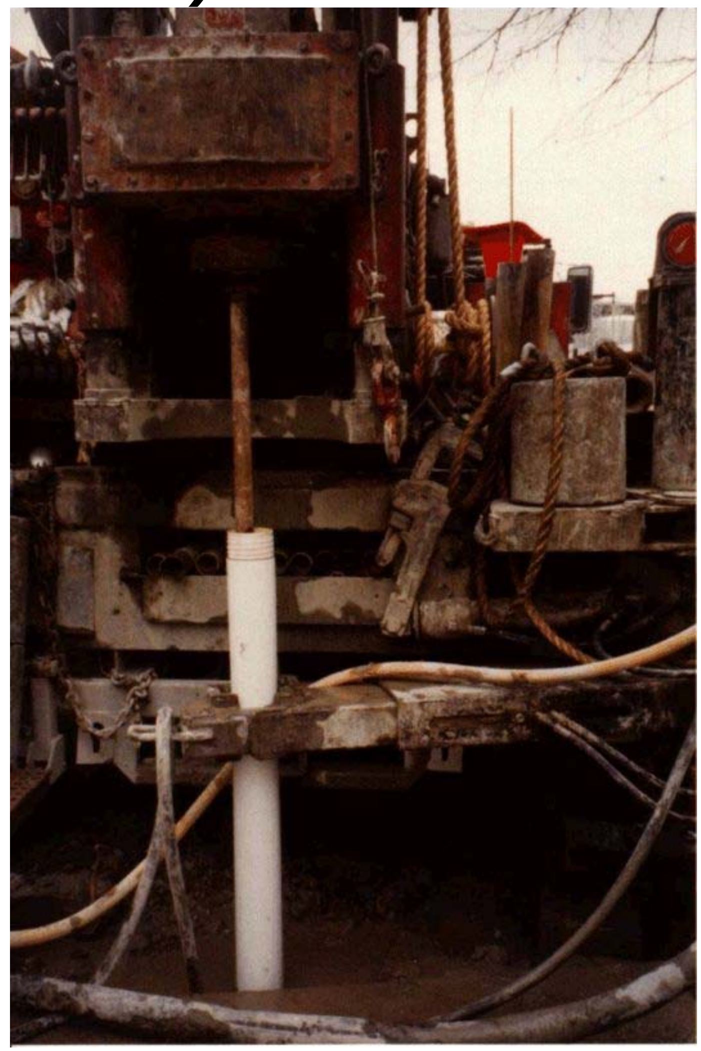
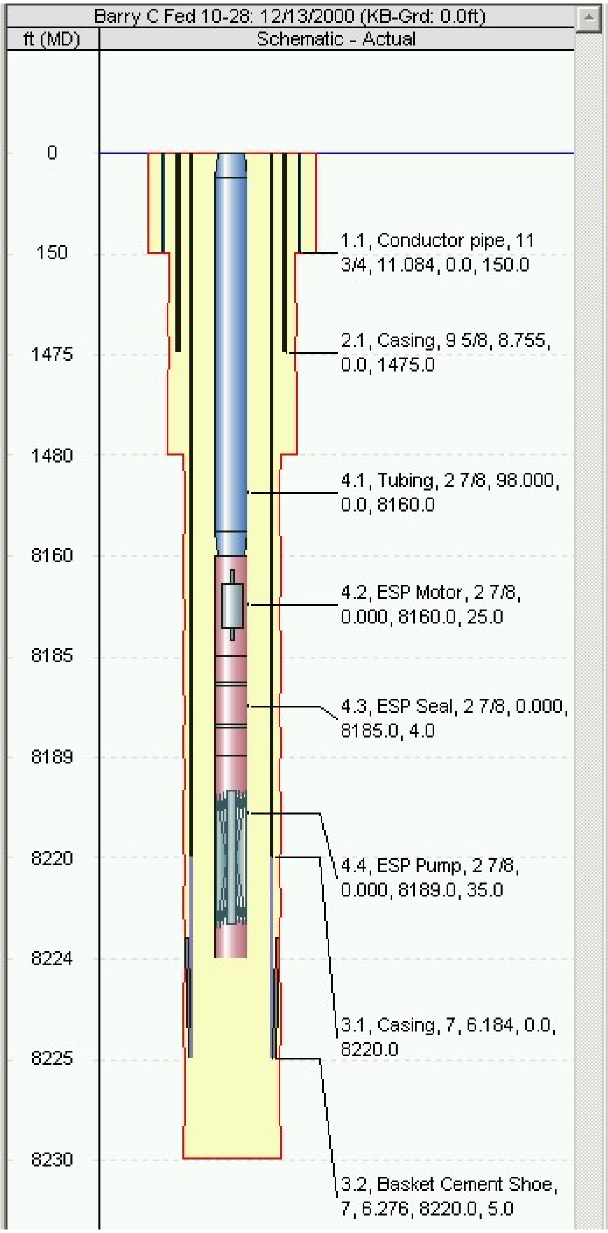
Production of Oil

Borehole Stabilization (Below Ground)

- Stabilized by casing
- Casing - lengths of PVC pipes are cemented in place
- Known as the wellbore
- Tubing which will be delivery device of the petroleum is inserted in wellbore





WellName	WellUserID	APICode	County
Barry C Fed 10-28	270216	49-035-20585	ALLEN, LA

Sec	Twn	Rge	Qtr1	Qtr2	Qtr3	XLoc	YLoc	Latitude	Longitude
28	27N	111W	NW	NW					

Engineer	Technician	Pumper
Bill Blass	Ronnie Fontenot	BOB ROZMAN

SpudDate	Comp Date	KB Depth	TD Drill Depth	TD Log Depth	TVD
/29/1980	8/13/1980	0	10210	0	0

