



**A new energy culture**

**sustainability and territories**



# Possibilities of offshore drilling in Croatia

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# The UN Convention on the Law of the Sea

❖ UNCLOS convention (the United Nations Convention on the Law at the Sea; came into force on 16/11/1994)

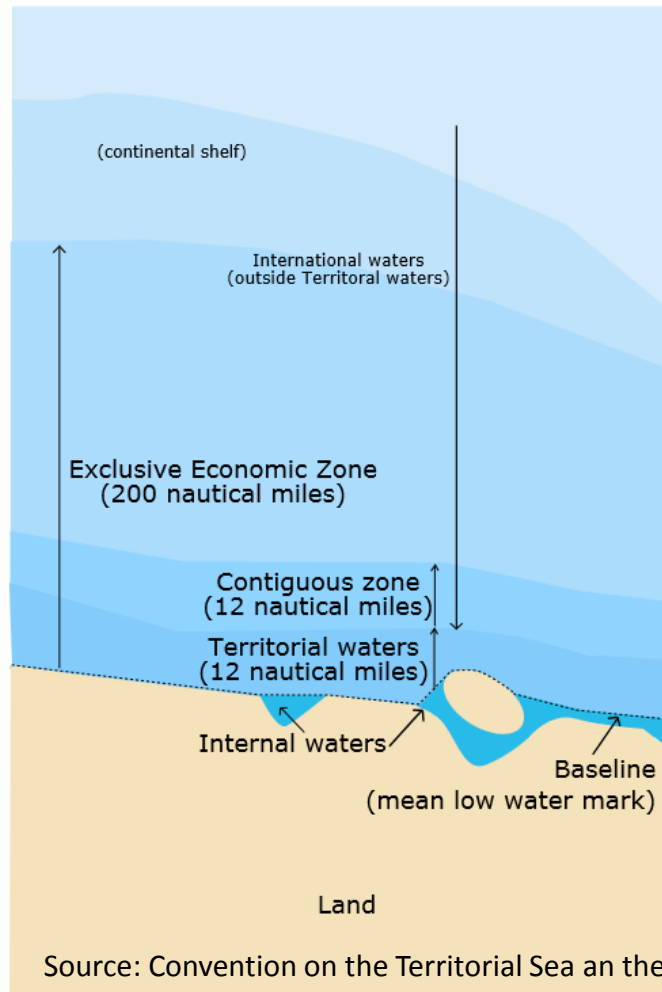
**a territorial sea** - a belt of coastal waters extending at most 12 nautical miles (22,2 km) from the baseline (usually the mean low-water mark) of a coastal state;

**a continental shelf** – a natural prolongation of the land territory to the continental's margin outer edge or 200 nautical miles from the coastal state's baseline, whichever is greater;

**an exclusive economic zone** – a sea zone over which a state has special rights regarding the exploration and use of marine resources. It stretches from the baseline out to 200 nm from its coast; within this area, the coastal nation has sole exploitation right over all natural resources; it have to be declared by the coastal state.

# UNCLOS

- a **contiguous zone** - further 12 nautical miles from the territorial sea baseline limit in which the state can continue to enforce laws in four specific areas: customs, taxation, immigration and pollution.

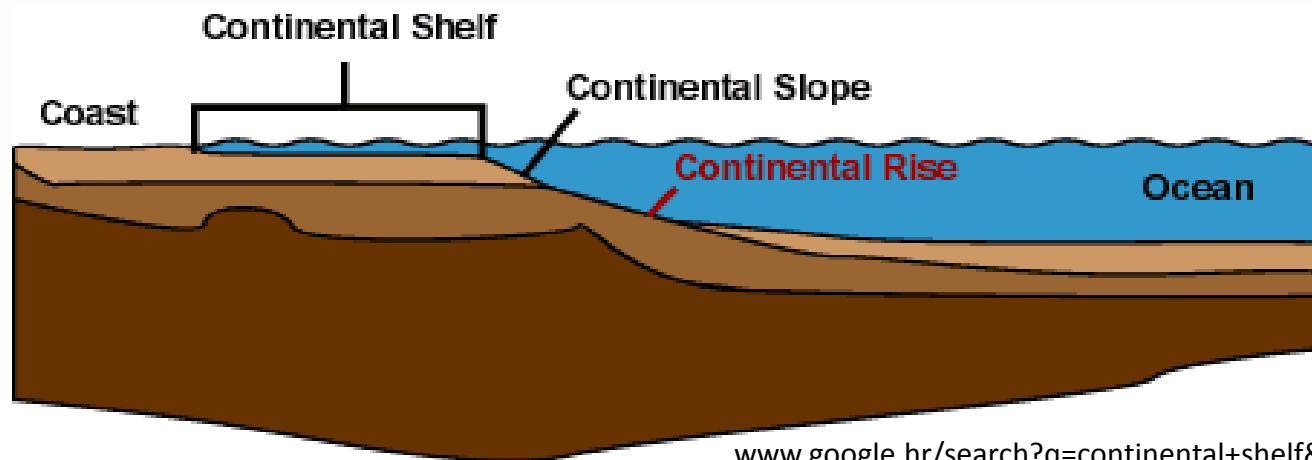


Source: Convention on the Territorial Sea and the Contiguous Zone, UN Treaty Series, Vol. 516

# Continental shelf

## Convention on the continental shelf

- continental shelf - 6,7% of seas and oceans area
- continental slope – 11%
- continental rise- 3,1%
- bottom of the ocean, abyssal plain



[www.google.hr/search?q=continental+shelf&espv](http://www.google.hr/search?q=continental+shelf&espv)

# Offshore drilling options



Source: [www.eoearth.org](http://www.eoearth.org)

Drilling platform types for different sea depths

# Standards for classification

*International Association of Classification Societies* - IACS is a technically based organization consisting of twelve marine classification societies, such as ABS, Bureau Veritas, Det Norske Veritas, Lloyd's Register, and others.

➤ „Marine classification is a system for promoting the safety of life, property and the environment primarily through the establishment and verification of compliance with technical and engineering standards for the design, construction and life-cycle maintenance of ships, offshore units and other marine-related facilities”.

➤ These standards are issued by the classification society as published rules. A vessel that has been designed and built to the appropriate rules of a society may apply for a certificate of classification from that society. The society issues this certificate upon completion of relevant classification surveys.

➤ A ship built in accordance with an IACS Member's rules will be assigned a class designation by the society on satisfactory completion of the relevant surveys.

