

The Lifecycle of Drilling Operations

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About Instructor

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Drilling Phases

Planning

Drilling

Casing

Cementing

Pre-completion

Completion



Introduction

- A well is any boring through the earth surface that is designed to find and acquire liquid and gas hydrocarbons
- Wells can be categorized based on objective into:
 - Exploration well
 - Appraisal well
 - Development well
 - Infill Well
 - Re-Entry Well



Planning Phase

- The objective of well planning is to formulate a program from many variables for drilling a well safely, effectively, and with the minimum cost.
- Planning phase involves many steps including:
 - Drilling Trajectory and target depth
 - Casing Design
 - Cement Design
 - Drilling fluid criteria and PPFG
 - Bit & BHA Selection
 - Identifying risks and hazards
 - Authorization for Expenditure (AFE)

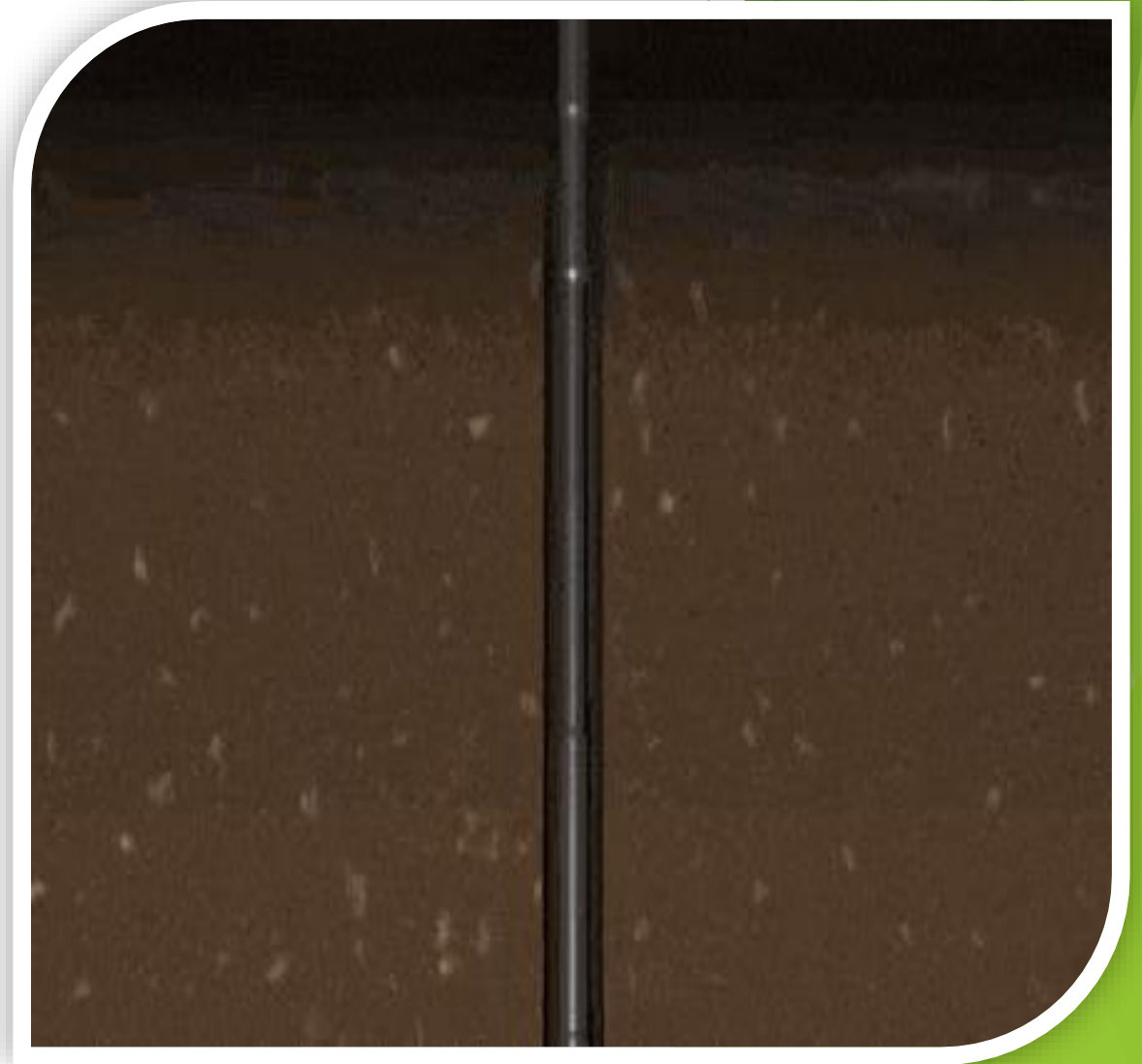


Pre-Rig Move

- After Next location is ready, a conductor string must be installed.
- Conductor: It is the first and widest string. It prevents the loose topsoil/seabed from washing
- It is driven into the soft formation till refusal point
- It can also be drilled and cemented as the rest of casing strings.

Drilling Phase

- Drilling is the cutting action into different formations to form a wellbore.
- Drilling fluid is circulated through the bit to remove the drilled cuttings generated inside the wellbore.
- To achieve rate of penetration (ROP), the following parameters must be applied:
 - WOB
 - RPM
 - GPM





Profile: Drilling ▾



11:23

11:26

11:30

11:33

11:36

Jan-22-2026

Hole Depth

376.51

m

Hook Load

122.3

klb

Top Drive RPM

98.1

RPM

Flow In Rate

764

galUS/min

Mud Volume

301

tbl

Bit Position

376.51

m

Block Height

23.17

m

Top Drive Torque

1977

ft-lbf

Pump Pressure

1238.63

psi

Trip Tank 1

11.3

tbl

Bit Weight

2.7

klb

ROP - Average

22.05

ft/hr

Flow Out Percent

0

%

Gain Loss

-1.2

tbl

Time

Depth



Well Charts



Gauges



Reports



Notes



More

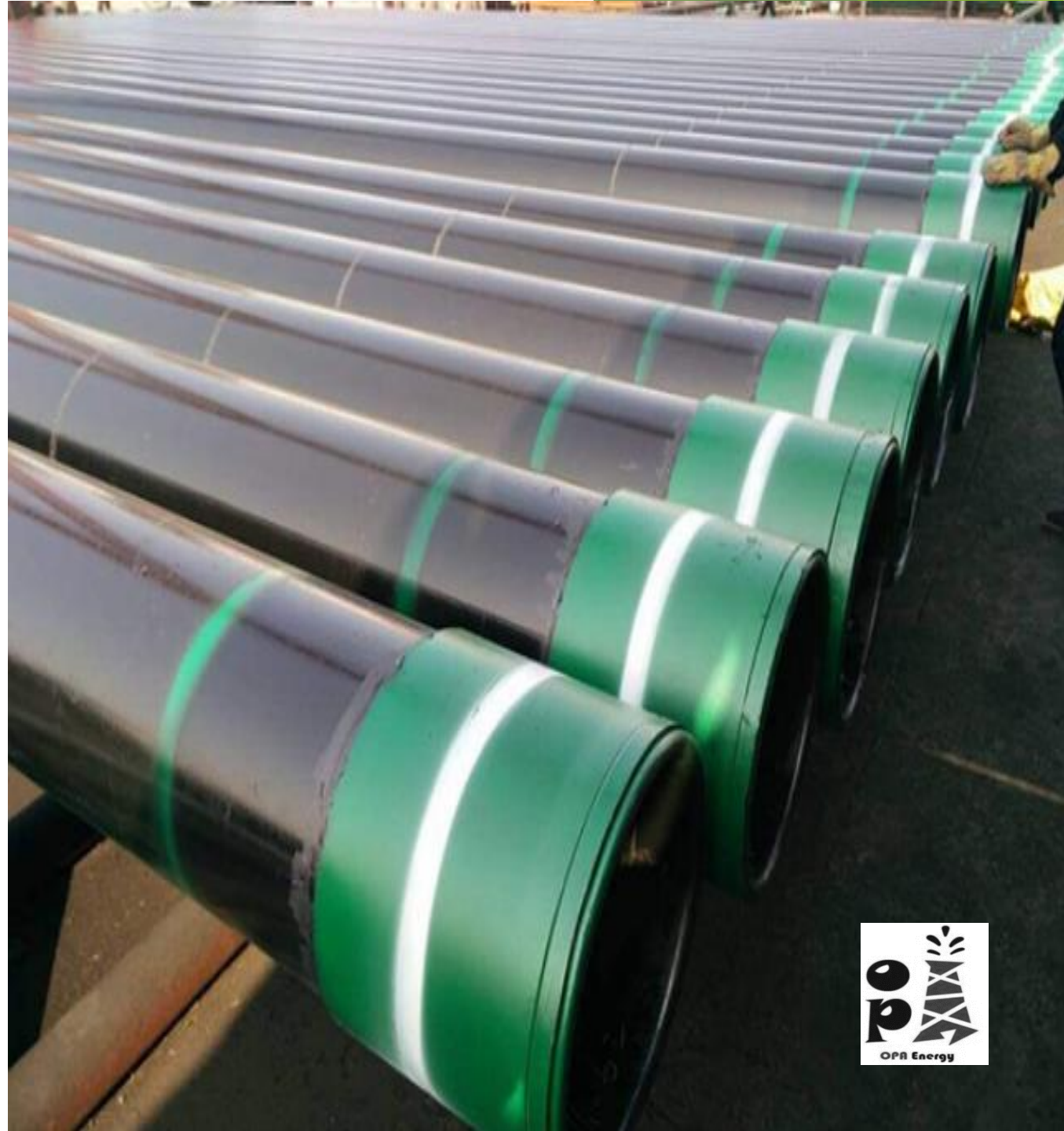
Casing Phase

- Casing is a large-diameter steel pipe that is lowered into a recently drilled open hole and cemented into place.
- It is the structural backbone of the well.
- Casing is classified based on:
 - Function & Size
 - Connection
 - Weight
 - Grade
 - Length (Range)



