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.
  - Ballled 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

- 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.

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

• Kick occurrence after loss of circulation depends on the mud level in the annulus and the formation pressure.
• Immediate action is,
  o 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,
  o Drill a pilot hole at a slow controlled rate.
  o Pump out of the hole on trips.
  o Control ROP to prevent too many cuttings in the hole.

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

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

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

27. Kick Indicators.
  o Decrease in pump pressure.
  o 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,
  o Shut the well in.

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

<table>
<thead>
<tr>
<th></th>
<th>Oil Base Mud</th>
<th>Water Base Mud</th>
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<td>Less</td>
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<tr>
<td>Hydrostatic Pressure Reduction</td>
<td>less</td>
<td>More</td>
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<tr>
<td>Shut In Casing Pressure</td>
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<tr>
<td>Initial Pit Gain</td>
<td>Lower</td>
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<tr>
<td>Gas Expansion</td>
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</tr>
<tr>
<td>Detection</td>
<td>Harder</td>
<td>Easier</td>
</tr>
</tbody>
</table>

29. Shutting The Well In.

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

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

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

<table>
<thead>
<tr>
<th></th>
<th>Soft Shut-In</th>
<th>Hard Shut-In</th>
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<td>Choke</td>
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<tr>
<td>HCR</td>
<td>Close</td>
<td>Close</td>
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<tr>
<td>Choke manifold gate valves</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>upstream and downstream of the choke to the mud gas separator</td>
<td></td>
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</tbody>
</table>


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

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