# ABS rules and guides

- Rules for building and classing *Mobile offshore drilling units – MODU* (January 2015), is a set of „Generic rules for conditions and classification.....and survey under construction”; the following rules are included:
  - conditions of classification
  - materials and welding
  - hull construction and equipment
  - machinery and systems
  - surveys
- Whereas classification requires periodic surveys of the classed vessel or offshore unit throughout its life (every five years), certification verifies that the item conforms to designated standards at a specified time. Certification can establish compliance with ABS, national, international, industry or other standards.



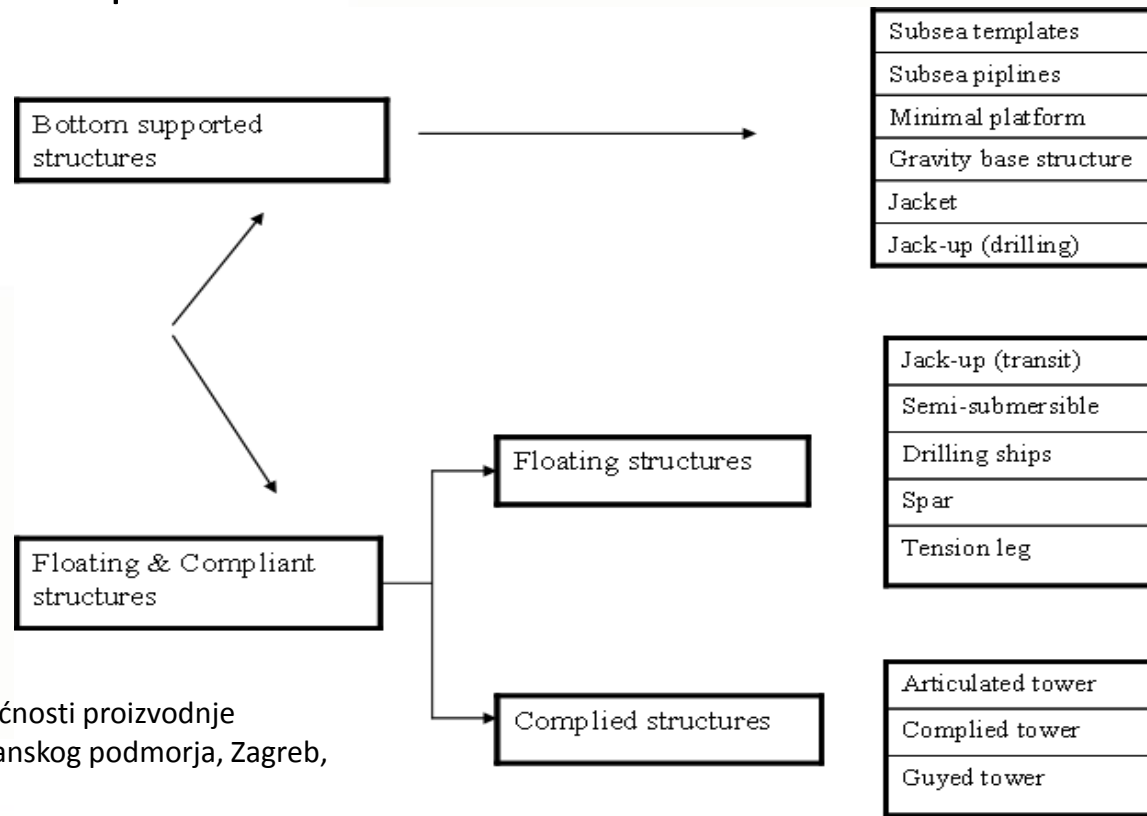
# Other relevant conventions and codes

During the survey classification society is verifying compliance and acceptance of the following international conventions and codes:

- *Code for Construction and Equipment of Mobile Offshore Drilling Units, 1989. - MODU CODE;*
- *International Convention on Load Lines, 1996;*
- *International Convention for the Safety of Life at Sea - SOLAS;*
- *International Convention on Tonnage Measurements of Ships;*
- *International Convention for the Prevention of Pollution for Ships 1973/1978.*

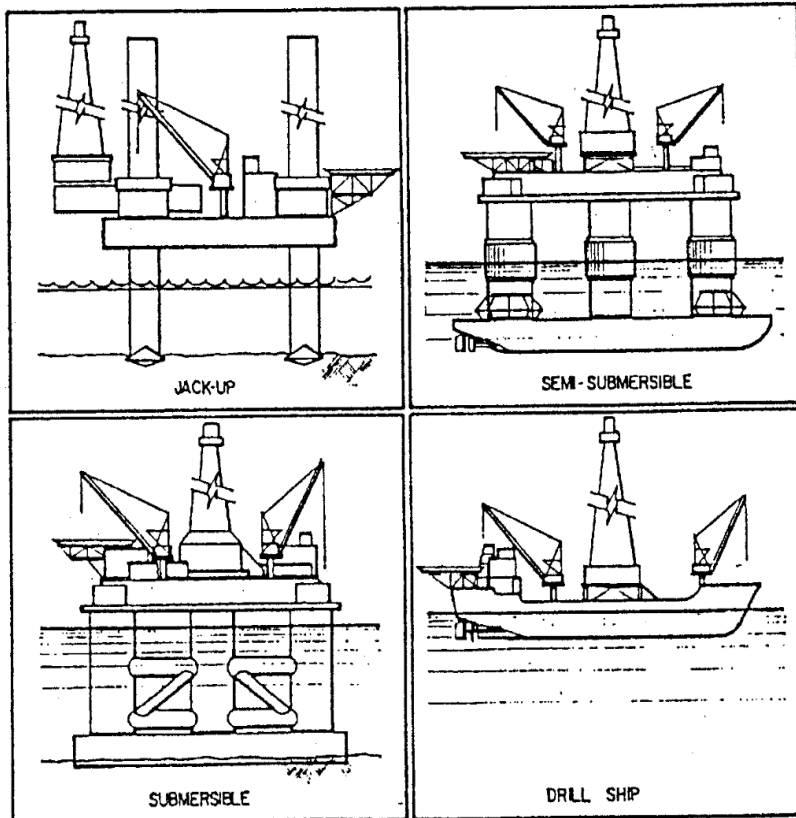
# Drilling rig - sea depth

- decision on drilling to be used for exploratory drilling is affected by the water depth



Source: Car,T., Mogućnosti proizvodnje ugljikovodika iz Jadranskog podmorja, Zagreb, 1989.

# MODU types



Source: ETA Offshore Seminars, Inc.