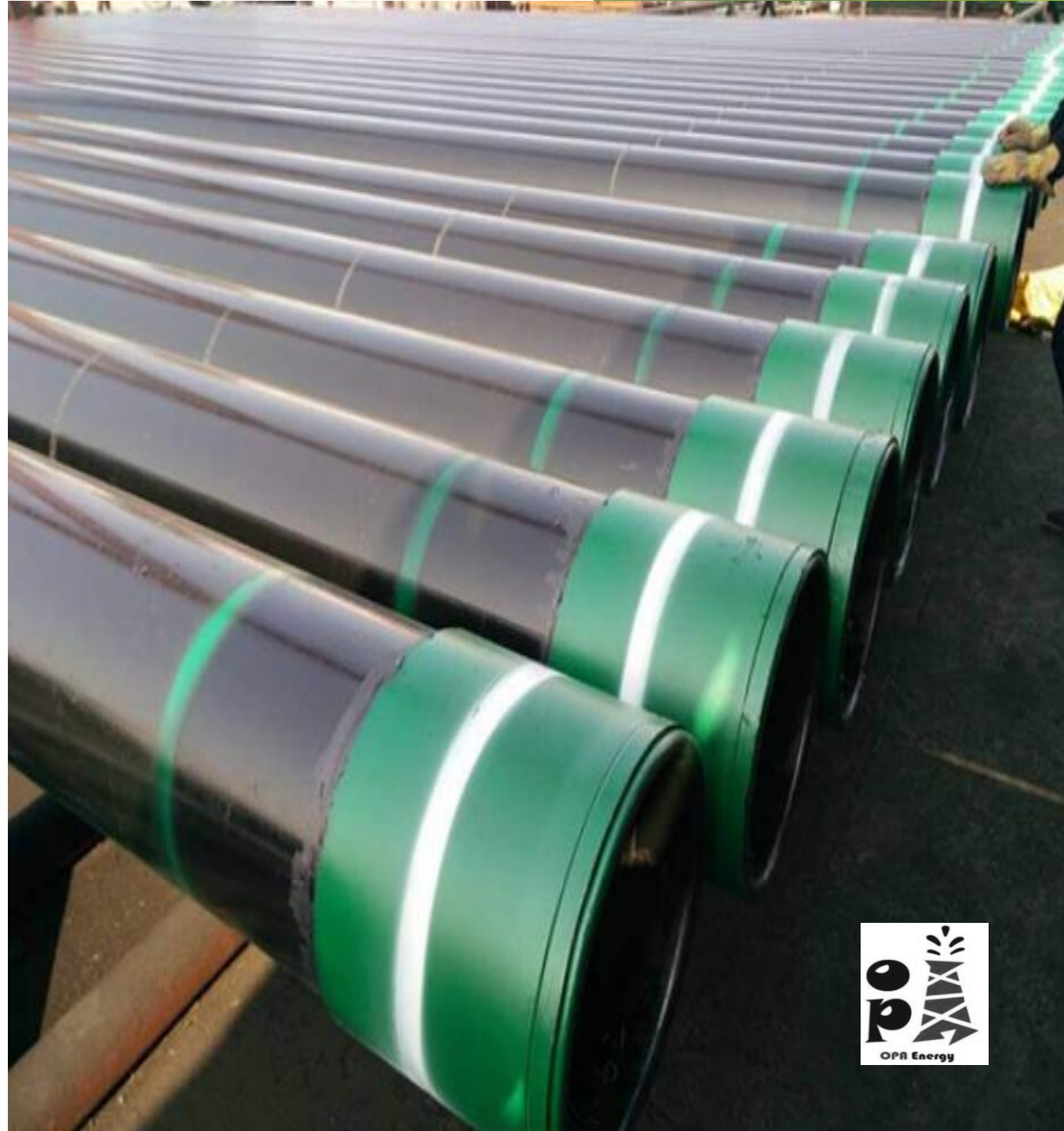
Functions of Casing

- Isolates porous formations with different pressure regimes
- Selectively produces from specific perforated formations
- Isolates troublesome zones
- Serves as a high-strength flow conduit.



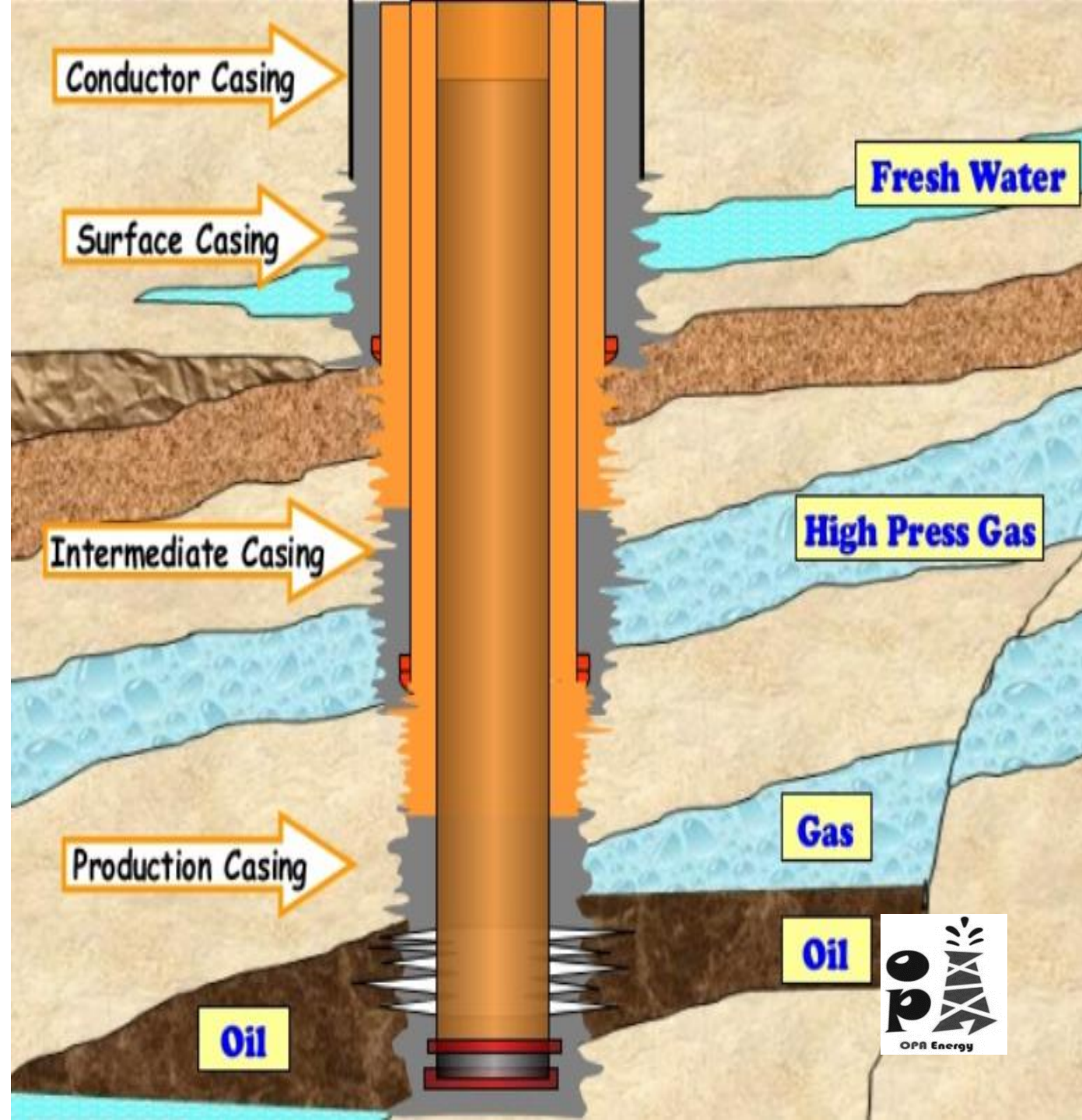
Functions of Casing

- Prevent shallow fresh-water zones from contamination
- Provide a connection for wellhead equipment & BOP
- Provide smooth conduit for tubular and equipment running.



