Intertek IWCF Study Guide

1. **Hydrostatic Pressure.**
   - The pressure created by a column of fluid.
2. **Primary Well Control.**
   - Maintaining hydrostatic pressure equal to or greater than formation pressure.
3. **Secondary Well Control.**
   - Control of the well using the BOP.
4. **Under Balance.**
   - Mud hydrostatic pressure is less than formation fluid pressure.
5. **Balance.**
   - Mud hydrostatic pressure is equal to formation fluid pressure.
6. **Over Balance.**
   - Mud hydrostatic pressure is more than formation fluid pressure.
7. **Formation Pore Pressure.**
   - The pressure of formation fluids within the pore spaces.
8. **Porosity.**
   - Percentage of space between the grains of rock.
9. **Permeability.**
   - Ability of rock to allow formation fluids to flow through it.
10. **Influx.**
    - Intrusion of formation fluids into the well bore.
11. **Kick.**
    - It is an influx of formation fluids into the hole.
12. **Blowout.**
    - Uncontrolled kick exit at surface.
13. **Surging.**
    - Momentary increase in bottom hole pressure.
14. **Swabbing.**
    - Momentary decrease in bottom hole pressure.
    - The immediate effect of swabbing is

- Reduction in bottom hole pressure.

- Main Causes of Swabbing
  - Tripping out too fast.
  - Small annular clearance.
  - Balled up stabilizers or bit.
  - High viscosity and gel strength of mud.
  - Pulling through tight spots with pump off.
  - Long bottom hole assembly.
- If Swabbing Is Apparent,
  - Run back to bottom, circulate bottoms up and consider pumping out of the hole.

15. Bottom Hole Pressure (BHP).

- Static Conditions
  = Hydrostatic Pressure
- Dynamic Conditions
  = Hydrostatic Pressure + APL
- Shut In Conditions
  = Hydrostatic $Pressure_{ds}$. + SIDPP
  = Hydrostatic $Pressure_{ann}$. + SICP

16. Equivalent Circulating Density (ECD).

- Determines the actual bottom hole pressure while circulating.
- The pressure loss in the annulus will contribute the ECD.

17. Normal Pressure.

- The hydrostatic pressure of formation water. The average pore pressure gradient is (0.465 psi/ft)

18. Abnormal Pressure.

- The formation fluid pressure that exceeds formation water hydrostatic pressure.
  - Under compacted shale's.
    - The most common cause of abnormally high formation pressures worldwide.
  - Artesian effect.
    - A formation water source located at a higher level than the rig floor has created the over-pressure.

19. Gas Cut Mud.

- Creates small drop in bottom hole pressure.
- The reduction in bottom hole pressure will be greatest when the gas reaches the surface.

20. Connection Gas.

- A decrease in bottom hole pressure during a connection.

- When connection gas is observed,
  - Control drilling rate so that only one slug of connection gas is in the hole at any one time.
  - Minimize the time during a connection when the pumps are switched off.

21. Lost Circulation.

- Kick occurrence after loss of circulation depends on the mud level in the annulus and the formation pressure.
- Immediate action is,
  - Fill the annulus with water (or lightest mud available) and record volume required.

22. Pumping Light/Heavy Mud.

- The bottom hole pressure will decrease/increase once the pill starts to be displaced into the annulus.

23. Top Hole.

- To minimize the risk of shallow gas,
  - Drill a pilot hole at a slow controlled rate.
  - Pump out of the hole on trips.
  - Control ROP to prevent too many cuttings in the hole.

24. Shallow Gas.

- If a shallow gas flow is detected,
  - Activate diverter system.
  - Increase pump rate.

25. Kick Warning Signs.

  - Hole is not taking or giving correct amount of fluid while tripping.
  - Variation of penetration rate.
  - Change of cuttings shape on the shakers.
  - Increasing background gas levels.
  - Increase in torque and drag.
  - Increase in temperature of the return drilling mud.
  - Increase in chloride content.
  - Decrease in shale density.
- When observing any warning sign,
  - Flow check.

26. Flow Check.

- Procedures
  - Pick up and space out.
  - Shut down the pumps.
  - Line up the well on the trip tank.
  - Check for flow while reciprocating the drill string.
  - Record the depth, time and duration of the flow check.
- Pumps are usually kept running when picking up to check for flow,
  - To maximize the pressure on the bottom of the hole.

27. Kick Indicators.

  - Decrease in pump pressure.
  - Increase in pump strokes.

- Increased in pit volume.(Positive)
- Increased in flow rate with constant pump rate.(Positive)
- Flow from the well with pumps off.(Positive)

- When observing any positive kick indicator,
  - Shut the well in.

28. Gas Behavior In Oil Base Mud And Water Base Mud.

	Oil Base Mud	Water Base Mud
• Solubility	More	Less
• Hydrostatic Pressure Reduction	less	More
• Shut In Casing Pressure	Lower	Higher
• Initial Pit Gain	Lower	Higher
• Gas Expansion	Lower	Higher
• Detection	Harder	Easier

29. Shutting The Well In.

- The well should be shut in quickly after a kick has been detected,
  - To minimize the size of the influx into the well bore.