- **submersible**  
(bottom supported - shallow waters...)
- **jack-up**  
(self-elevating drilling units - SEDU, to max. 150 m)
- **semi-submersible**  
(floating drilling units, from 50 to 3000 m +)
- **drillship**  
(ex. Saipem 12000 ft - appr. 3600 m)
- **barge**  
(mostly not self-propelled)
- **tender assist drilling** (shaped like barges or ships, moored next to drilling equipment set)

# Jacking and processing modulus building

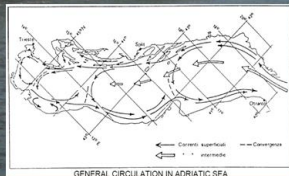
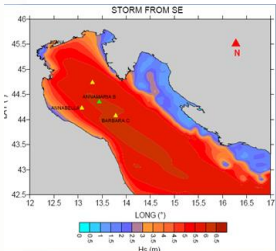


Source: INAgip, Plc photodocumentation

# Jacket towing to position

- towing a jacket

- jacket uprighting using crane barge

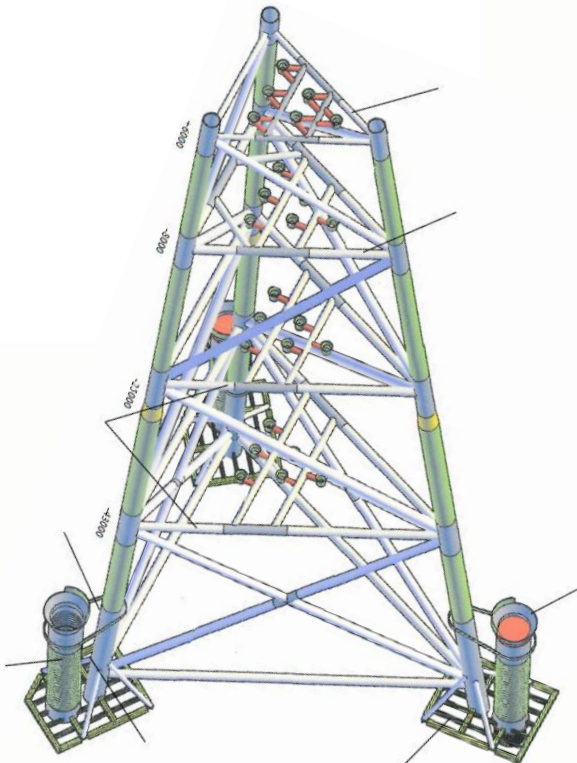


Source: INAgip, Plc photodocumentation

# Fixing jacketed structure

- steel jacketed structure

- driving pilots



Source: INAgip, Plc photodocumentation



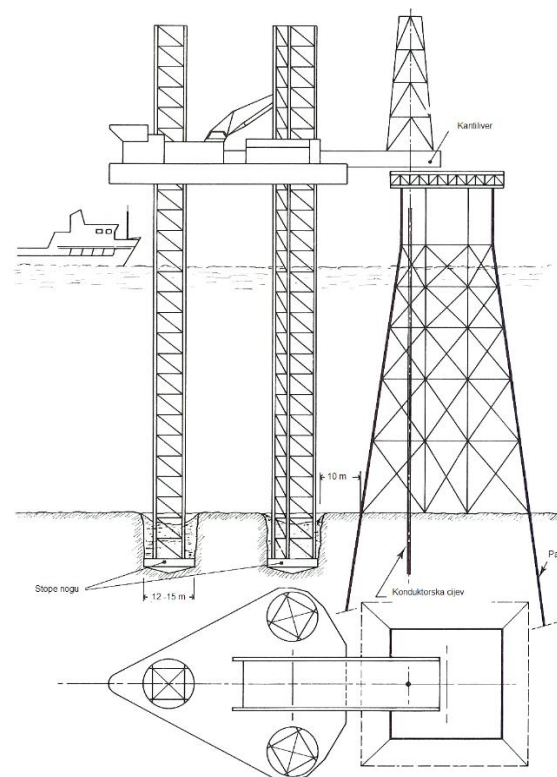
# Preliminary work prior to drilling (spud in)

- driving conductor string



Source: INAgip, Plc photodocumentation

- jack-up platform positioning



# Drilling in progress

- drilling rig „Ocean King” on a site



Source: INAgip, Plc photodocumentation



# Assembling production modulus

- towing of production modulus



Source: INAgip, Plc photodocumentation

- jacket and modulus connecting



# Platform in production

- wellheads

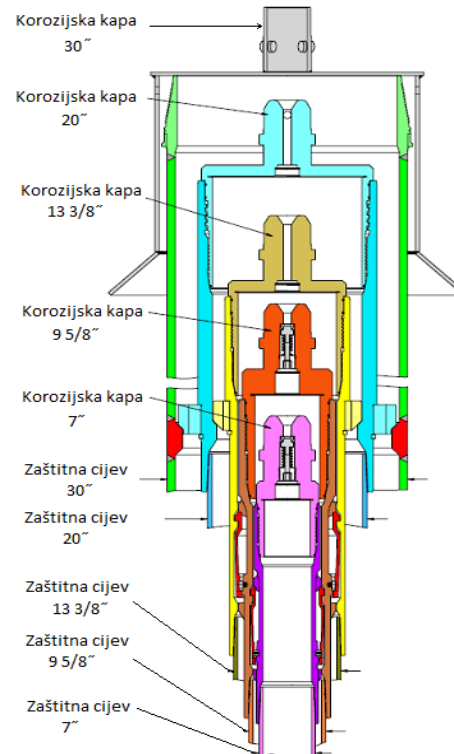
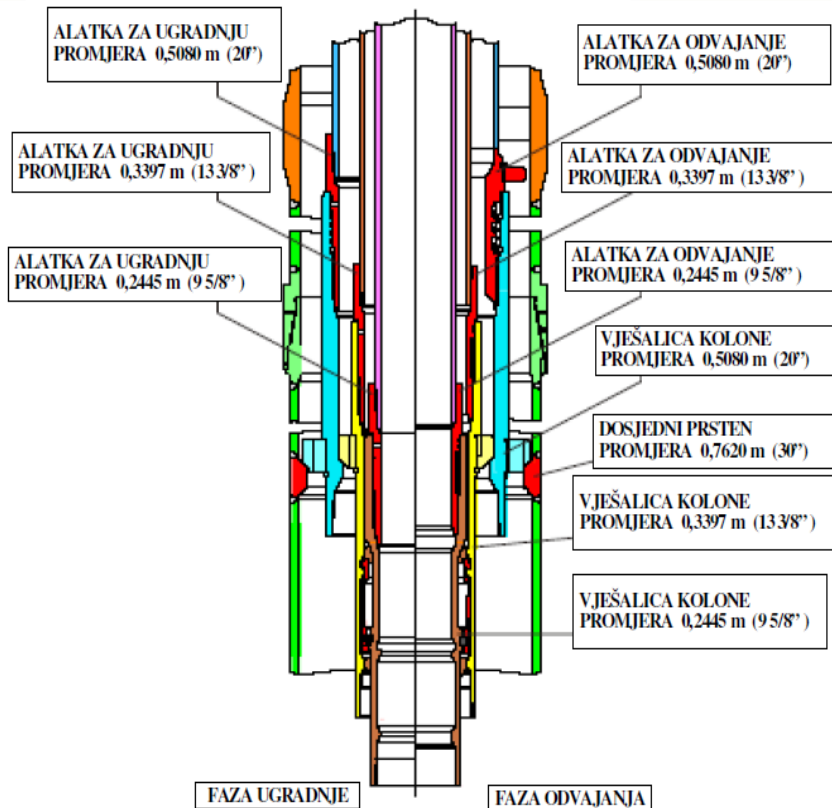