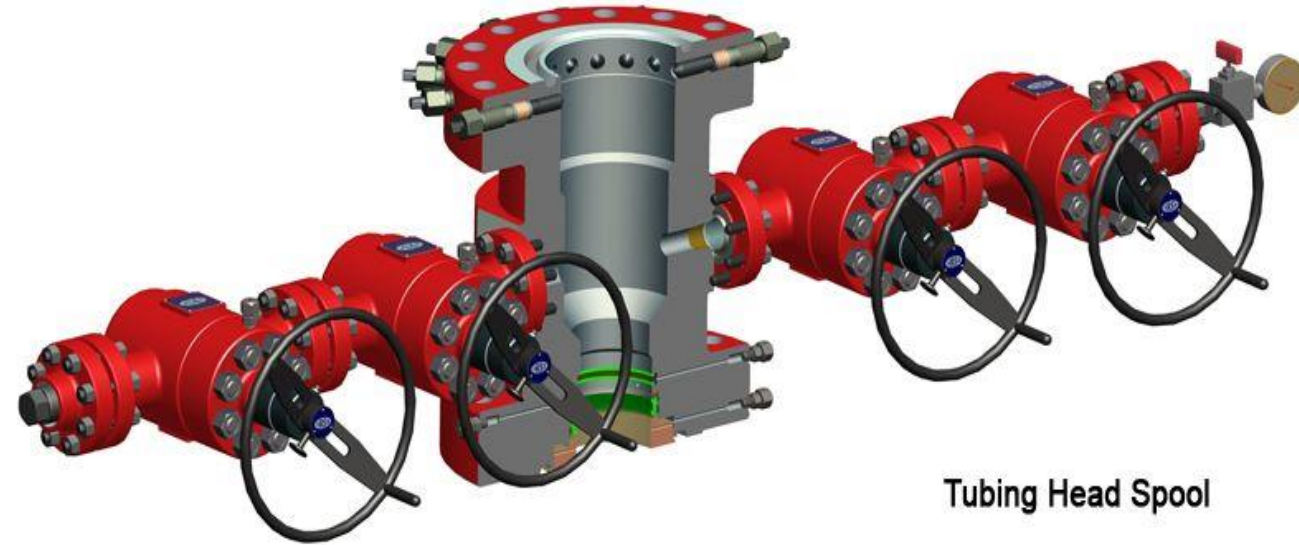
Casing Types & Sizes

- **Conductor:** the first and widest string. It prevents the loose topsoil/seabed from washing
- **Surface Casing:** protects freshwater aquifers from contamination and provides the structural foundation for BOP.
- **Intermediate Casing:** isolates problem zones
- **Production Casing/ Liner:** isolates the pay zone from other rock layers



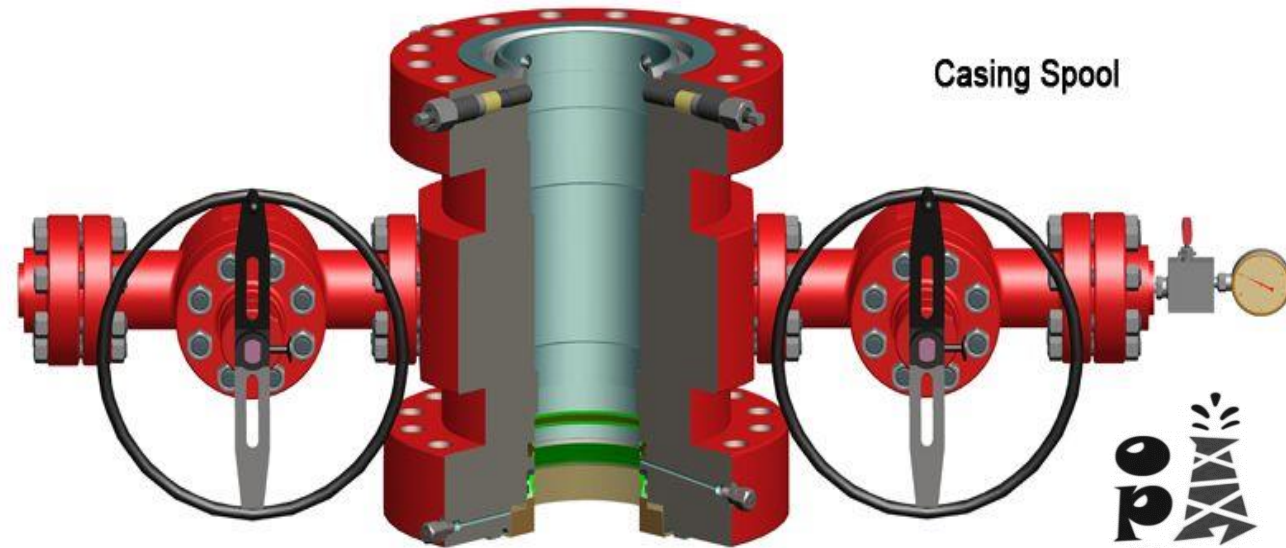
Wellhead

- Provides a connection point for BOP during drilling and X-mass tree during production
- Hang downhole tubing and casing string
- Sealing tubing-casing and casing-casing annuluses with optional access.
- Injecting steam, gas, water, and chemicals