Casing

Date In	Casing Type	Hole Dia	Size	Wt	Grade	Depth	Jts	Ft
3/10/1988	Conductor	13.750	0.000	0		150	0	0
3/12/1988	Surface	10.500	9.625	43.5		1487	1	1475
3/30/1988	Production	8.000	7.000	29	K-55	8237	240	8220

Tubing

Date In	Size	Wt	Grade	Cou OD	ID	Depth	Avg Jt	Intake
10/24/1999	2.875	7.8	L/N-80	3.5	0.000	8236	34.87	8236

Sucker Rods

Type	Size	Grade	Length	Jts	Depth

Formations

	Tops						
Formation	Ref Well	Cur Wel	Subsea	Elec	Thick	Porosity	Perm

Borehole Stabilization (Above Ground)

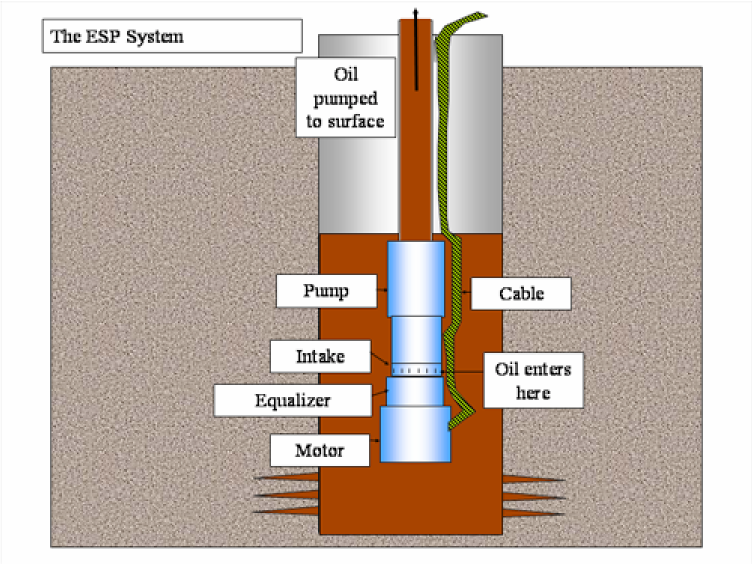
- Installation of a wellhead, commonly know as a “Christmas Tree”
  - Regulates the flow of oil or gas from the wellbore
  - Helps avoid the gushing of oil wells

Stages of Recovery

- Primary Recovery
- ~20% recovery rate
- Secondary Recovery
- ~25-35% recovery rate (P+S)
- Tertiary Recovery
- ~5-15% recovery rate

Primary Recovery

- Production that uses the pressure of gases present in the wellbore
- As production decreases, techniques must be employed to assist the declining pressure, although it is not replacing the pressure
- Techniques known as artificial lift
- Main form of artificial lift in primary recover is pumps
  - **Electrical Submersible Pumps (ESPs)**
    Multistage centrifugal pumps that use blades, or impellers, attached to a long shaft. The shaft is connected to an electrical motor that is submerged in the well. The pump usually is installed in the tubing just below the fluid level, and electricity is supplied through a special heavy-duty armored cable.

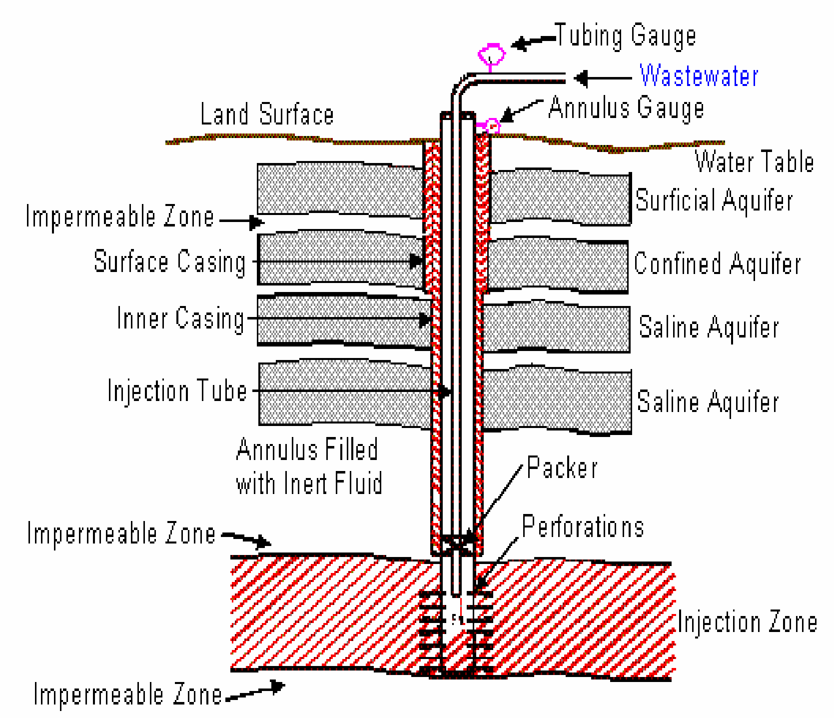


Primary Recovery

- **Subsurface Hydraulic Pumps**
  There are two types of hydraulic pumps:
- Fixed-pump: Downhole pump is attached to the end of the tubing string and run into the well. Power fluid is directed down an inner tubing string, and the produced fluid and the return power fluid flow to the surface inside the annulus between the two tubing strings
- Free-pump design: Downhole pump is circulated into and out of the well inside the power-fluid tubing string, or they can be installed and retrieved by wireline operations.
- Jet pumps are a special class of hydraulic subsurface pumps and are sometimes used in place of reciprocating pumps.