- assembled platform in production



Source: INAgip, Plc photodocumentation

# Mudline suspension system (MLS)



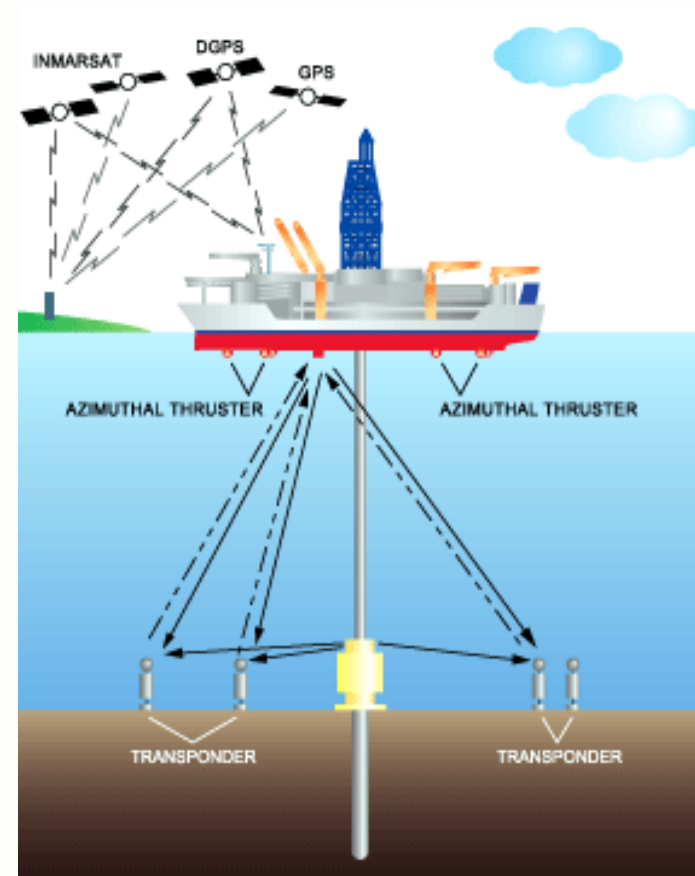
When drilling in deeper water the need to transfer the weight of the well to the seabed and provide a disconnect- and-reconnect capability become beneficial

Source: [www.vetcogray.com](http://www.vetcogray.com)

MLS system enables the well to be temporarily abandoned, when the total depth is achieved, and reconnecting (tie-back) the mudline hangers to the surface for re-entry and/or completion

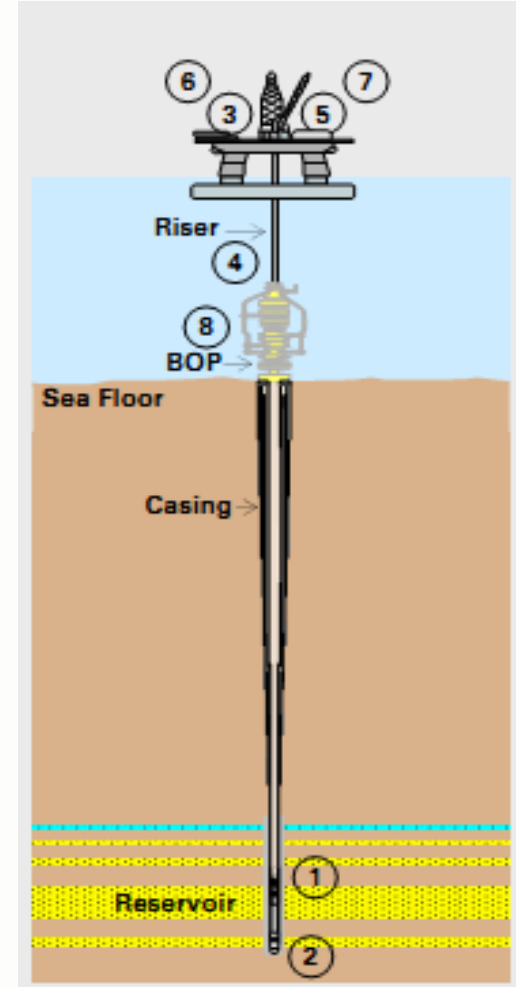
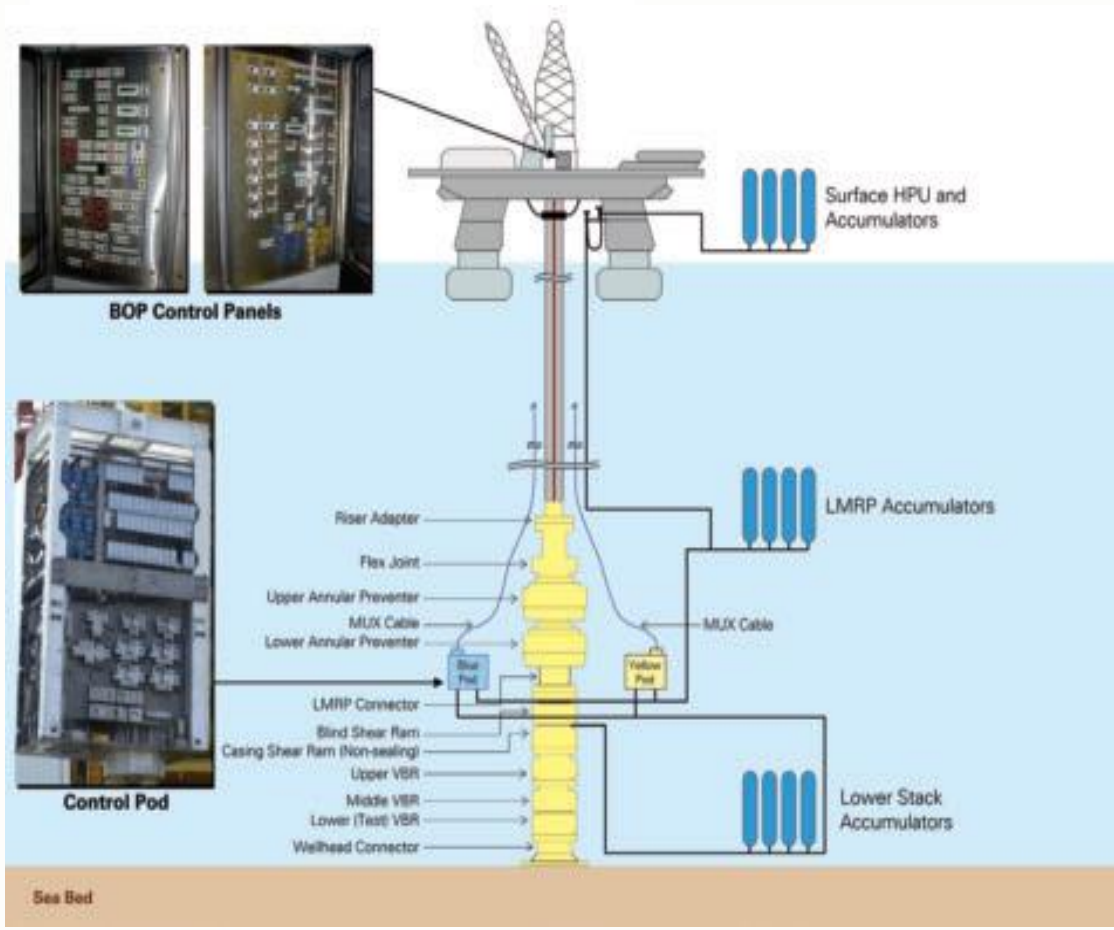
# Keeping the vessel on required spot