Tubing Head Spool

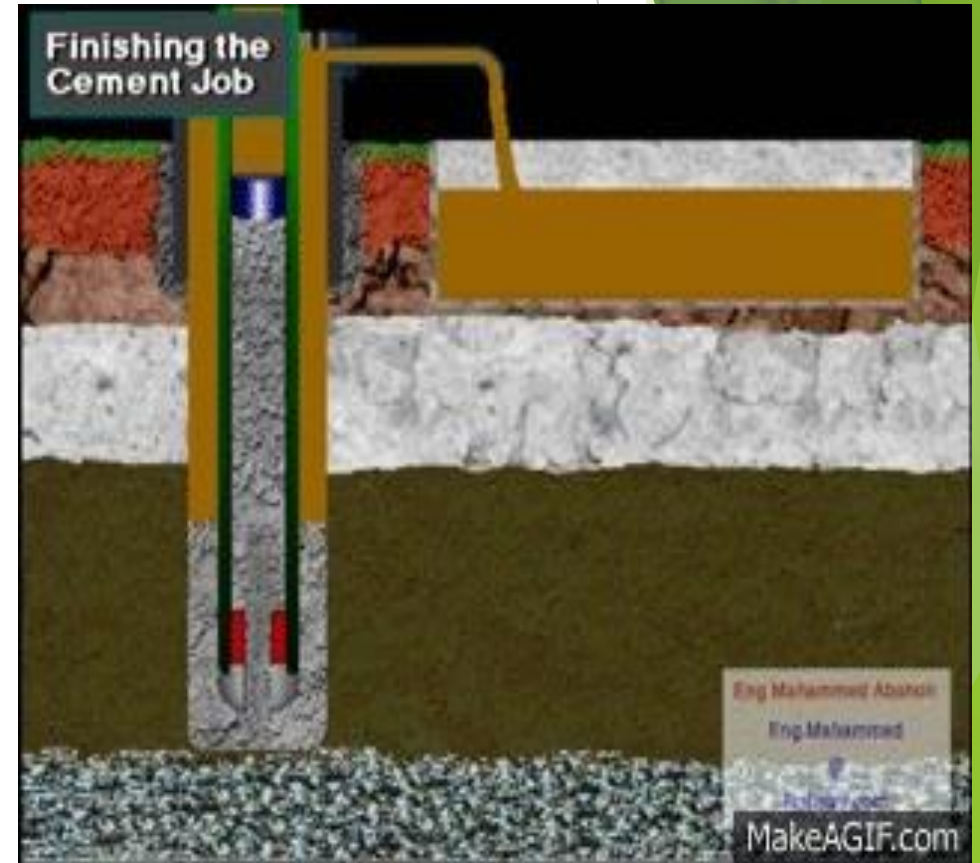
www.h-rs-b.com



Casing Spool

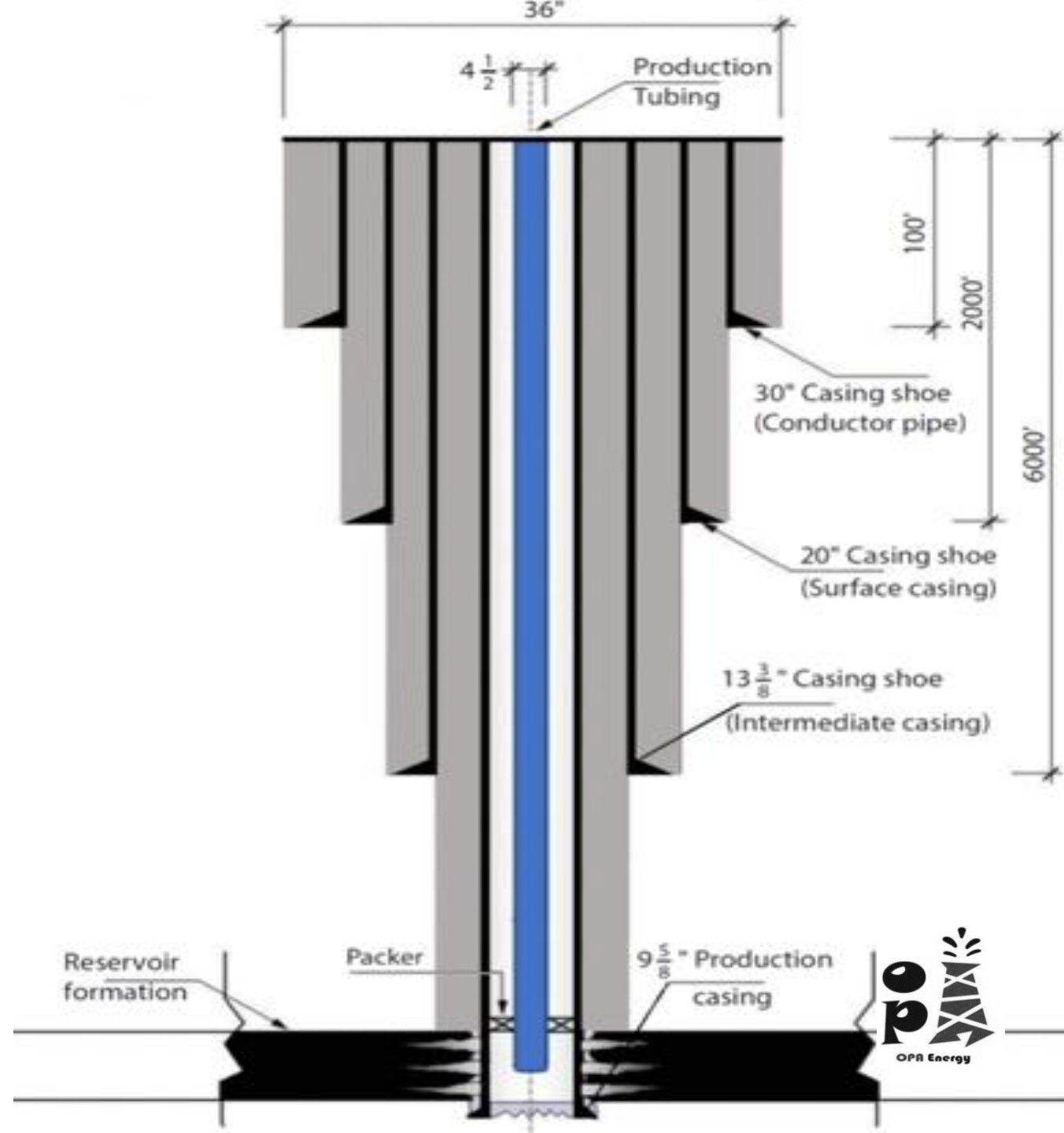
Cementing

- Cementing is the process of mixing a slurry of cement and water and displacing it down the casing, tubing or drill pipe and into the annulus to a pre specified point in the well
- The casing pipes are held in its position by an adequate length of cement bond between pipe and annulus.



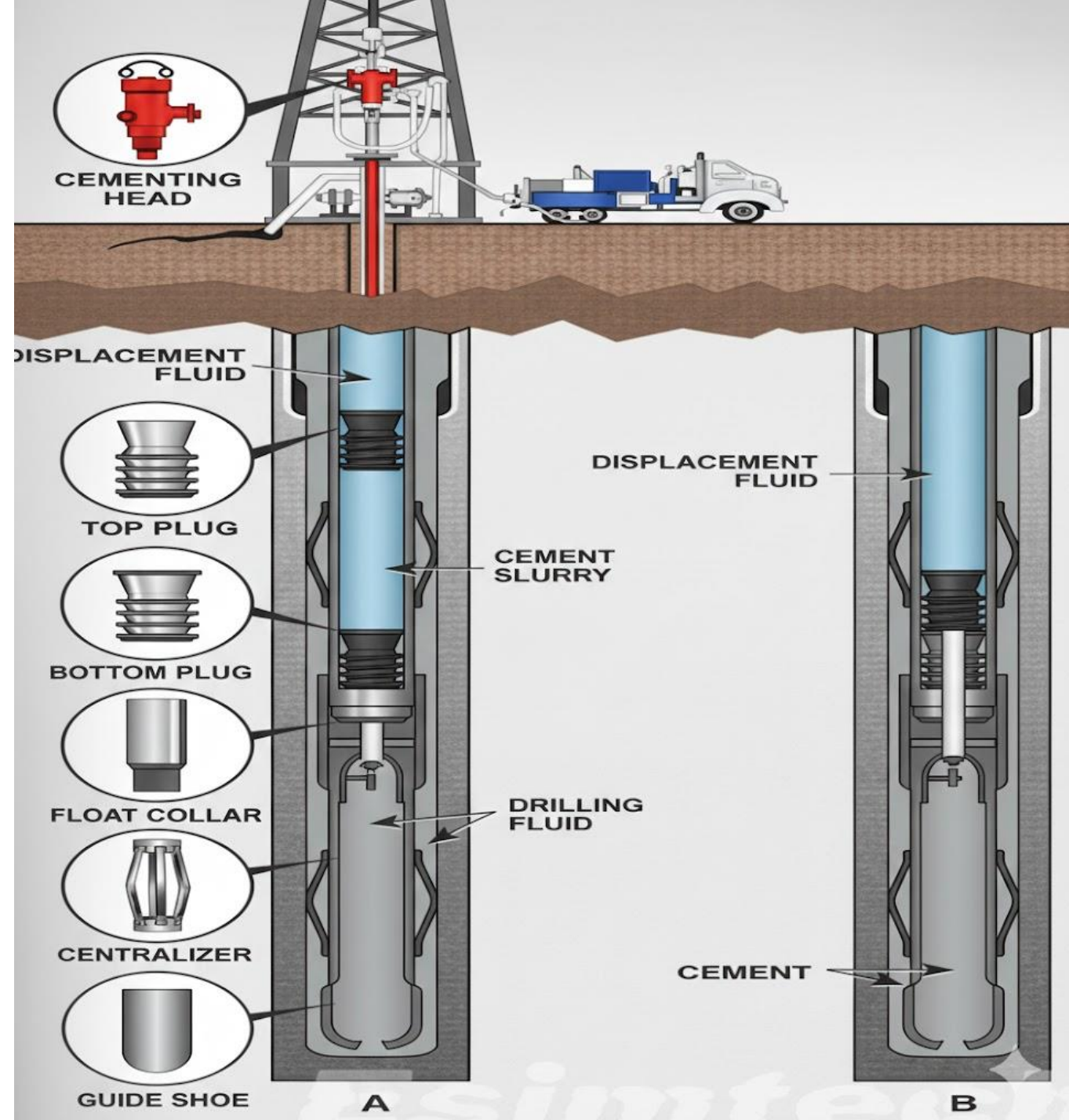
Why Cementing?

- Bond and support the casing
- Protect the casing from corrosion
- Sealing-off problematic zones.
- Restrict fluid movement between formations



Cementing Procedures

- Pump spacer ahead of cement
- Drop Bottom Plug
- Pump Cement slurry
- Drop Top Plug
- Displace the top plug until bump down plug
- Wait on cement



Pre-Completion

- It is a transition phase between drilling and completion
- This phase focuses on three main goals:
 - Formation evaluation.
 - Structural integrity
 - Wellbore cleanup



Formation Evaluation

- It is the study of the physical properties of rocks and the fluids contained within them.
- It includes, but not limited to, the following:
 - Coring
 - Open-hole Logging
 - Logging While Drilling
 - Formation Testing
 - Cased Hole Logging