Secondary Recovery

- Involves the injection of water or a gas to increase the pressure in the well
- Waterflooding
  - Injection wells are drilled into the reservoir and water equal in volume to the oil removed is injected into the well
- Immiscible Gas Injection
  - Natural Gas Liquids or other gases are injected into the well
- Utilized for light and medium crude only



Tertiary Recovery

- A substance is added to increase the efficiency of recovery of the injected gas or water
- Carbon Dioxide Miscible Injection
  - Carbon dioxide is injected into injection wells
  - Dissolves crude, reduces its viscocity and reverts it to its carbon dioxide phase
  - Water can e alternated with the CO2 to push oil towards production well
  - Vaporized oil is extracted, clean of its impurities and the CO2 is reinjected

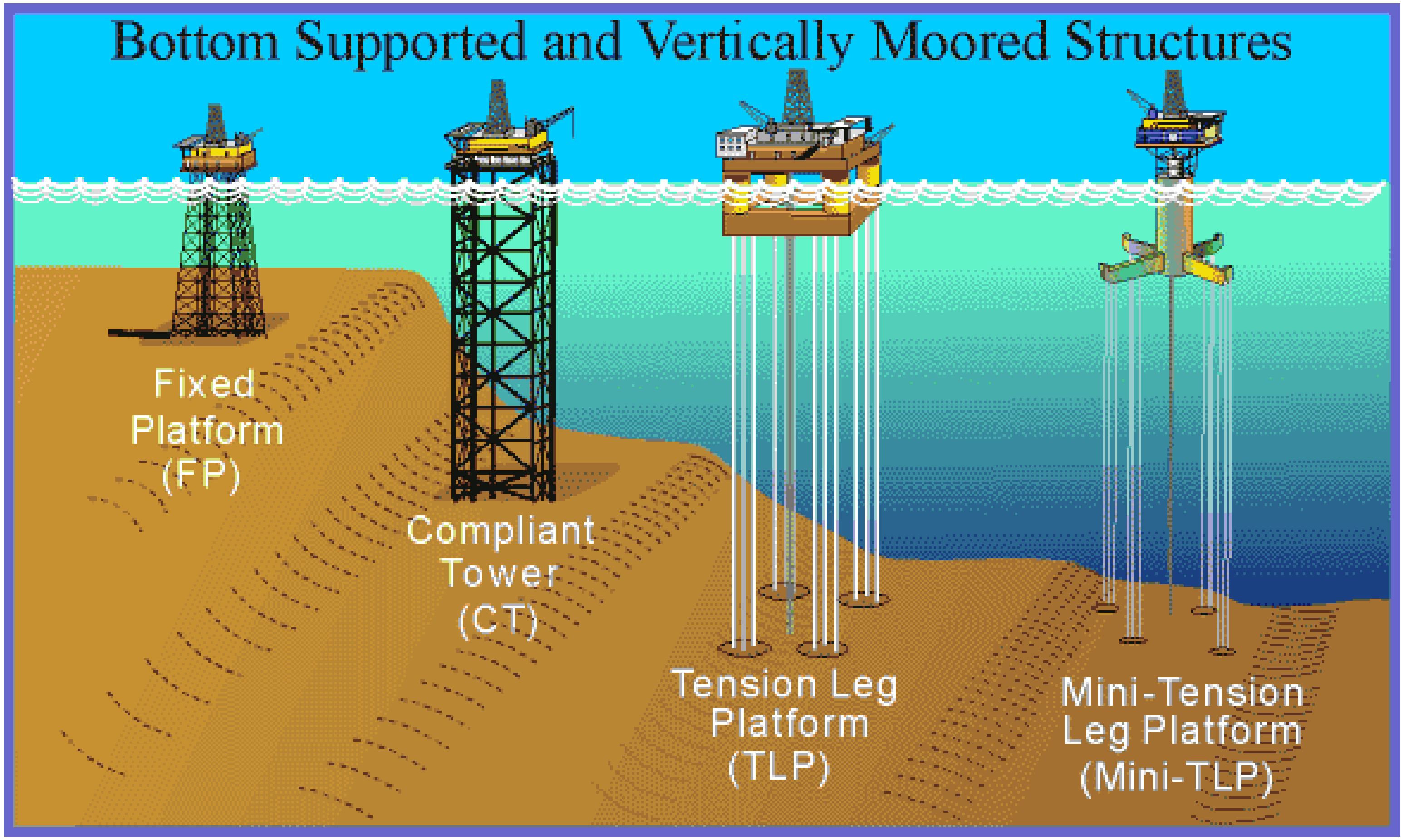
Tertiary Recovery

- Polymer Augmented Waterflooding
  - Polymers are added to the water before it is injected in order to make it thicker reducing the probability that water will bypass oil in less permeable areas
- Micellar-Polymer Flooding
  - A chemical concentrate is injected into the wells and, when mixed with oil it increases its viscosity

Tertiary Recovery

- Cyclic Steam Injection
  - Steam is injected into the producing well
  - A well is shut off for several days allowing heat to uniformly distribute and thin the oil
  - The newly thinned oil is produced
- Steam Drive
  - Steam is injected into injection wells and the oil is pushed towards production wells
  - Similar effect as water or gas injection
- In situ Combustion
  - Air is injected into the well
  - Air ignites or is ignited (depends on temperature) an composition
  - The resulting heat and gases increase the pressure and increase the viscosity of the oil

