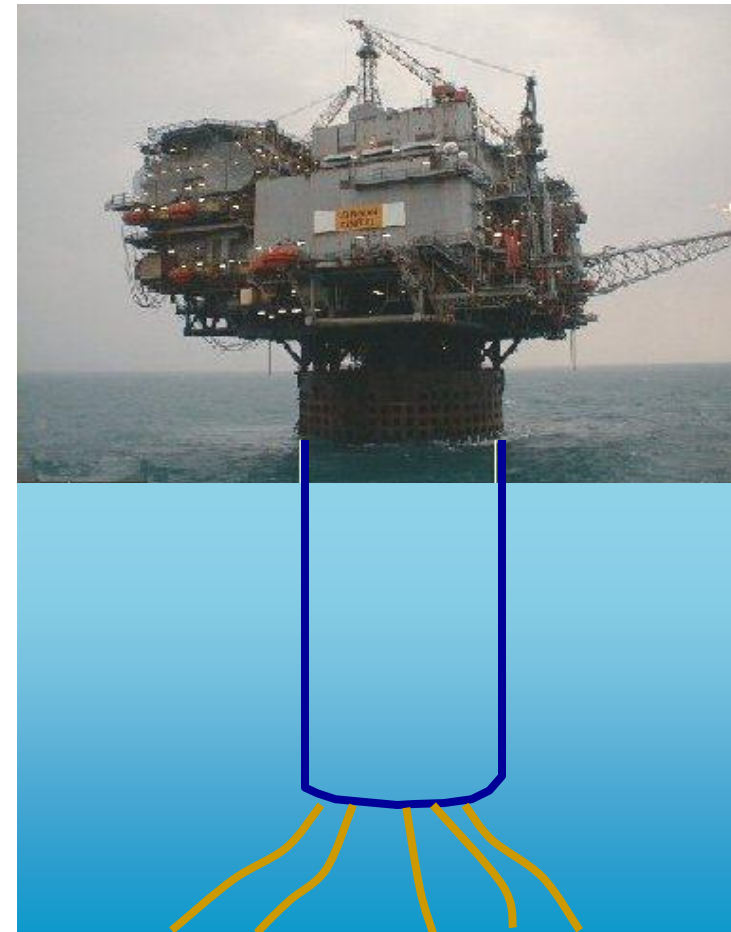
Floating platforms

Floating production platforms are used when the oil fields are too small or the water depth are too deep to invest into an expensive and fixed production platform.

There again are many designs in use depending on the field and sea conditions.

This example shows only a little derrick, a flare boom on the right, a heli deck on the top left and life boats.

Petroleum from e.g. 25 wells, drilled e.g. by a semisub, reaches from subsea manifolds via hoses at the bottom of the platform.



FPSO



HESS
FPSO "Triton 1"