Coring

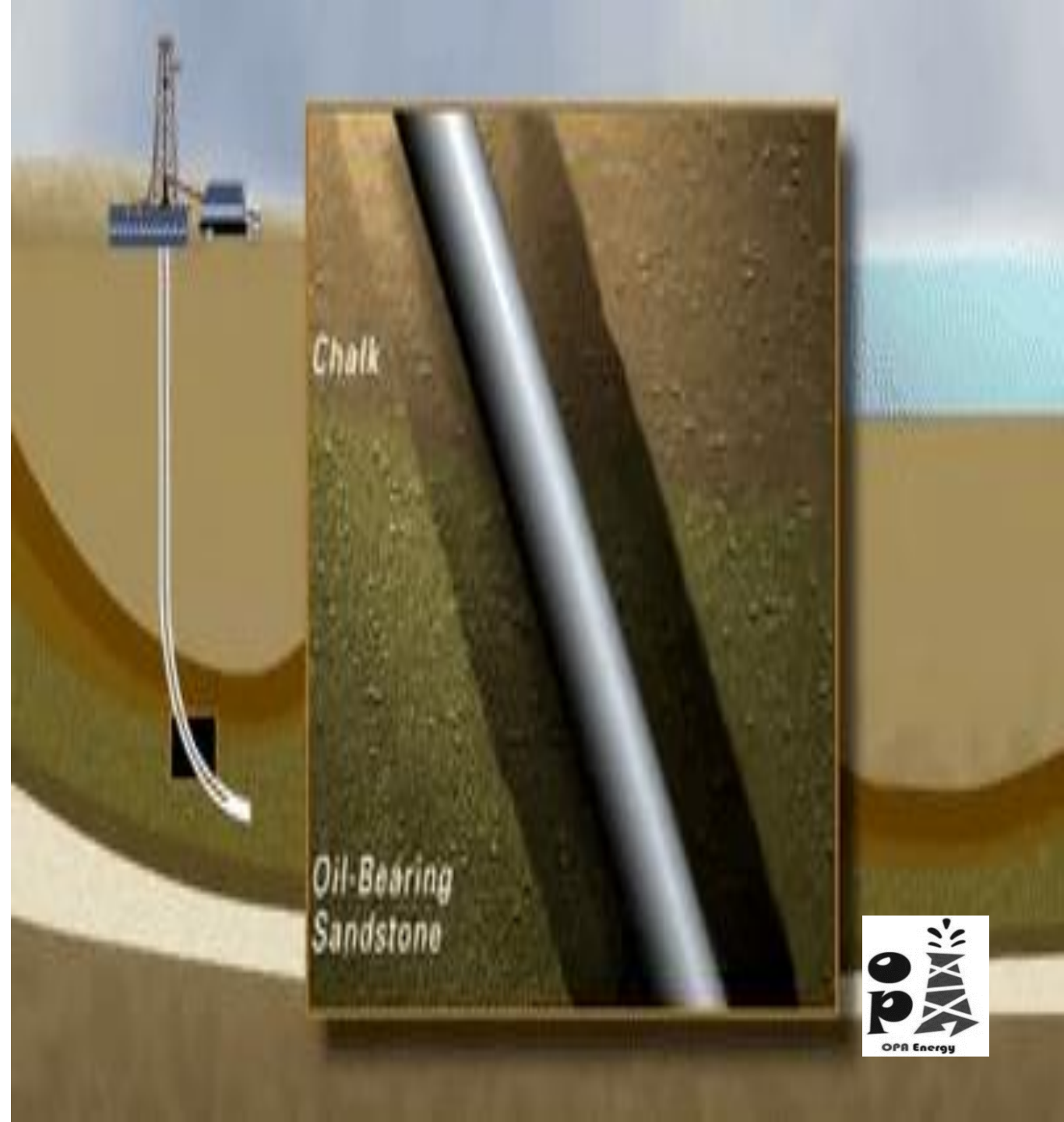
- Formation sample is drilled out by means of special bit.
- The core should be prevented from drying out, coming into contact with oxygen or being mechanically damaged.
- This sample can provide: Detailed lithological description, Porosity, permeability, fluid saturation and grain density.
- Performed in reservoir section before cementing production string/ liner.



Illustration © 2018 OPA Energy

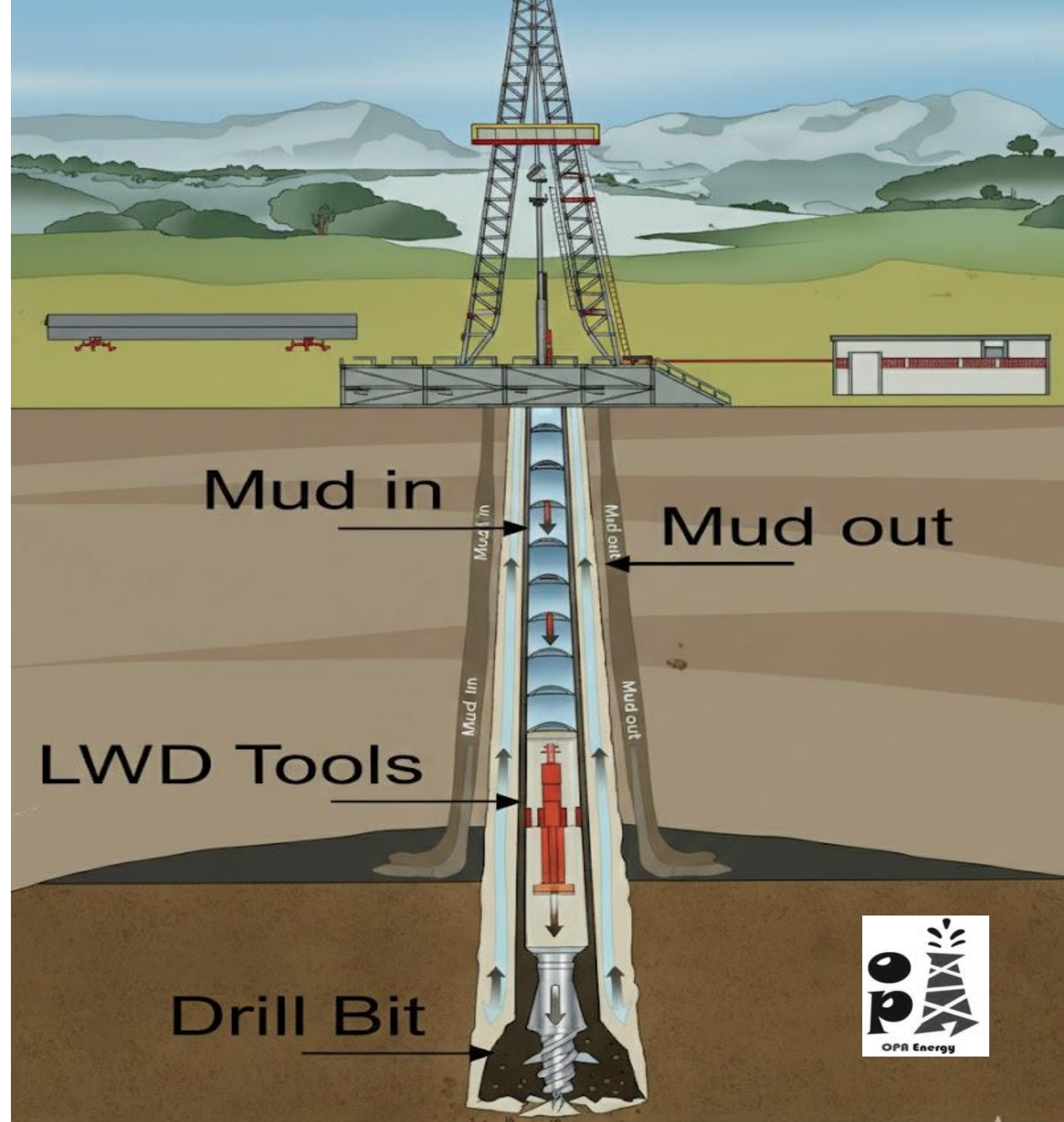
Open-hole logging

- The practice of making a detailed record (a well log) of the geologic formations penetrated by a borehole.
- Done by utilization of wireline
- Performed in reservoir section before cementing production string/ liner.



Logging while Drilling

- Conveying well logging tools into the well borehole downhole as part of the drilling BHA
- Performed in reservoir section during drilling.
- It can be also used after drilling if wireline logging failed.