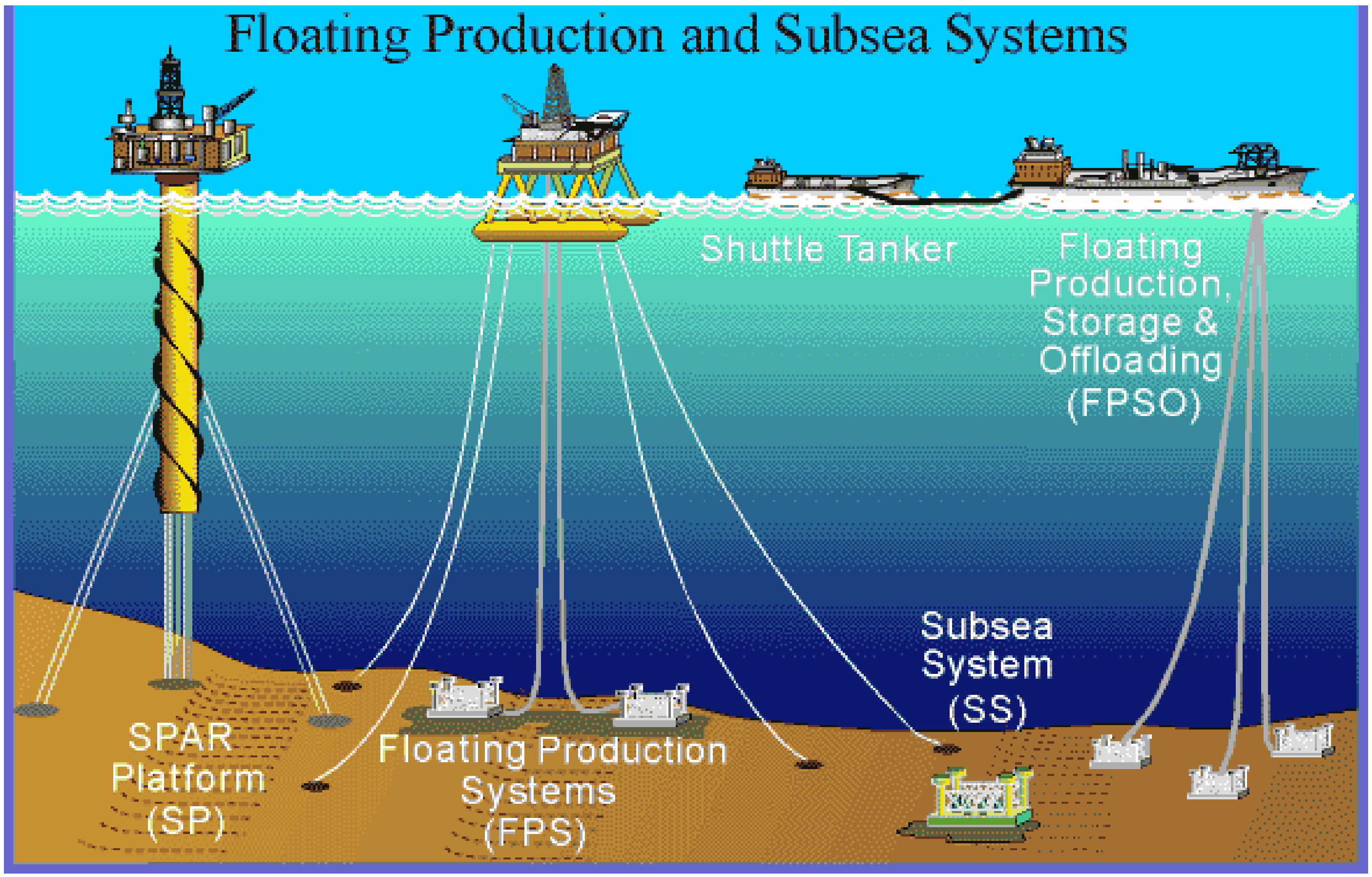
Deepwater Production



Deepwater Production

- **Fixed Platform (FP)** is made up of a jacket (a tall vertical section made of tubular steel members supported by piles driven into the seabed) with a deck placed on top, providing space for crew quarters, a drilling rig, and production facilities. The fixed platform is economically feasible for installation in water depths up to 1,500 feet.
- **Compliant Tower (CT)** is made up of a narrow, flexible tower and a piled foundation that can support a conventional deck for drilling and production operations. It is usually used in water depths between 1,000 and 2,000 feet.
- **Tension Leg Platform (TLP)** is made up of a floating structure held in place by vertical, tensioned tendons connected to the sea floor by pile-secured templates. Tensioned tendons provide for the use of a TLP in a broad water depth range with limited vertical motion. The larger TLP's have been used in water depths approaching 4,000 feet.
- **Mini-Tension Leg Platform (Mini-TLP)** is a floating mini-tension leg platform of relatively low cost developed for production of smaller deepwater reserves which would be uneconomic to produce using more conventional deepwater production systems. It can also be used as a utility, satellite, or early production platform for larger deepwater discoveries. The world's first Mini-TLP was installed in the Gulf of Mexico in 1998.