- mooring systems for semisubmersible (up to 500 m of water depth);
- dynamic positioning system - semisubmersible platforms and drillships (GPS, space based satellite navigation system providing position and time information in all weather conditions anywhere on or near the earth); propellers able to rotate full circle keeping vessel in exactly required position.



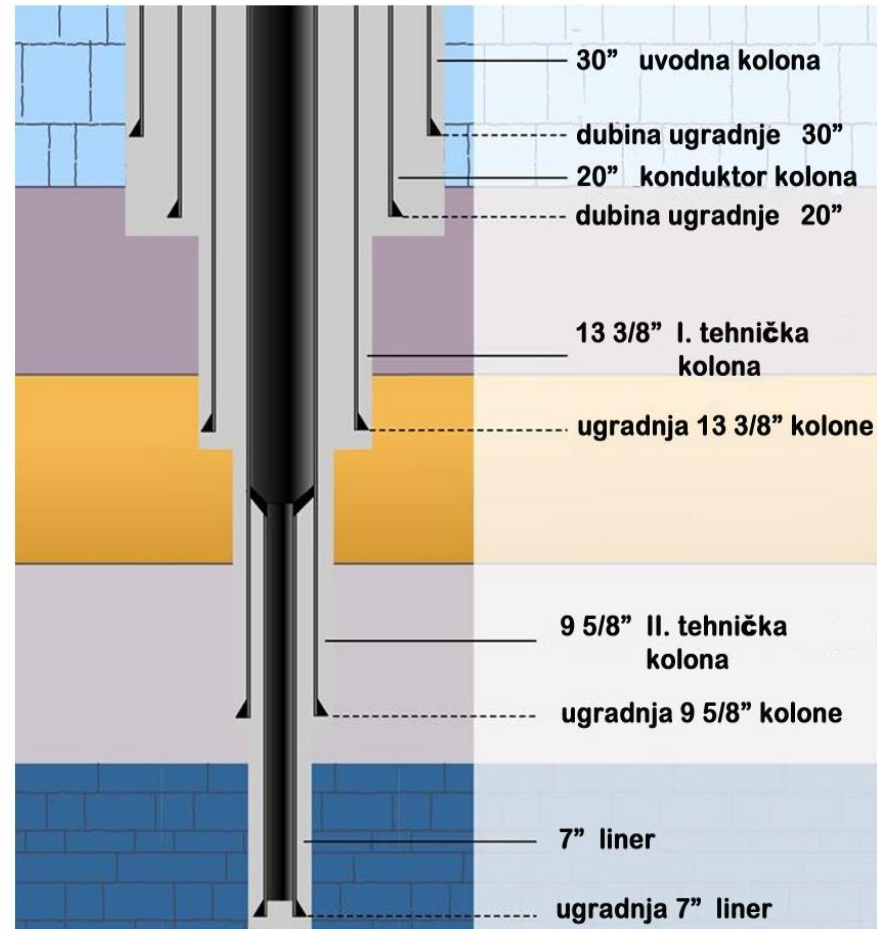
Source: [www.farinha0.tripod.com](http://www.farinha0.tripod.com)