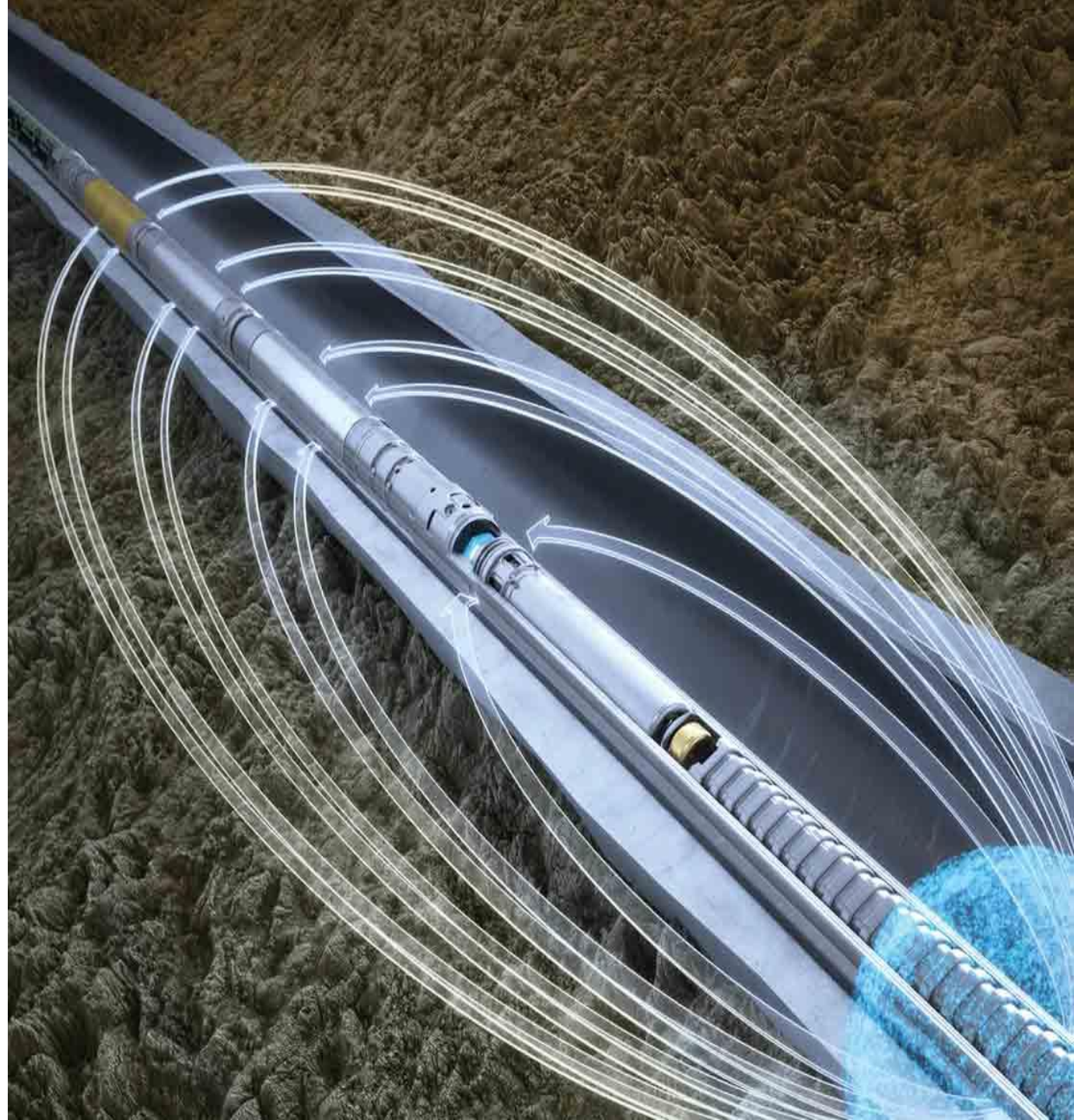
Formation Testing

- Obtaining information concerning the liquid and pressure in an open-hole formation.
- It is composed of three major ways:
 - Wireline testing
 - Drill stem test (DST)
 - Well Test Analysis



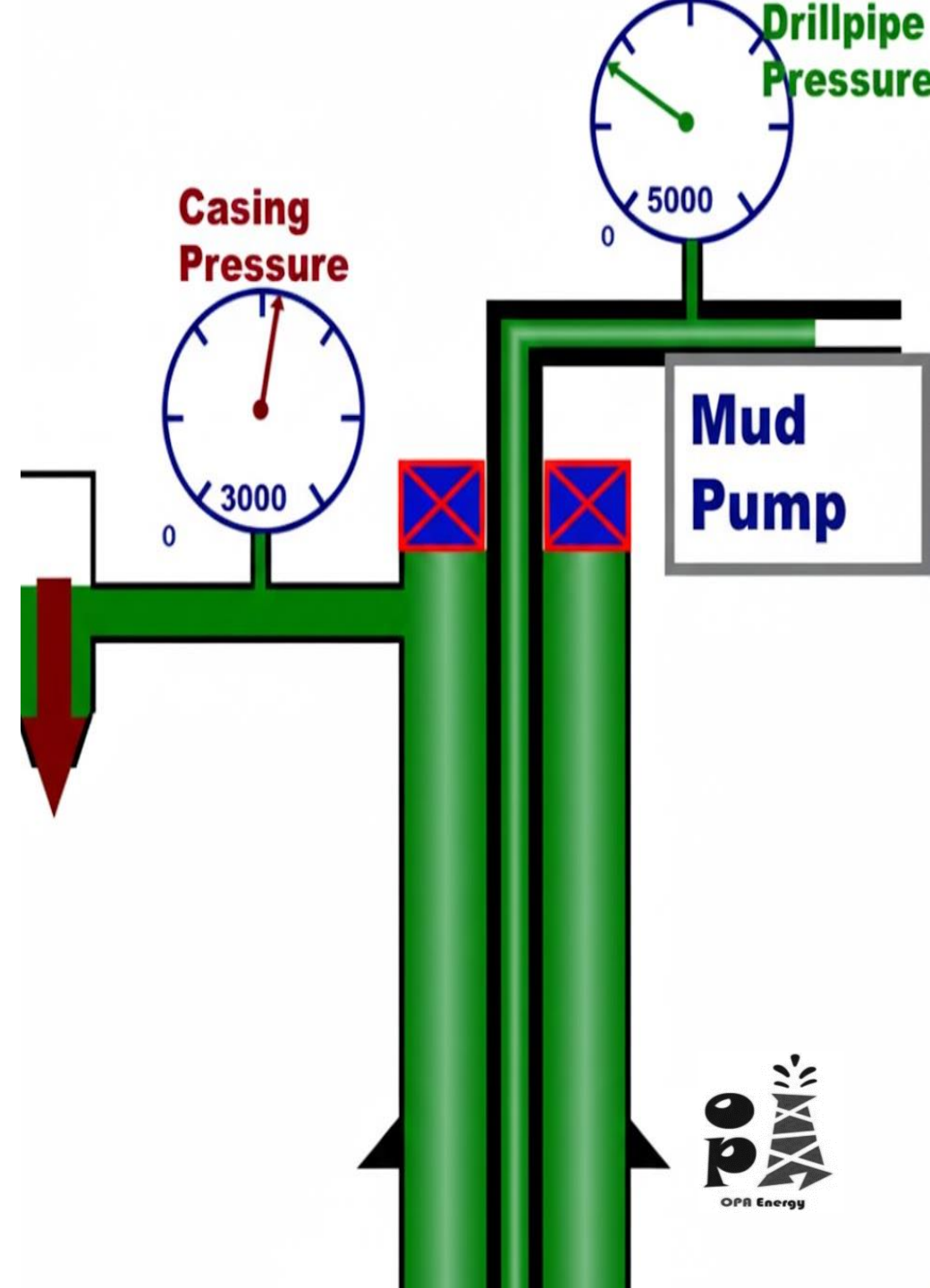
Cased-Hole Logging

- It is mainly used for production logging & reservoir monitoring
- Production logging refers to obtaining production or injection profiles over a completed interval.
- Reservoir monitoring refers to obtaining real time information about changes in hydrocarbon saturation.



Structural Integrity

- Cased-hole logging: Tools like CBL (Cement Bond Logs) are used to check if the cement behind the steel casing is solid. If there are gaps, oil could leak into the wrong rock layers.
- Pressure Testing: The casing is pressurized to ensure it can withstand the high pressures of production or hydraulic fracturing.



Wellbore cleanup

- During drilling, the well is filled with drilling mud, which contains heavy solids and chemicals that can clog the production equipment or damage the oil-bearing rock.
- **Mechanical Cleaning:** casing scrapers and brushes are run into the hole to "scrub" the inside of the metal casing, removing hardened mud, scale, or cement leftovers.
- **Chemical Displacement:** The thick drilling mud is replaced by a clear, filtered completion brine..