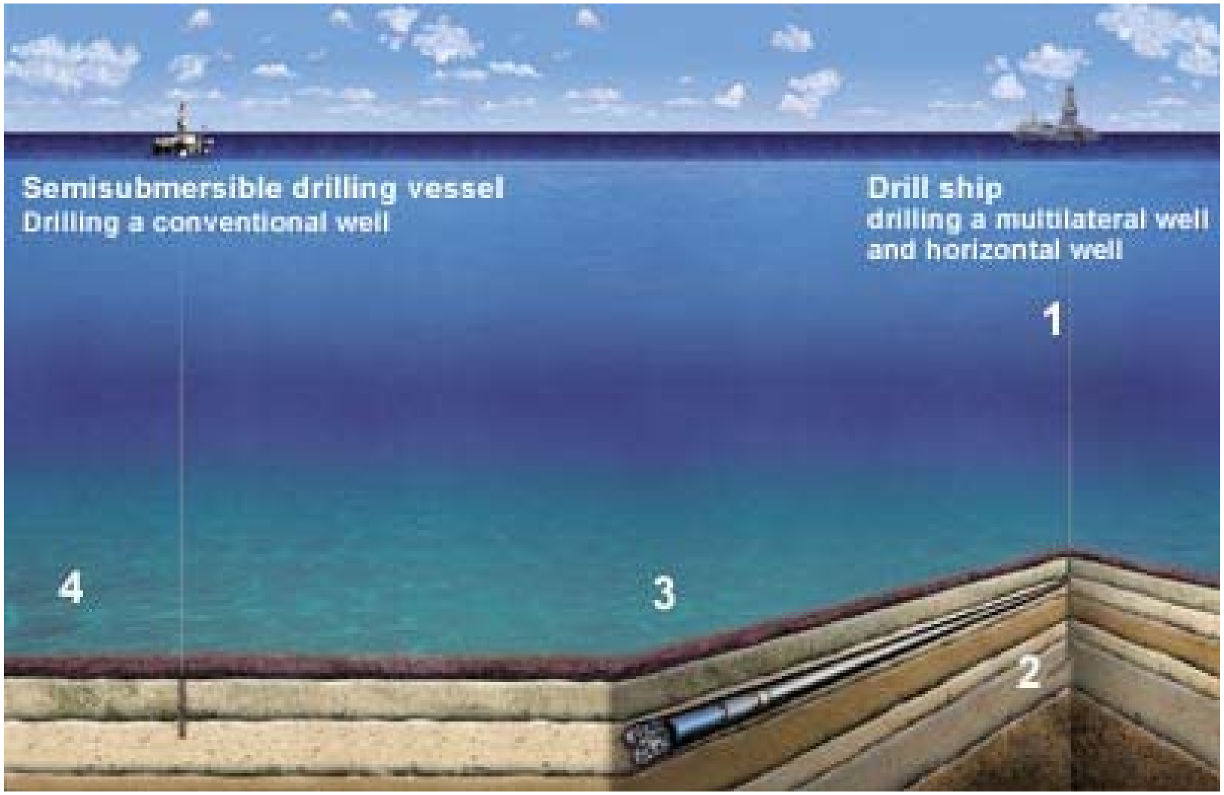
Deepwater Production



Deepwater Production

- **SPAR Platform (SPAR)** consists of a large diameter single vertical cylinder supporting a deck. It has a fixed platform topside (surface deck with drilling and production equipment), three types of risers (production, drilling, and export), and a hull which is moored using a taut caternary system of six to twenty lines anchored into the seafloor. SPAR's are presently used in water depths up to 3,000 feet, although existing technology can extend its use to water depths as great as 7,500 feet.
- **Floating Production System (FPS)** consists of a semi-submersible unit which is equipped with drilling and production equipment. It is anchored in place with wire rope and chain, or can be dynamically positioned using rotating thrusters. Production from subsea wells is transported to the surface deck through production risers designed to accommodate platform motion. The FPS can be used in a range of water depths from 600 to 7,500 feet.
- **Subsea System (SS)** ranges from single subsea wells producing to a nearby platform, FPS, or TLP to multiple wells producing through a manifold and pipeline system to a distant production facility. These systems are presently used in water depths greater than 5,000 feet.
- **Floating Production, Storage & Offloading System (FPSO)** consists of a large tanker type vessel moored to the seafloor. An FPSO is designed to process and stow production from nearby subsea wells and to periodically offload the stored oil to a smaller shuttle tanker. The shuttle tanker then transports the oil to an onshore facility for further processing. An FPSO may be suited for marginally economic fields located in remote deepwater areas where a pipeline infrastructure does not exist. Currently, there are no FPSO's approved for use in the Gulf of Mexico.

Deepwater Drilling Structure



1 Research is under way to develop new technology for drilling in water depths greater than 3,000 meters (10,000 feet).

2 Multilateral well

By drilling extensions off the main well, operators reach multiple oil-bearing rocks. Called multilateral drilling, this new technology lowers costs because it requires fewer wellheads, less casing and less drilling rig time.

3 Horizontal well

In some reservoirs, wells can be drilled horizontally for hundreds of meters through the oil-bearing rock, making the well as much as 10 times more productive than a conventional well.

4 Conventional well

Traditional vertical wells contact the rock bearing oil and gas only over the limited thickness of the reservoir in the immediate vicinity of the well.