# Deeper sea drilling

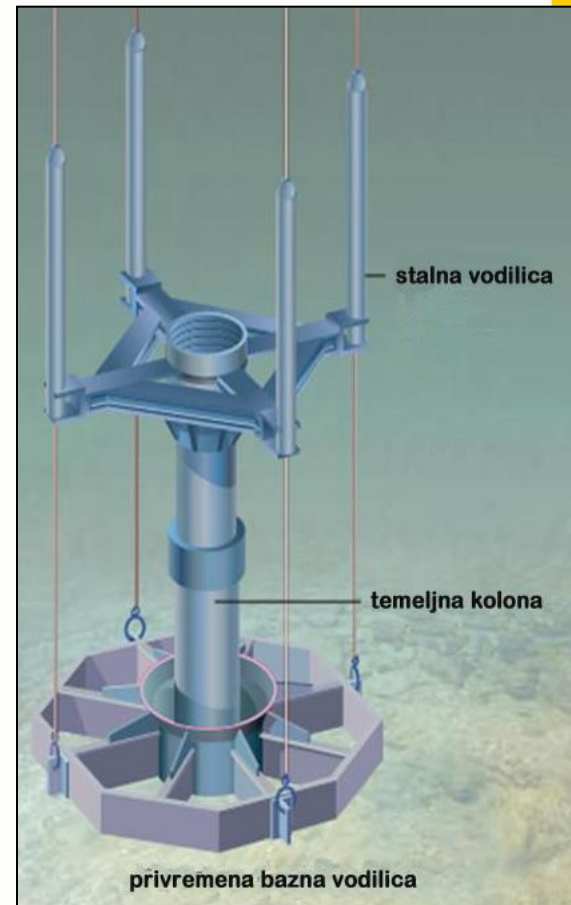
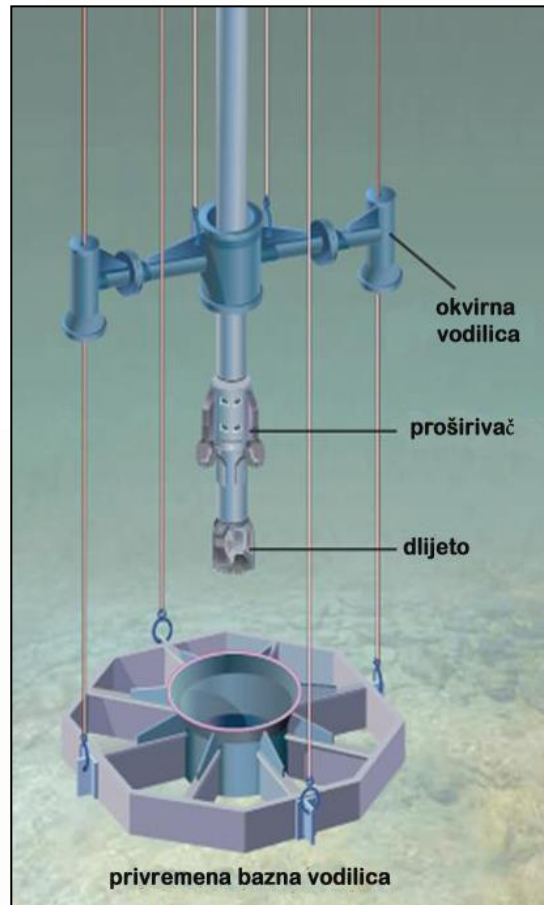
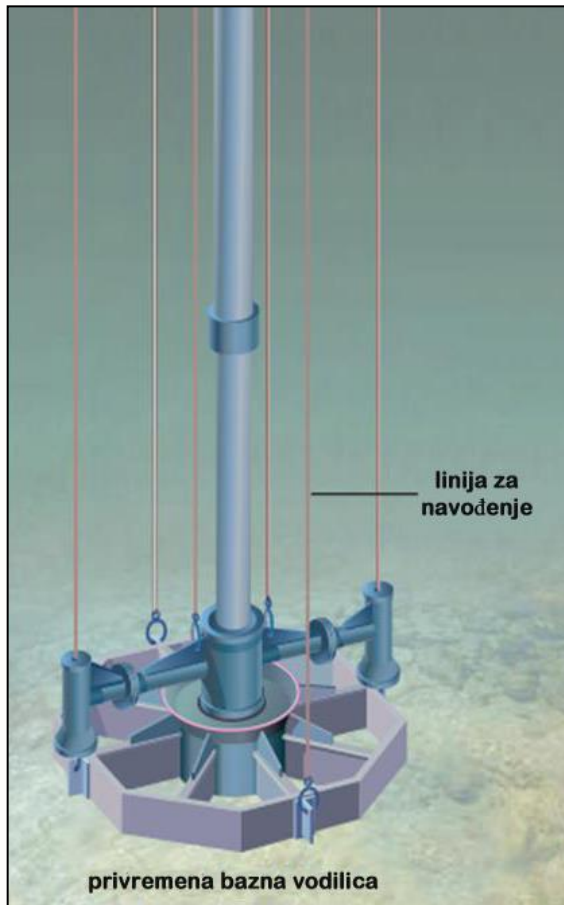


# Deep exploratory well plan (Vlasta - 1 well)

- **Conductor  $\varnothing$  30"**
  - - setting depth - 250 m
- **Surface casing string -  $\varnothing$  20"**
  - - setting depth - 700 m
- **I. intermediate string  $\varnothing$  13 3/8"**
  - - setting depth - 2500 m
- **II. intermediate string -  $\varnothing$  9 5/8"**
  - - setting depth - 4800 m
- **Liner  $\varnothing$  7"**
  - - setting depth - 6500 m



# Underwater drilling (moored platforms)

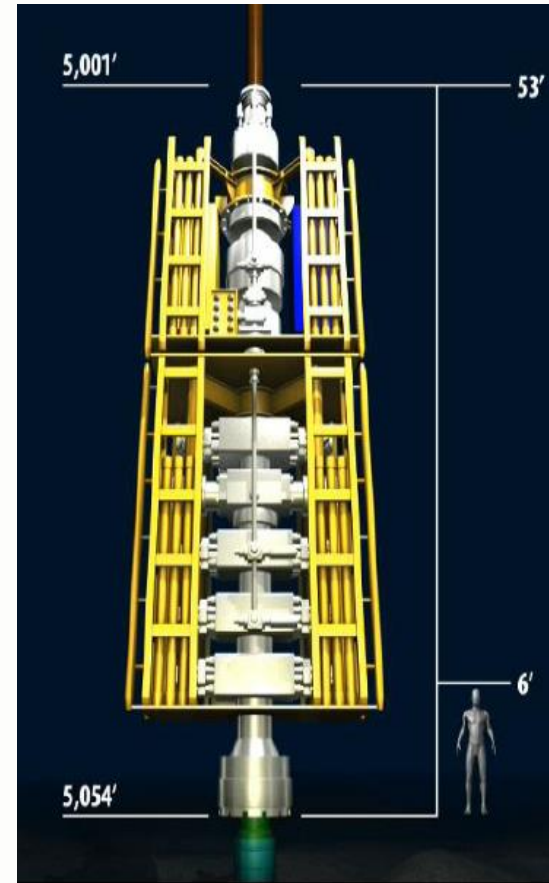


Source: [www. google.hr/search?q=semi+submersible+wellhead&espv](http://www.google.hr/search?q=semi+submersible+wellhead&espv)

# Subsea BOP stack



Source: INAgip, Plc photodocumentation;



Source: www.oilpro.com

- wellhead protection while drilling in deep sea (blowout preventers on the ocean floor)