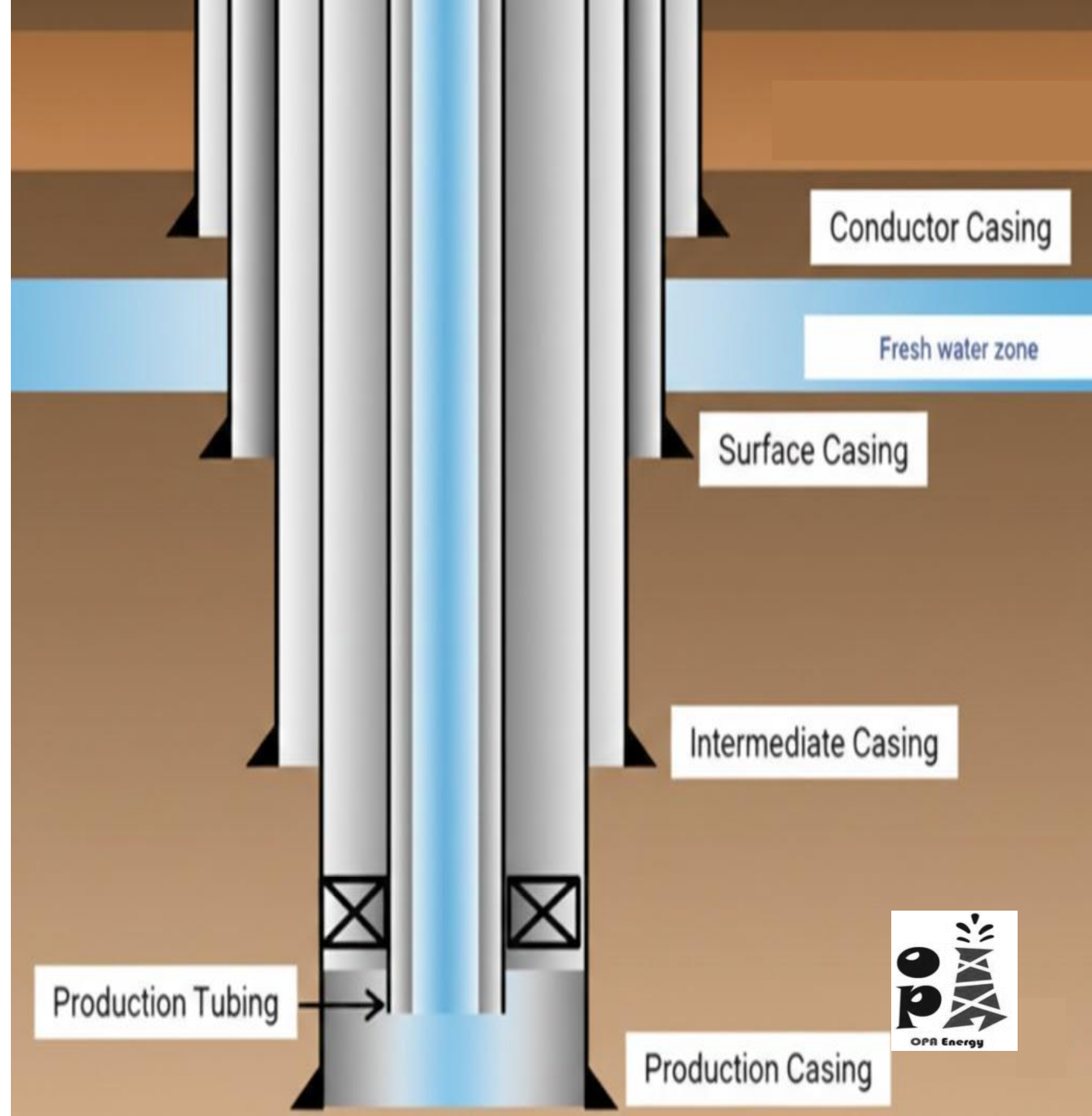


Well Completion

- Well completion means to prepare the well for production by installing the necessary equipment into the well in order to allow the safe and controlled flow of HCS at the surface.
- Conventionally, the main completion equipment can be represented by the following:
 - Production casing or Liner
 - Tubing
 - Tubing accessories
 - X-mass tree

Tubing

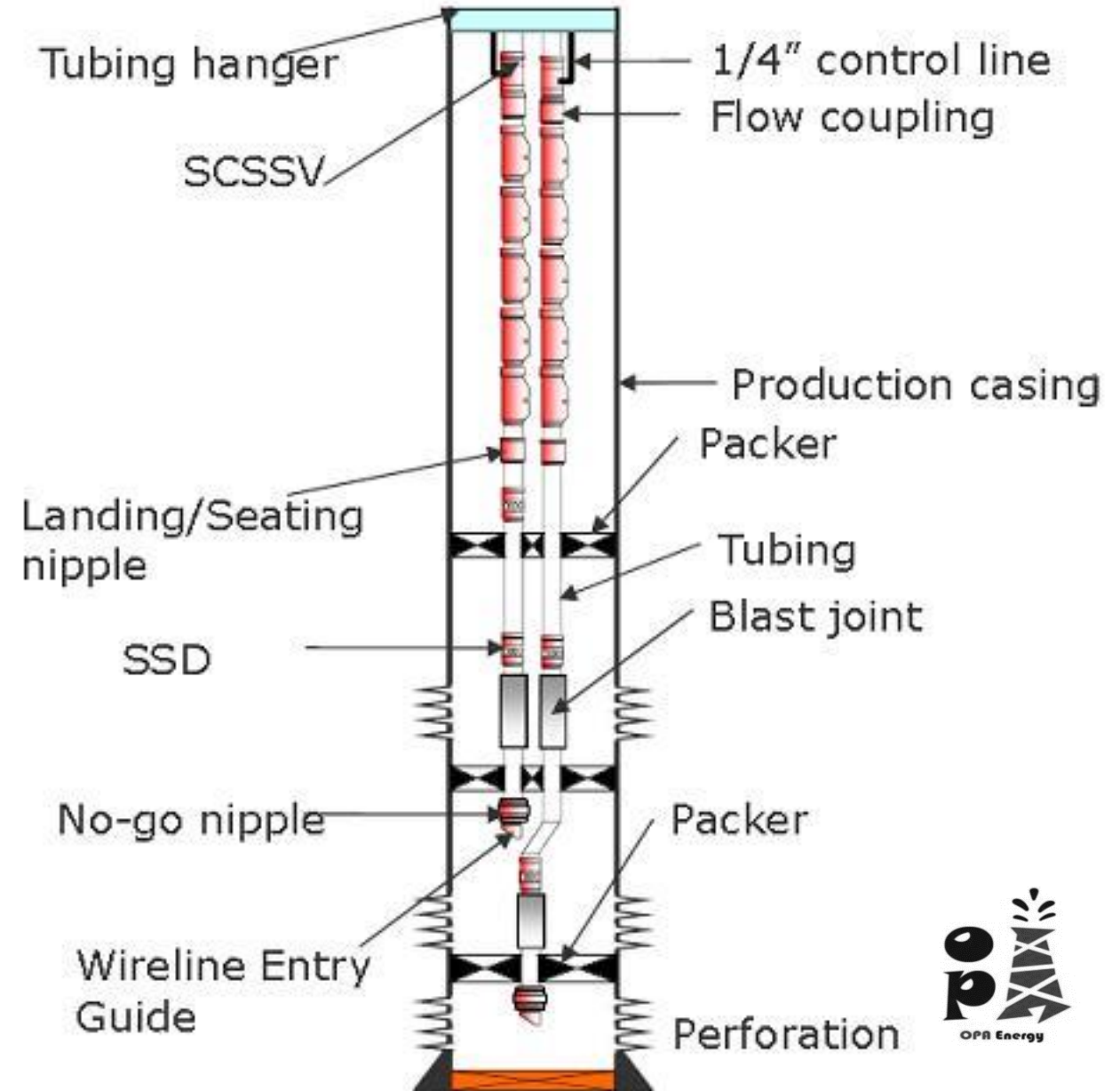
- It is a specialized pipe run inside the well casing.
- Unlike casing, tubing is designed to be removed and replaced if it becomes corroded or damaged.
- Because it has a smaller diameter than the casing, it maintains the high flow velocity needed to lift HC to the surface.
- It is hanged from the surface by tubing hanger and downhole by packer.



Tubing Accessories

- Production Packers: a sealing device that isolates the annulus
- Landing Nipples: provide a seat for plugs, gauges, etc.
- Sliding Side Doors: communication device between tubing and annulus
- Blast Joints: resist the sandblasting effect of high-velocity fluids.