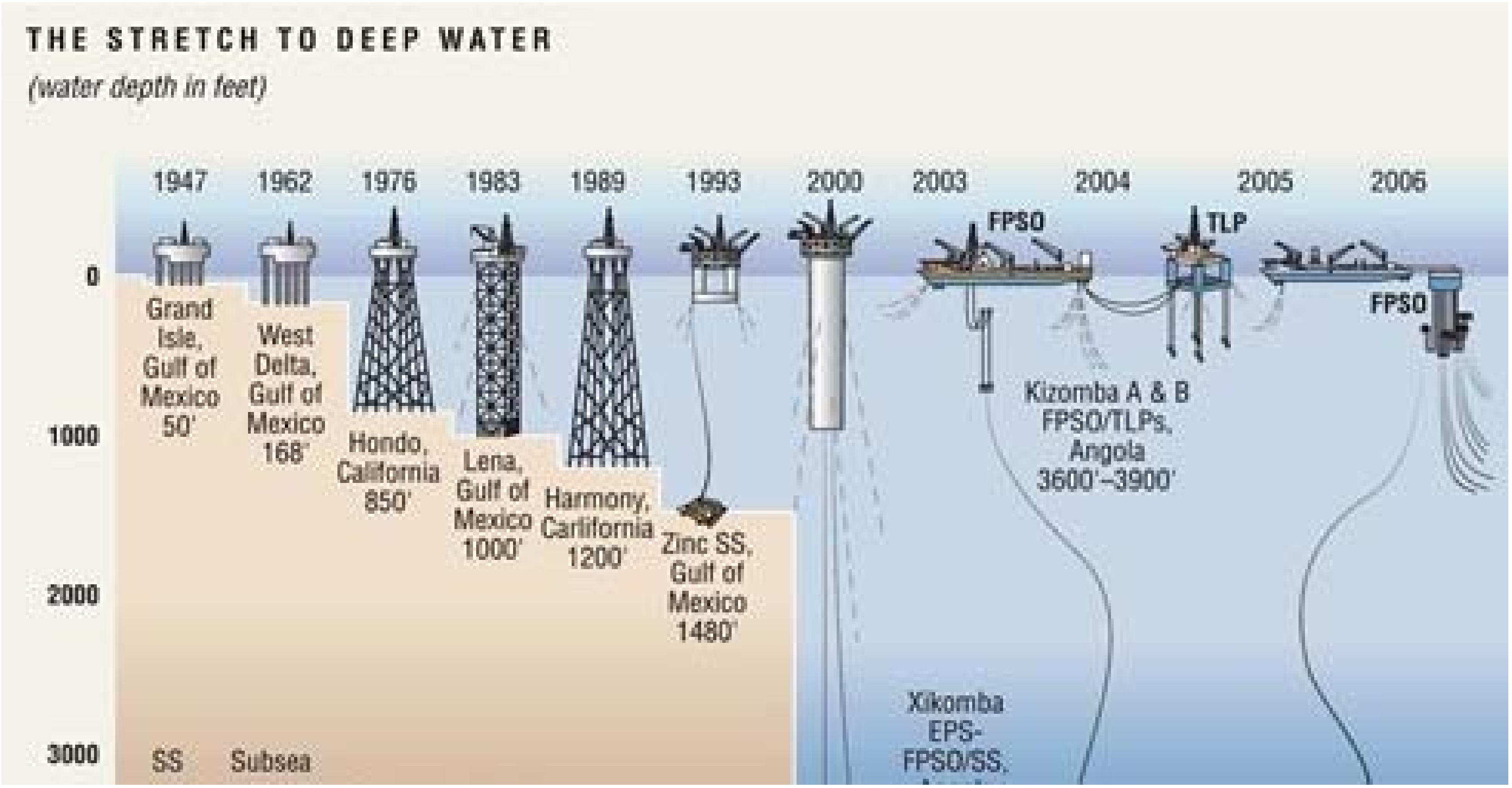
Flexibility of the fleet

ExxonMobil's worldwide deepwater drilling program requires great flexibility in both the type of rigs we select and the terms of our drilling contracts. This flexibility lets us match a suitable rig to each new drilling program. With our current contract fleet, we can drill in almost any environment and in water depths approaching 3,000 meters (10,000 feet).

Deepwater mooring technology

Mooring lines are normally deployed from the drilling vessel, with help from an anchor boat that supports most of the weight. But in deep water, those lines can be 3.2 kilometers (2 miles) long and weigh more than 294 metric tons each.
If the anchor boat deploys the line too quickly, it pulls the drilling vessel along with it. If the anchor boat goes too slowly, both vessels drift with the ocean currents. To overcome these problems, ExxonMobil engineers developed a proprietary computer program that determines precisely how much weight can be shared between the drilling vessel and the anchor boat as they set out each line.

Deepwater Techniques Usage



Costs of Production

Annual Equipping Costs for 10-well Oil Leases in 2002 (Current US Dollars)

	Producing Depth, feet			
Region	**2,000**	**4,000**	**8,000**	**12,000**
California	1,169,600	1,403,000	1,783,500	2,144,000
Oklahoma	866,300	1,080,000	1,558,400	1,876,200
South Louisiana	952,400	1,117,800	1,421,400	2,147,300
South Texas	889,600	1,034,200	1,282,800	2,049,700
West Texas	862,600	1,060,400	1,777,400	1,900,900
Rocky Mountains	880,100	1,084,800	1,693,700	1,939,200
Lower 48 States excluding offshore	936,800	1,130,000	1,586,200	2,009,600
Additional cost for Secondary Recovery in West Texas	2,338,400	4,472,000	8,356,500	N.A.

Costs of Production

Table ES2. Annual Operating Costs for 10-well Oil Leases in 2002 (Current US Dollars)

	Producing Depth, feet			
Region	**2,000**	**4,000**	**8,000**	**12,000**
California	161,700	211,300	370,600	545,000
Oklahoma	144,100	167,500	301,200	361,700
South Louisiana	177,000	252,700	299,600	426,400
South Texas	175,600	229,200	281,900	435,600
West Texas	135,200	157,400	216,200	338,700
Rocky Mountains	149,700	169,500	240,600	338,900
Lower 48 States excluding offshore	157,200	197,900	285,000	407,700
Additional cost for Secondary Recovery in West Texas	322,600	440,000	616,300	N.A.

