Times to Flow Check:

- Before pulling out of the hole
- Before pulling BHA into the BOP
- When bit is pulled into the casing
- Increase in cuttings at shakers with same ROP
- On connections
- Upon abnormal trip tank fills while tripping
- Deviation from fingerprint trend

Shallow Gas Top-hole Drilling Considerations:

- Control ROP
- Pump out of hole trips
- Max pump rates on kick
- Drill riser-less

Warning Signs of kicks/abnormal pressure:

- Drilling break- gradual increase in ROP
- Increase in return flow rate
- Pit gain
- Well Flows with pumps off
- Decrease in circulating pressure
- Reduction is mud weight
- Increase in torque/drag- RPM

Gas in Oil-base Mud:

- Can stay in solution until "Bubble Point"- Bubble Point is the point near the surface when the hydrostatics pressure above the gas is low enough to allow the gas to break out of solution.
- When gas breaks out surface pressures will increase rapidly
- Harder to detect gas influx with low permeability formations

Ballooning:

- At connection well flows and when pumps on lose mud
- Annular Pressure Loss (APL) causes the extra pressure that induces the loses
- SICP ≤ SIDP
- If you suspect ballooning, first thing to do is to shut the well in.
- Verify by bleeding 1-2 barrels then check to see if pressures drop; if casing increases at all then it is not ballooning (it is a kick)
- After verifying ballooning circulate bottoms up through an open choke

Slow Circulating Rates (SCR's):

- Retake:
  a. When you drill long sections of hole rapidly (500' of new hole)
  b. Each tour
  c. After mud weight change or significant mud properties type change
  d. Following pump repairs- pulsation dampener is not a pump repair
  e. After BHA change or trip
- Gelled mud can give inaccurate readings
- Reasons for using slow pump rates:
  a. To provide lower pressures during kill- lowers APL and choke line friction for subsea
  b. To provide more reaction time on the choke
  c. Pump and pressure limitations
- Record on gauge to be used on the kill- choke panel drillpipe gauge

Indications of Abnormal Pressure:

- Increasing gas levels- connection gas, background gas (lagging indicators)
- Changes in mud weight
- Increase in cavings/cuttings shape and volume
- Decrease in cuttings/formation density
- Drilling break- gradual increase in ROP
- Changes in mud properties (viscosity, chlorides, etc.)
- MWD

Oil-base Mud Temperature/Pressure:

- Increase in temperature increases volume and deceases density
- Increase in pressure increases density

Transition Zones:

- Fingerprint connections
- Increase crew awareness to warning signs
- Monitor shakers for cavings

Determines Size of Influx:

- Formation permeability (high permeability will give larger influx)
- Kick Intensity (difference in mud weight and formation pressure)
- Closing Time

Determines SIDPP:

- Hydrostatic pressure of the column of fluid in the drill pipe (bit at bottom of hole)
- Formation pressure

Determines SICP:

- Hydrostatic pressure of the column of fluid in the annulus
  a. Annulus capacity per foot (height of influx)
  b. Size of kick (barrels)
- Formation pressure

Kick Gas Expansion during circulation:

- Volume of gas increases
- Pressure of gas decreases
- Pit level will increase until gas enters the choke then pit level will decrease

Only times casing can be held constant:

- Changing SPM (start-up, shut-down, etc.)
- Pumping kill mud to bit 2nd circulation Drillers Method (no influx in the annulus)
- Once influx is out 1st circulation Drillers Method (no influx in the annulus)

Shoe Pressures and MASP/MAASP

- Fracture pressure is the total pressure applied at the shoe that breaks down the formation
- Maximum Allowable Surface Pressures are the casing burst and the pressure that causes breakdown at the shoe
- Needed to calculate shoe leak off:
  a. Shoe TVD
  b. HP of mud at the shoe
  c. Pressure applied to leak off
  d. Accurate calibrated gauge
- Larger risk of exceeding MASP when mud hydrostatic pressure is closer to formation pressure
- Shoe pressures greatest upon initial influx or top of gas bubble at the shoe
- Shoe pressures will remain constant once all gas influx is in the casing
- Short open hole section least likely to exceed MASP

Gas in Horizontal Section:

- Pit volume remains constant as influx is circulated along horizontal section
- SIDPP equal to SICP- because the kick in the horizontal section does not have the vertical height to affect the hydrostatic pressure in the annulus
- Casing pressure will increase as gas influx is being circulated from horizontal into vertical section
- Using Wait &Weight Method vertical kill sheet on a horizontal well will apply too much pressure

Bit above the Influx:

- SIDPP equal to SICP
- If can't strip back to bottom, use Volumetric Method until influx past the bit then switch to circulation method.
- When stripping through the gas bubble, must allow casing to increase. (If you were to hold casing constant, you would decrease Bottom Hole Pressure (BHP).)

Bottom Hole Pressure (BHP):

- Basic principle of BHP technique is to maintain BHP at least equal to formation pressure.
- U-tube concept keeps BHP the same on both sides of the well.
- In all constant BHP methods of well control, if you are doing the right thing, BHP will remain constant.
- If action is the wrong thing to do, then decide which way you go with the choke. (open will decrease BHP, close will increase BHP)

Wait & Weight Method:

- Follow drillpipe pressure schedule while pumping Kill Mud to the bit.
- With Kill Mud to the bit SIDPP should be equal to "0." If not, check for trapped pressure then circulate more strokes if still has pressure.
- If mixing hopper blockage, shut-in and fix blockage.
- Hold FCP once Kill Mud is past the bit.

Drillers Method:

- On 1st circulation, once kick is out SICP should equal original SIDPP.
- If mixing hopper blockage on 1st circulation, keep circulating while blockage is fixed.
- On 2nd circulation of Kill Mud to the bit, follow drillpipe step-down schedule or hold casing constant as long as no influx in the annulus.
- Hold FCP once Kill Mud is past the bit.

Wait & Weight verses Drillers Method:

- Wait & Weight provides lower equivalent pressures at the shoe than Drillers Method when the drill string volume is less than the open hole volume. Otherwise the pressures at shoe will be the same with either one.
- Wait & Weight requires one circulation where Drillers Method requires two circulations.
- Drillers Method requires more time on the choke with underbalanced kicks.

Volumetric Method:

- Maintains constant bottom hole pressure while gas migrates to surface.
- Volumetric is complete when all the gas is at the surface.
- Once gas exits choke, shut-in and check pressures, if casing increases, continue with volumetric.

Lube & Bleed:

- It is a remedial method to be used after Volumetric Method is complete.
- Also known as pump mud bleed gas
- Reduces surface pressures by increasing hydrostatic pressure and removing gas.

Cementing, Self-fill, and Non-Return Float:

- Circulate a full bottoms-up before cementing to insure a good column of mud.
- As cement sets hydrostatic pressure can reduce causing a kick.
- If the self-fill failed to convert to a check valve:
  a. Fluids from the formation or the annulus can enter the casing.
  b. Cement could u-tube back inside the casing when pumps are stopped.
  c. Pressure would have to held on casing head to prevent u-tubing.
  d. If it plugs, normal hook load with depth will slow down due to buoyancy effect.
- Non-Return Float assembly:
  a. If casing is not kept full and it fails, mud could u-tube into casing.
  b. Mud u-tubing back into casing will cause a loss in BHP.