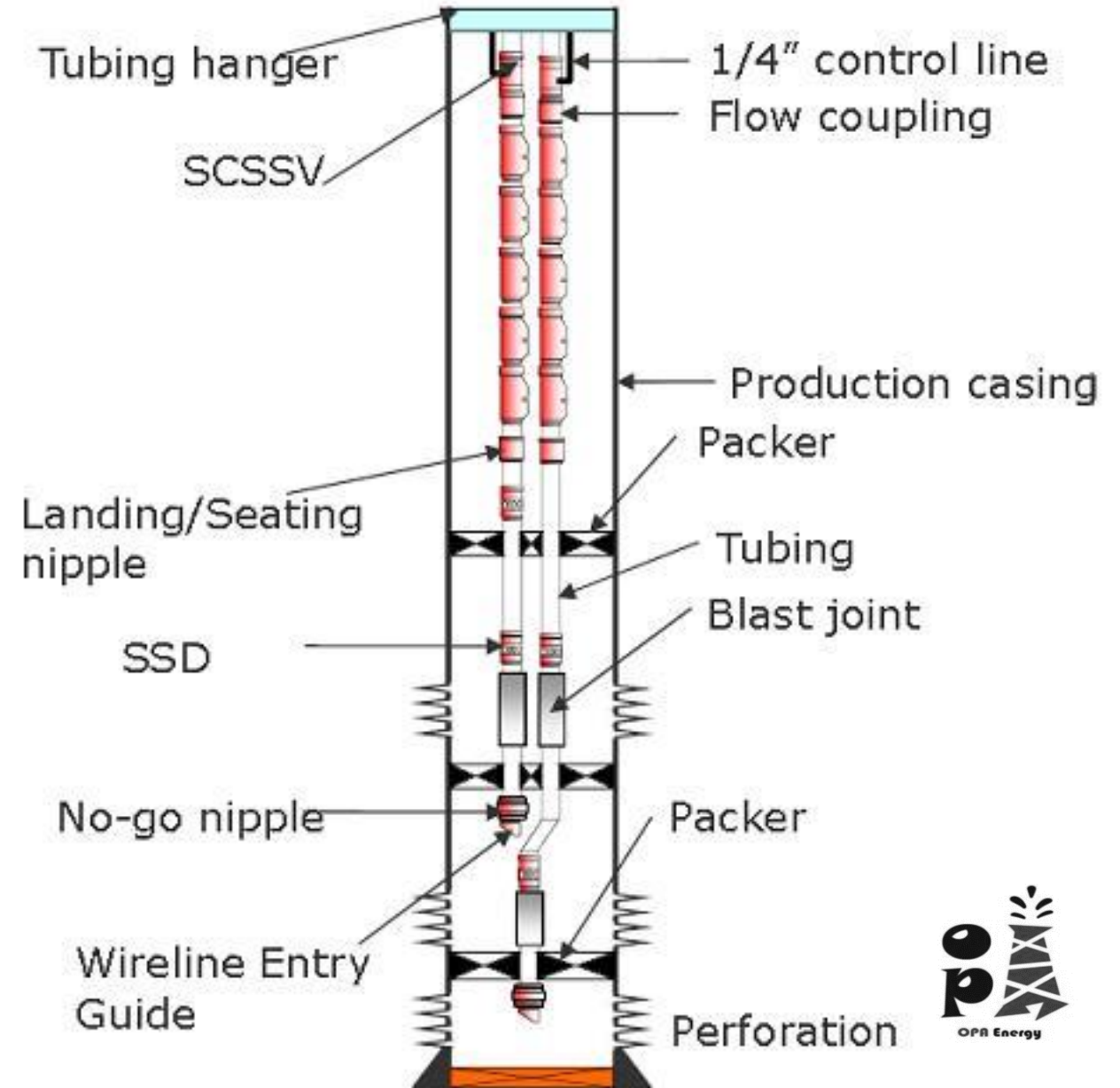
Well Completion Equipment



Tubing Accessories

- Flow Couplings: resist internal turbulence and erosion.
- SCSSV: emergency shut-in If the surface equipment is damaged.
- Side Pocket Mandrels: Houses gas lift valves
- Wireline Entry Guide: guides the tool string back into the tubing.

Well Completion Equipment



X-mass tree

- An assembly of valves and gauges installed on top of the wellhead **after** the drilling is finished to control the flow.
- **Master Valves:** The main "on/off" switches.
- **Production Wing:** sends oil to the pipeline
- **Kill Wing:** is used to pump fluids into the well for maintenance.
- **Swab Valve:** allows tools to be lowered into the well without stopping production.



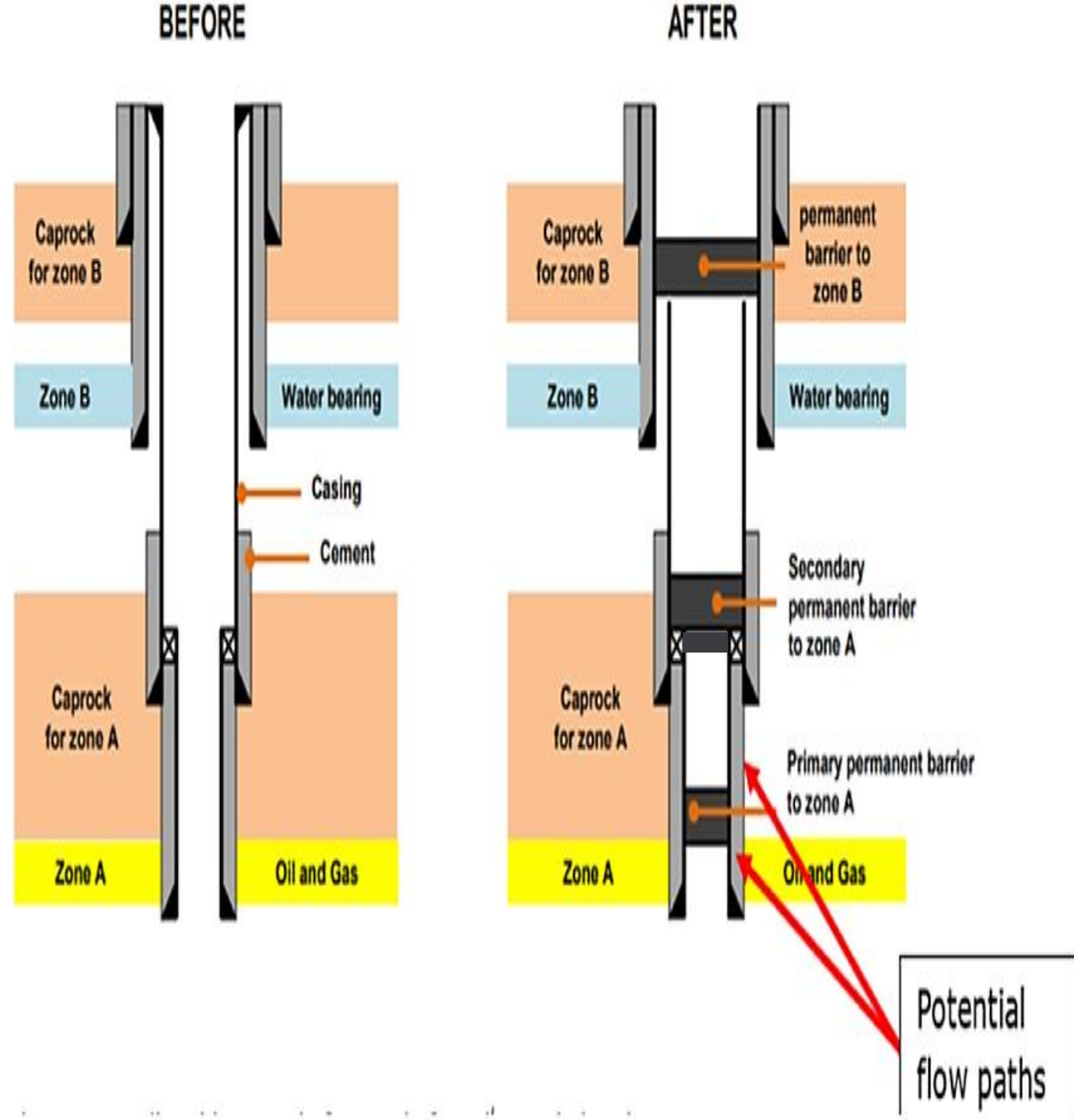
Plug and Abandon (P&A)

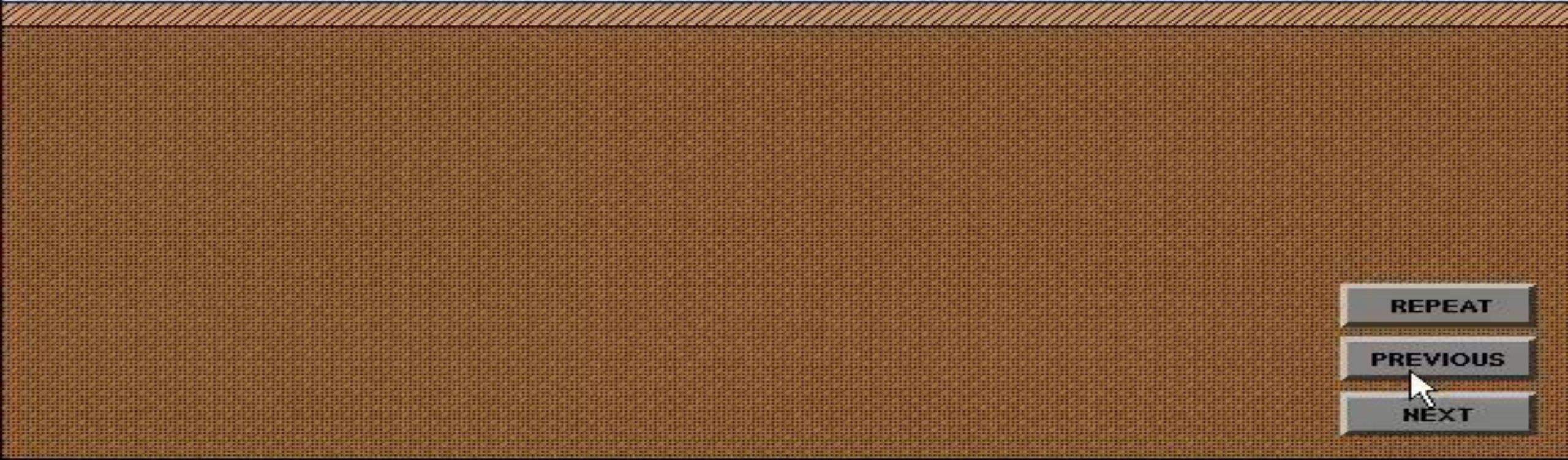
- If a newly drilled well turns out to be a "dry hole," it must be permanently sealed to prevent environmental damage.
- In dry wells, no production casing, liner, tubing, or x-mass tree are used.
- Instead, cement plugs are used to seal-off the well and the site is returned to its original state as close as possible.



P&A Steps

- Multiple cement plugs at strategic depths are set:
 - Reservoir plugs: set across or above each pay-zone
 - T-plug, set across liner
 - Surface plug: Set near the top of the well
- Each plug is "tagged" and pressure tested to verify a perfect seal.
- The upper sections of the casing are pulled out of the ground to be recycled.
- The wellhead is removed and a steel "cap" is welded onto the top.





REPEAT

PREVIOUS

NEXT

Any Questions?



THANK YOU