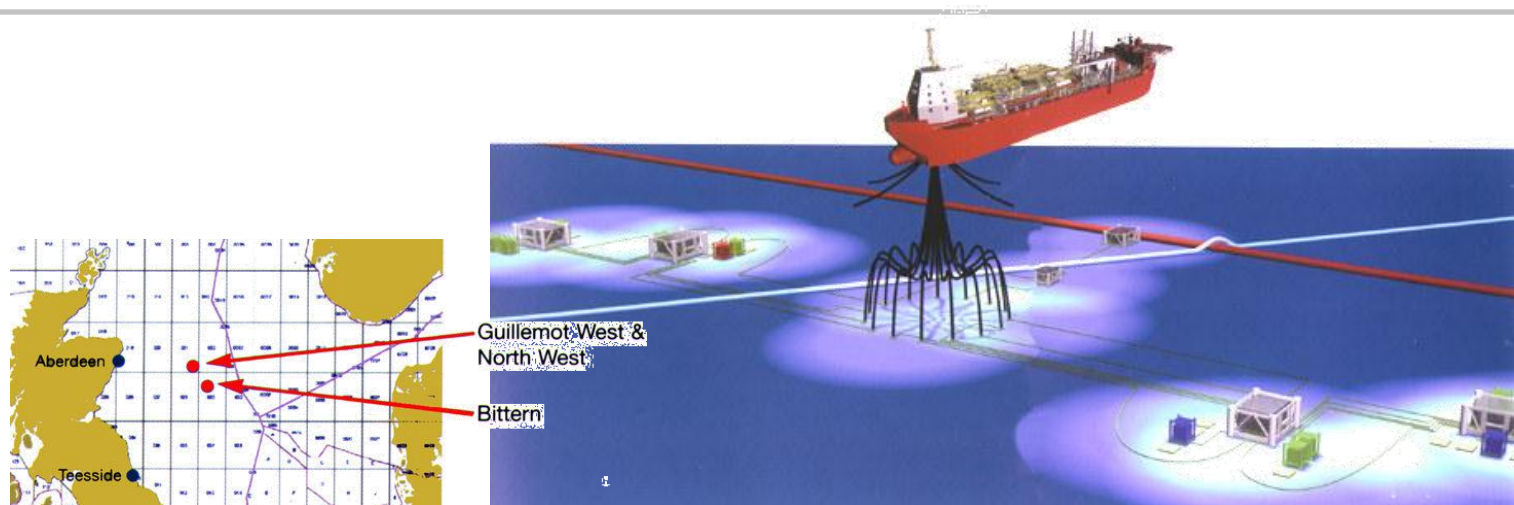
Floating Production Storage Offloading

These new installations combine the advantages of a tanker and a production platform. They are used to produce from subsea manifolds which connect many wells and even several oil fields many km apart. Their main advantage is the easy and cheap relocation after a field has been exploited.

Crude is separated on the FPSO and temporarily stored in its tanks before being exported by tankers. Gas is being used as fuel and exported by pipeline.

The FPSO is double hulled, 244 m long, 42 m wide and 21 m in the water. It has 105,000t deadweight, stores 630,000 STB (100,000m³) - six days work at peak production - accommodates 80 people and is designed for 20 years. Rig costs are close to a million USD a day.

FPSO operation figures



In this example the wellstream enters the FPSO through nine flexible risers. There are 15 riser slots available for future expansion. The subsea manifolds are controlled by two umbilicals.

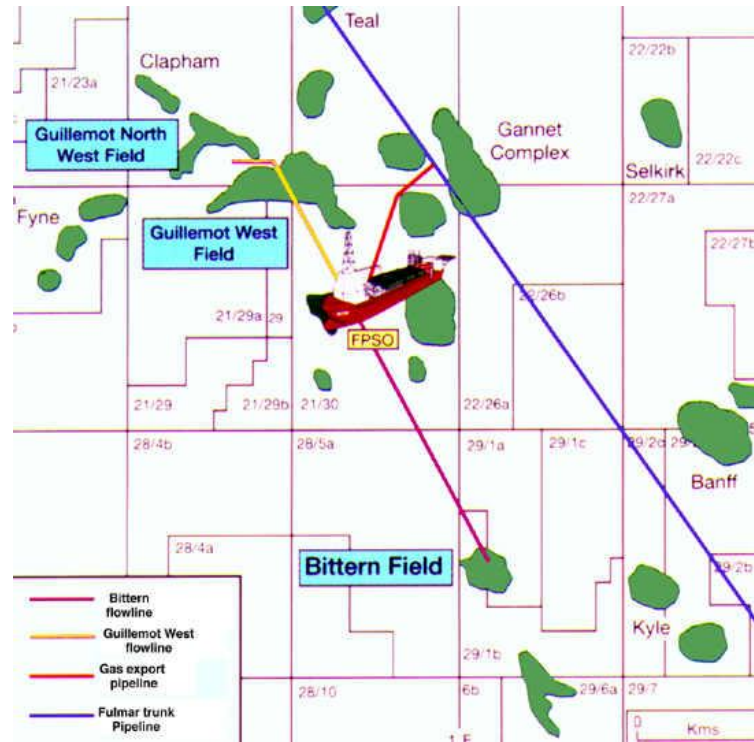
Average daily production is 92,000 bopd (max 105 mbopd) and 13 mmscfd gas using a three stage separator with a dehydrator. Well testing is done with a test separator.

The gas system can handle 140 mmscfd at 173 bar, dried and metered to pipeline requirements. 100,000 bbl water (bwpd) at 170 bar and water injection of 125,000 bwpd, deaerated (CO₂ removed) and filtered to 80 microns can be handled.

Power generation by two gas turbines of 42 ME ISO rating.

Operated by HESS

FPSO production field



The three Triton fields, the Guilemot West field (12 km) and the Bittern field (20km) of the North Sea, 190 km east of Aberdeen, are being produced through six subsea structures with four production manifolds and nine pipelines totalling over 160 km in length to one FPSO. Water depth is around 100 m.