- The type of BOP to be used for shut in is,
  - Either type of BOP can be used.

30. Stack And Choke Manifold Set Up For Shut In.

	Soft Shut-In	Hard Shut-In
• Choke	Open.	Close.
• HCR	Close.	Close.
• Choke manifold gate valves upstream and downstream of the choke to the mud gas separator	Open.	Open.

31. Soft Shut-In Procedures.

- While Drilling.
  - Pick-up off bottom and space out for tool joints.
  - Shut down pumps.
  - Open BOP side outlet hydraulic valve (HCR).
  - Close BOP.
  - Close choke.
  - Record pressures.

- While Tripping.
  - Stab full opening safety valve.
  - Close the safety valve.
  - Space out for tool joints.
  - Open BOP side outlet hydraulic valve (HCR).
  - Close BOP.
  - Close choke.
  - Record pressures.

32. Hard Shut-In Procedures.

- While Drilling.
  - Pick-up off bottom and space out for tool joints.
  - Shut down pumps.
  - Close BOP.
  - Open BOP side outlet hydraulic valve (HCR).
  - Record pressures.
- While Tripping.
  - Stab full opening safety valve.
  - Close the safety valve.
  - Space out for tool joints.
  - Close BOP.
  - Open BOP side outlet hydraulic valve (HCR).
  - Record pressures.

33. Shut In Drill Pipe Pressure (SIDPP).

- Reflects the difference between the formation pressure and hydrostatic pressure in drill string
  - Used to calculate the kill mud density.
  - Used to calculate the formation pressure.
  - Formation pressure and mud density in string affect Shut In Drill Pipe Pressure.

34. Kill Rate Circulating Pressures, Slow Circulation Rate (SCR).

- Should be recorded on the drill pipe pressure gauge on the choke panel.
- Should be recorded with the bit near the bottom.
- Should be recorded when mud properties have changed significantly.
- Should be recorded at the beginning of every shift.
- Should be recorded after bit or BHA changes.
- Should be recorded when long hole sections are drilled rapidly - 500 ft.
- Should be recorded when returning to drilling after killing the well.

35. Leak-Off Test (LOT).

- Is the operation to find the surface pressure at which mud starts to leak into the formation.
- Will be carried out after drilling out the casing shoe and 5 to 15 feet of new formation.
- To minimize the chance of stuck pipe, raise the bit up inside the shoe.
- Parameters considered essential for an accurate Leak-off test
  - Drill out the casing shoe and into the new formation.
  - Circulate the mud to get a uniform column of mud in the hole.
  - The TVD for the casing shoe.
  - A calibrated surface pressure gauge.
  - Mud volume pumped till leak-off starts.

36. Maximum Allowable Annular Surface Pressure (MAASP).

- Is the surface pressure which, when added to the existing hydrostatic pressure that, if exceeded, would result in fracture the formation at shoe.
- Is the margin between mud hydrostatic and fracture pressure of the formation at the shoe.

- The following parameters will affect the MAASP
  - The mud density.
  - The fracture pressure of the formation at the shoe.
  - The depth of the last casing shoe.
- The MAASP will be recalculated when changing the mud density.
- If the mud density is increased, the MAASP will decrease.

37. Kill Methods.

- Objective
  - Remove formation fluid from the well bore.
  - Circulate kill mud into the well.
- All methods to be used to bring the well under control are based on the 'Constant Bottom Hole Pressure' concept.
- Maintain Shut In Casing Pressure Constant during,
  - Starting up the pump.
  - Increasing SPM.
  - Decreasing SPM.
  - Stopping the pump.

38. Driller's Method.

- Two separate circulations
- 1st Circulation
  - Circulate out the influx with existing mud density holding Drill Pipe Pressure constant; Initial Circulation Pressure (ICP).
  - Once the kick is out of the hole, shut the well in.
- After the first circulation, considering all the influx has been removed;
  - SICP should equal the SIDPP; this pressure should be equal to the original SIDPP.
- 2nd Circulation
  - Pumping kill mud from surface to bit (drop Drill Pipe Pressure from ICP to FCP).
  - Pumping kill mud from bit to surface holding Drill Pipe Pressure Constant; Final Circulation Pressure (FCP).

39. Wait and Weight Method.

- One circulation; Pumping kill mud at the same time circulating influx up the Annulus.
  - Pumping kill mud from surface to bit (drop Drill Pipe Pressure from ICP to FCP).
  - Pumping kill mud from bit to surface holding Drill Pipe Pressure constant; Final Circulation Pressure (FCP).

40. Gas Migration.

- With the well shut in, gas is light and will migrate (percolate) up the annulus both drill pipe and casing pressure readings will increase at same rate causing,
  - Increase in SICP.
  - Increase in SIDPP.

- Increase in BHP.
- Increase in Casing Shoe pressure.
- Gas bubble pressure will stay the same (equal to the formation fluid pressure).