Costs of Production (Deepwater)

Table ES5. Annual Operating Costs for Gulf of Mexico wells in 2002 (Current US Dollars)

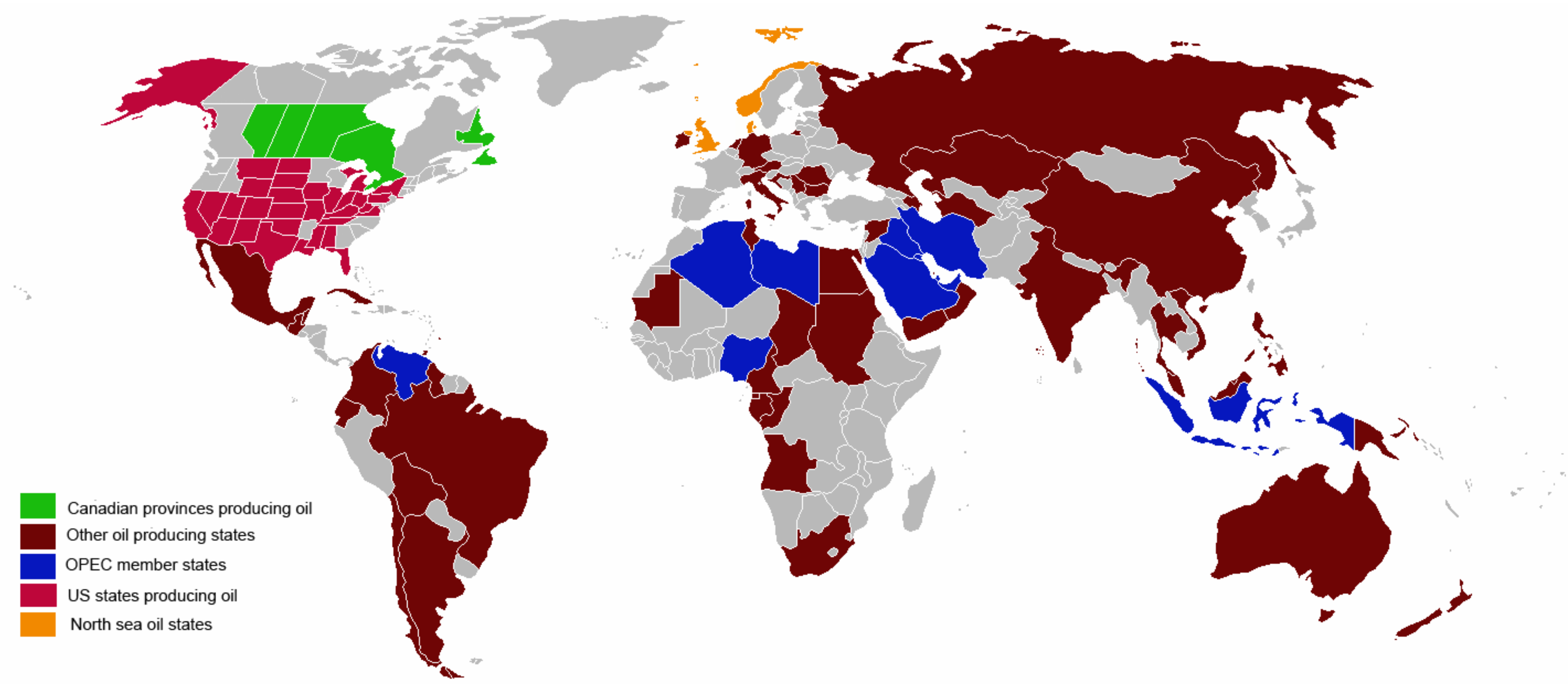
	Water Depth, feet		
Platform Size	**100-ft**	**300-ft**	**600-ft**
12 Slot	4,580,100	4,768,000	
18 Slot	5,606,300	5,822,500	6,237,600
GOM Average	5,093,200	5,295,300	6,237,600

Top Producers, Exporters, Consumers and Importers (2004)