Drilling platform with storage

Canada

Hibernia field is the largest offshore field in Newfoundland

350 km offshore Newfoundland

Gravity Base Structure supports the rig to withstand the rough sea and icebergs

Production 56,000 POPD

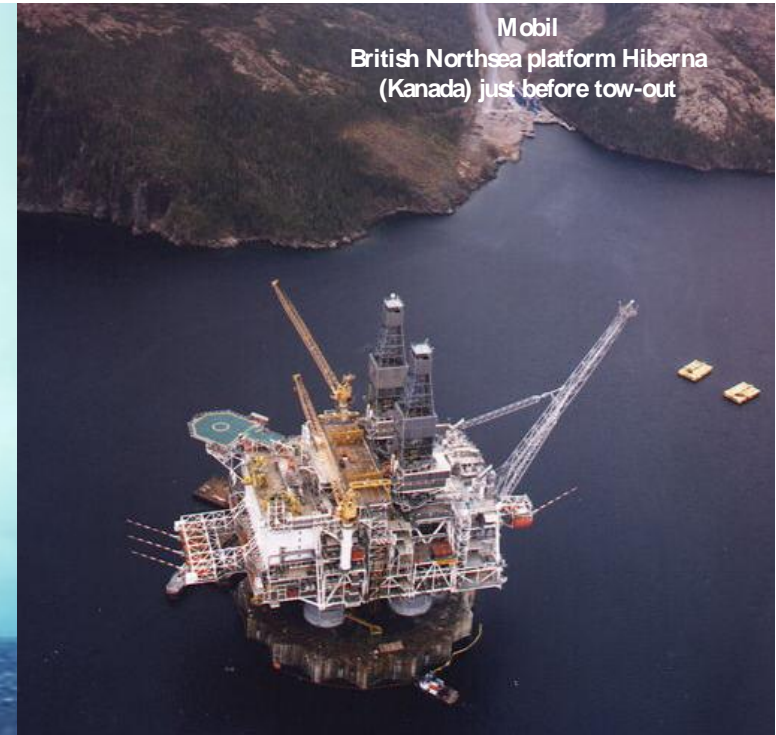
Capital and operating expenditure 1998 \$ 350 million

water depth 90 m

average employed 960 people

Two derricks for drilling and work-over.

Production set-up and in the concrete basement subsea storage tanks



Mobil
British Northsea platform Hiberna
(Canada) just before tow-out

To exploit large oil fields, especially built platforms with drilling and storage facilities are used. A complete concrete construction is floated to the location and positioned for many years to come.

MPSVs, Multipurpose Service Vessel



Such vessels provide special workshop and well repair facilities.

Operations done are:

- Workover and recompletion
- Coil tubing drilling
- Measurement while drilling and logging while drilling with coil tubing
- Wireline and perforation
- Pumping mud, cementing, acid, gravel packs and completion fluids
- Slickline operations

Supply boat



Courtesy of OMV, Australia PTY



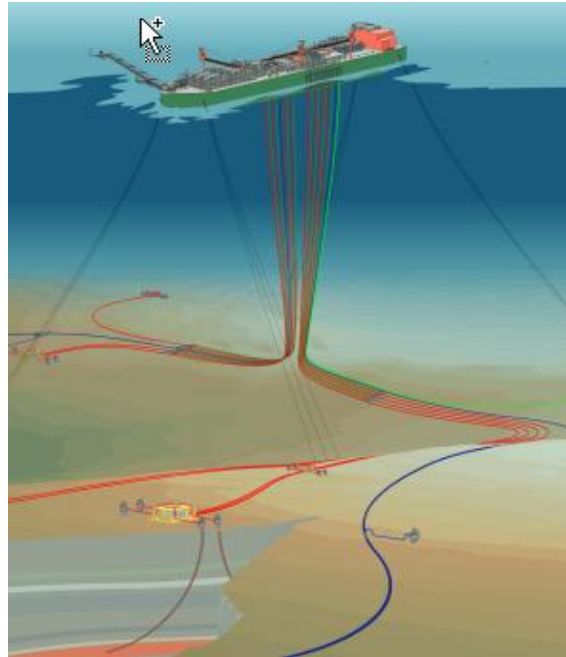
MV Pagenturm, Ekofisc North Sea, 1976, RB

Oilfield supplies are always heavy and big. They are supplied by a supply boat. These are also often able to pull up the anchors and reposition them. For safety reasons, to quickly evacuate a rig crew, a standby boat is always within 1 nm circle (nautical mile, 1,853 km) around the rig.

Never at anchor, one of the most challenging jobs for a 6 to 12 weeks duration!

Personnel are moved to and off the boat with the basket. Specially thrilling at rough weathers and after a nice lunch over 50 m above the water.

Summary



FPSO Shell
Investment:
\$1.3 billion

Water depth: 1,700 to
2,300 m



Cluster of risers of a FP, fixed platform

So far we saw how a well is being drilled and what kind of rigs and platforms are involved.

To finally make a well produce we need to connect the wellhead to a pipeline or a tanker.



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