# Underwater drilling (using dynamic positioning system)

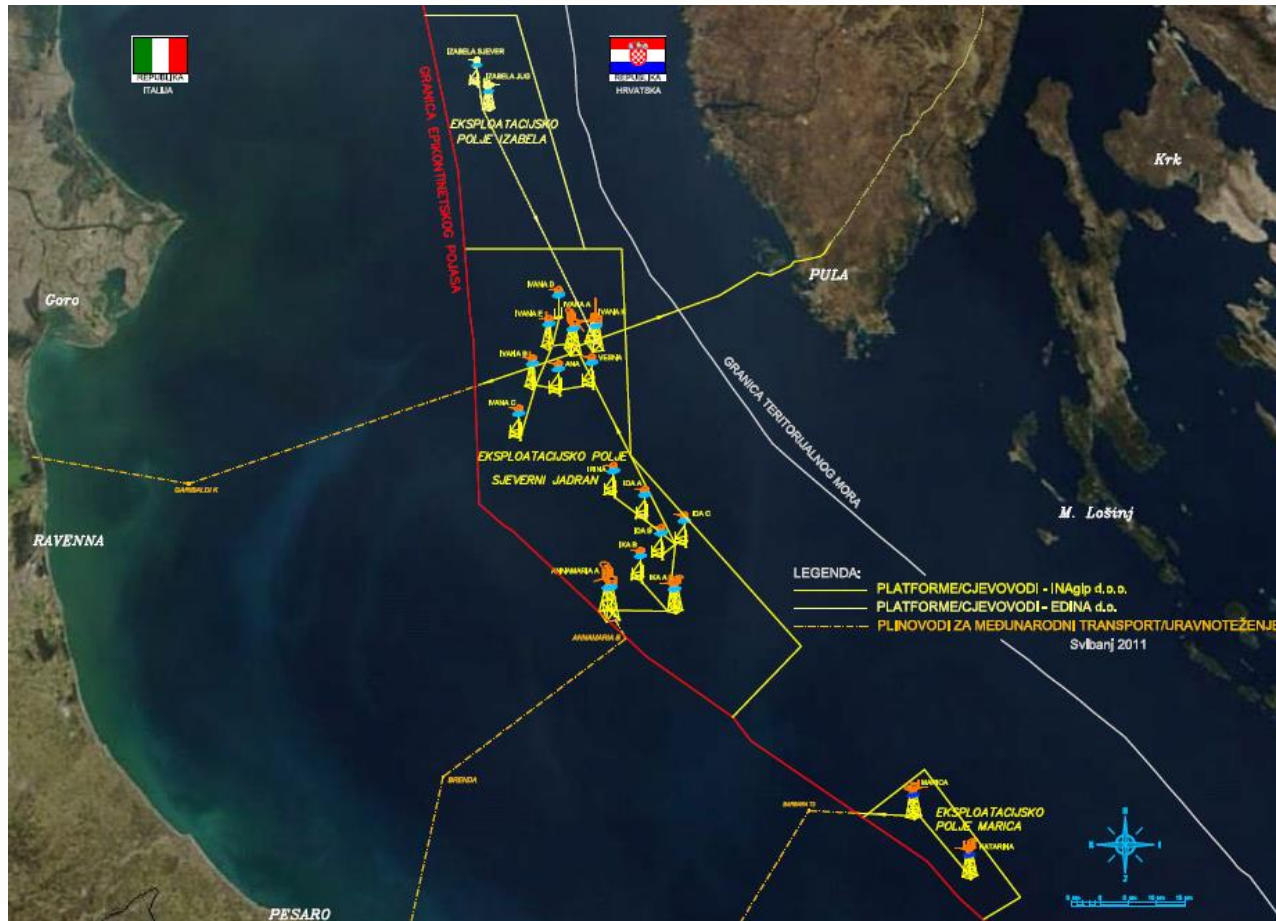
## Running conductor pipe

- After positioning, a  $\varnothing$  36" (0,92 m) conductor is attached to the guide base with acoustic signal sources installed
- Running down to the sea floor on drill pipes
- The conductor pipes penetrate the sea floor (20 – 50 m)
- The process is surveyed by TV-camera or remotely operated vehicle (ROV)



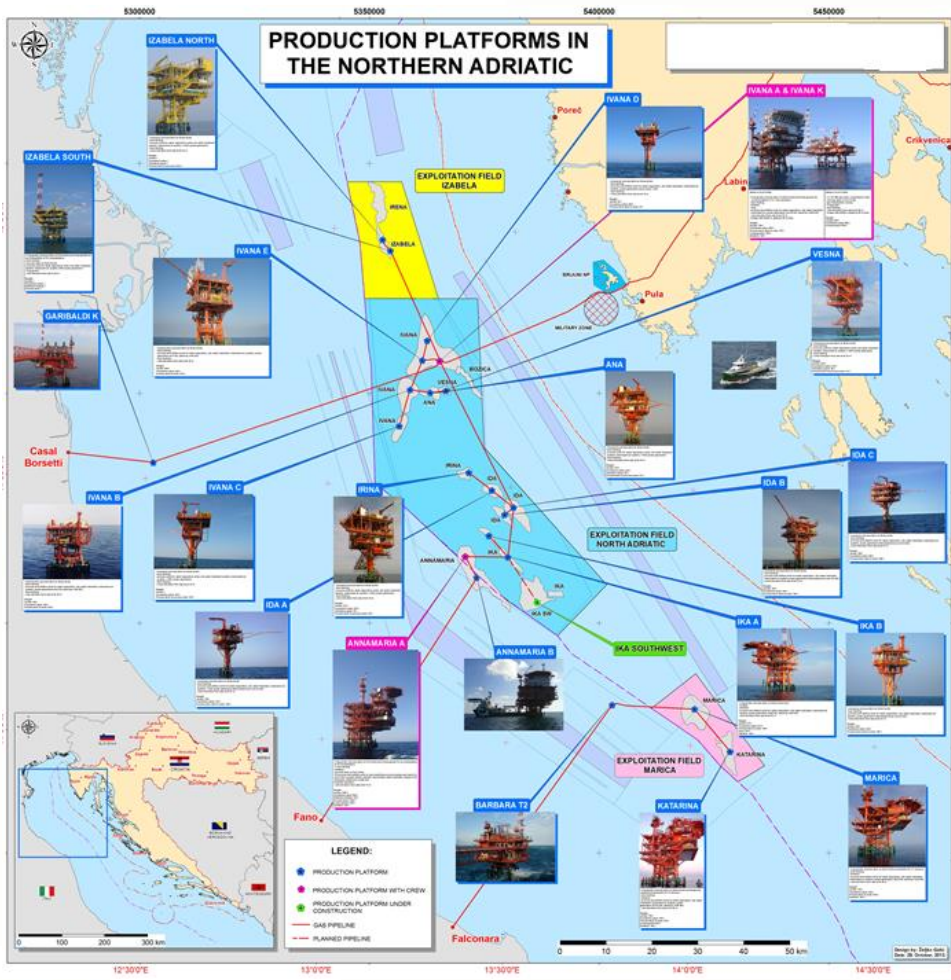
Source: [www.youtube.com/Animation](http://www.youtube.com/Animation) of deepwater drilling