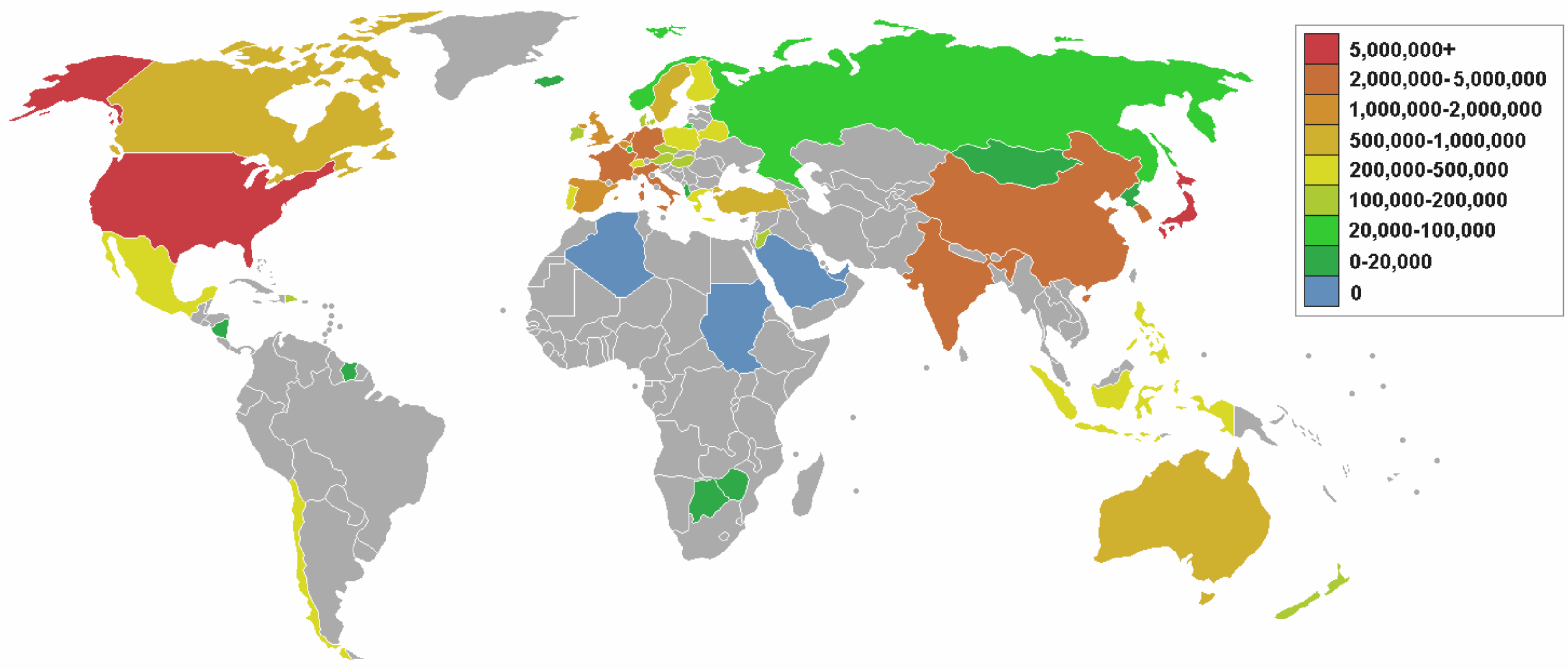
Producers[1]	Total oil production	Exporters[2]	Net oil exports	Consumers[3]	Total oil consumption	Importers[4]	Net oil imports
1. *Saudi Arabia*	**10.37**	**1. *Saudi Arabia***	**8.73**	**1. United States**	**20.5**	**1. United States**	**11.8**
2. Russia	**9.27**	**2. Russia**	**6.67**	**2. China**	**6.5**	**2. Japan**	**5.3**
3. United States	**8.69**	**3. Norway**	**2.91**	**3. Japan**	**5.4**	**3. China**	**2.9**
4. *Iran*	**4.09**	**4. *Iran***	**2.55**	**4. Germany**	**2.6**	**4. Germany**	**2.5**
5. Mexico	**3.83**	**5. *Venezuela***	**2.36**	**5. Russia**	**2.6**	**5. South Korea**	**2.1**
6. China	**3.62**	**6. *United Arab Emirates***	**2.33**	**6. India**	**2.3**	**6. France**	**2.0**
7. Norway	**3.18**	**7. *Kuwait***	**2.20**	**7. Canada**	**2.3**	**7. Italy**	**1.7**
8. Canada	**3.14**	**8. *Nigeria***	**2.19**	**8. Brazil**	**2.2**	**8. Spain**	**1.6**
9. *Venezuela*	**2.86**	**9. Mexico**	**1.80**	**9. South Korea**	**2.1**	**9. India**	**1.5**
10. *United Arab Emirates*	**2.76**	**10. *Algeria***	**1.68**	**10. France**	**2.0**	**10. Taiwan**	**1.0**
11. *Kuwait*	**2.51**	**11. *Iraq***	**1.48**	**11. Mexico**	**2.0**		
12. *Nigeria*	**2.51**	**12. *Libya***	**1.34**				
13. United Kingdom	**2.08**	**13. Kazakhstan**	**1.06**				
14. *Iraq*	**2.03**	**14. Qatar**	**1.02**				

NOTE: OPEC members in italics.
1. Table includes all countries with total oil production exceeding 2 million barrels per day in 2004. Includes crude oil, natural gas liquids, condensate, refinery gain, and other liquids.
2. Includes all countries with net exports exceeding 1 million barrels per day in 2004.
3. Includes all countries that consumed more than 2 million barrels per day in 2004.
4. Includes all countries that imported more than 1 million barrels per day in 2004.
Source: Energy Information Administration (EIA). www.eia.doe.gov/emeu/cabs/ .

Oil Producers



Oil Imports


5,000,000+
2,000,000- 5,000,000
1,000,000-2,000,000
500,000-1,000,000
200,000-500,000
100,000-200,000
20,000-100,000
0-20,000
0

- Federal Remediation Technologies Roundtable http://www.frtr.gov/matrix2/section4/D01-4-54.html
- Wikipedia
- Energy Information Agency http://www.eia.doe.gov/oil_gas/natural_gas/data_publications/cost_indices/c_i.html
- U.S. Department of the Interior: Minerals Management Service. http://www.gomr.mms.gov/homepg/offshore/deepwatr/options.html
- Production Access. http://www.productionaccess.com/ProductServices/Drilling_Wellbore.htm
- Shell http://www.shell.com/home/Framework?siteId=eandp-en&FC2=/eandp-en/html/iwgen/zzz_lhn.html&FC3=/global/about_shell/what_we_do/eandp_swf/eandp_swf_offshoreprod_ga_0830.html
- ExxonMobil
- http://www.exxonmobil.com/scitech/leaders/capabilities/mn_upstream.html
- Society of Petroleum Engineers http://www.spe.org/spe/jsp/basic/0,,1104_1008218_1109305,00.html
- Schlumberger http://www.glossary.oilfield.slb.com/default.cfm
- Ultra Petroleum http://www.ultrapetroleum.com/ppt/20060629C.pdf