# Gas fields in Northern Adriatic



Source: INAgip, Plc documentation

# Production platforms in the northern Adriatic



- 20 platforms
- ~ 50 production wells

Source: INAgip, Plc photodocumentation

# Offshore activities overview in Croatia

- offshore seismic surveys in the Adriatic started in 1968;
- first offshore drilling in 1970 using contracted platform „Neptune”;
- the total of 133 wells drilled offshore, on islands and in coastal area;
- first gas production platform „Ivana - A” in production since 1999;
- oil and gas production in Croatia from 33 oil and 25 gas and gas-condensate onshore fields;
- offshore gas production from 9 gas fields;
- the past few years offshore gas production exceeded production from all onshore gas fields;
- 20 gas production platforms in the Adriatic installed;
- oil and gas account for about 60% of the primary energy in Croatia.

# Contemporary exploration overview of the Adriatic

- 29 exploratory areas are defined;
- 8 blocks in sea depth up to 100 m;
- 16 blocks - from 100 to 500 m;
- 5 blocks in sea depths from 500 m to 1300 m



# Worldwide achievements in offshore drilling

- the deepest offshore well: 10683 m (10685 m MD)
  - september 2009; in the Tiber oil field at Keathley Canyon block 102 in 1259 m of water - Deepwater Horizon, dynamically positionned semi-submersible offshore drilling rig, owned by Transocean, drilled the deepest offshore well;
- the greatest sea depth: 3107 m (10,194 ft)
  - offshore drilling group Transocean reported that it had set the world record for deep water drilling at an ocean depth of 3107 m, off the coast of India (in 2011);
- extended reach wells
  - Qatar - jack-up platform owned by Transocean (operator: MAERSK Oil Qatar AS) in only 36 days drilled a well of 12289 m MD with horizontal section of 10902 m;
  - Sakhalin-1 project; extended reach well at the Chayo field; O-14 production well (Orlan drilling platform) - 13500 m MD (44,291 ft); horizontal reach - 12033 m (39,478 ft);

# Croatian offshore drilling rigs



Semisubmersible drilling platform Zagreb - 1



Source: CROSCO, Integrated drilling services Co. photodocumentation

Jack-up drilling platform Labin

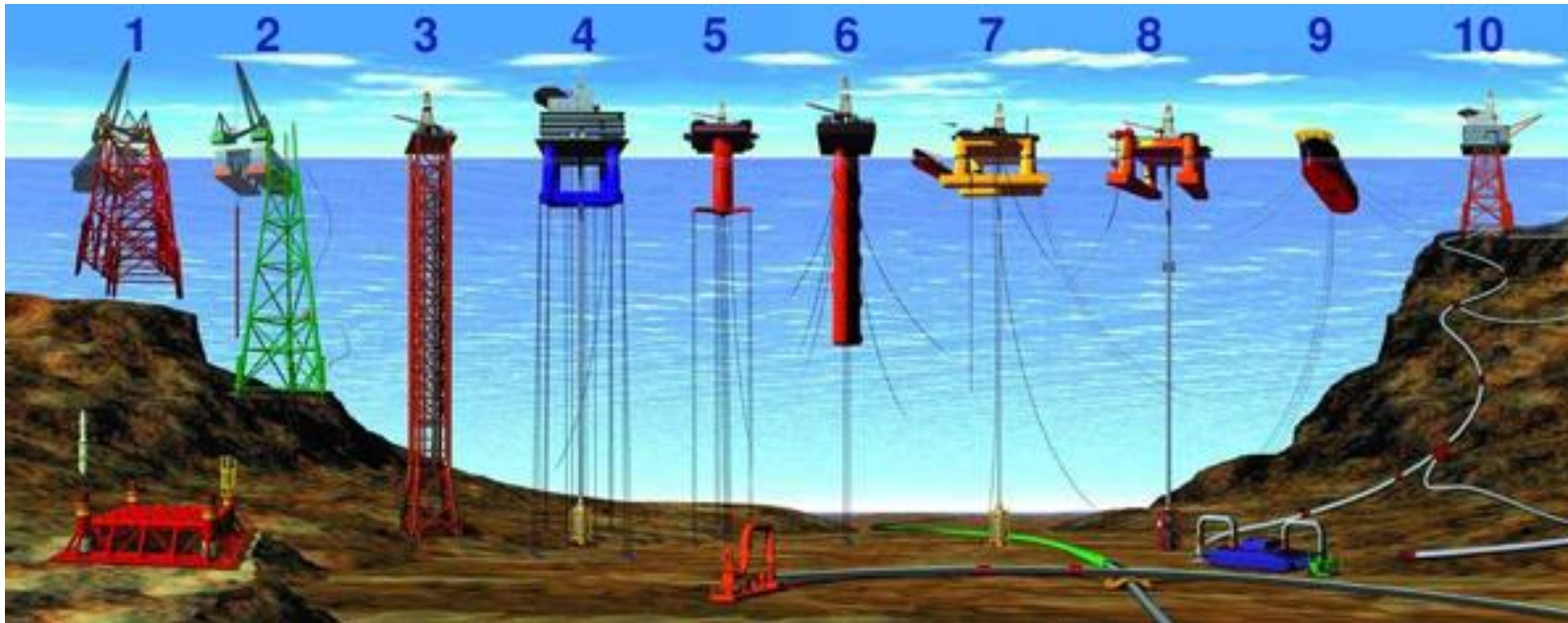
# Offshore production systems

Field development options include a definition of number of wells to be drilled, selection of the most feasible type of production facility, oil & gas processing, power-generation systems and other operational factors. All of those is largely affected by:

- geographical position of hydrocarbon reservoir;
- sea depth at the site of production system;
- distance from the shore;
- reservoir size and quantity of recoverable reserves;
- oil and gas prices;
- production and transportation expenditures, etc.



# Types of production platforms



Source: [www.en.wikipedia.org](http://www.en.wikipedia.org)

1,2) conventional fixed platforms; 3) compliant tower; 4,5) vertically moored tension leg and mini-tension leg platform (TLP); 6) spar; 7,8) semi-submersibles; 9) floating, production, storage and offloading facility (FPSO); 10) subsea completion and tie-back to host facility