Well Control Barrier Philosophy

1. What is a Well Control Barrier?

- A Well Control Barrier can be defined as any physical component(s) or operational practice that prevents formation fluids from flowing unintentionally from a formation, into another formation or to escape at surface.

2. Types of Well Control Barriers

2.1 Physical Component Barriers – *"Something I can touch"*

- A physical component or mechanical device which has been designed and/or tested to prevent formation fluids from flowing unintentionally.
  - *Examples include*: Hydrostatically overbalanced fluid column, cement plugs, Blowout Preventer Equipment, Bridge Plugs, Casing, Cement behind Casing, Valves, Managed Pressure Drilling Equipment, etc.

2.2 Operational Practice Barriers – *"Something I can do"*

- An operational practice or action which requires human recognition to analyze data/trends and react appropriately to prevent or manage formation fluids flowing unintentionally.
  - *Examples include*: Flow checks, Gas Unit Trending, Pressure Testing Physical Barriers, Pit/Trip/Choke Drills, Monitoring for Abnormal Pressure Indicators, Setting Alarms, Effective Communication Between Rig Crew Members, etc.

3. General Well Control Barrier Design Concepts

3.1 Quantity of Well Control Barriers

- Physical Components – Minimum of 2 in each potential flow path - 1 *active* (ex: Hydrostatically overbalanced fluid column) & 1 in a *"ready"* state (ex: Pressure tested Blowout Preventer). Failure of the primary barrier must not result in the failure of the backup.
- Operational Practices – Unlimited – The more discussion, practice & verification that a team utilizes with regards to Well Control Barriers, the more effective that team is at building a Well Control Culture.

3.2 Placement of Physical Well Control Barriers

- Physical Barriers are to be placed as close to the source as possible to minimize the potential size of influx. Barriers placed in series are to be placed in such a manner that allows for testing and verification of each barrier independently.
- Physical Barriers which are placed and not able to be effectively pressure tested, will have its integrity verified by other means to ensure that the component is functioning as designed/intended.
- Physical Barrier locations must be known & documented at all times.
- Physical Barriers must be able to endure the environment (Temp, Fluid Type, Pressures, etc) in which it was placed for the period of time which it was intended.

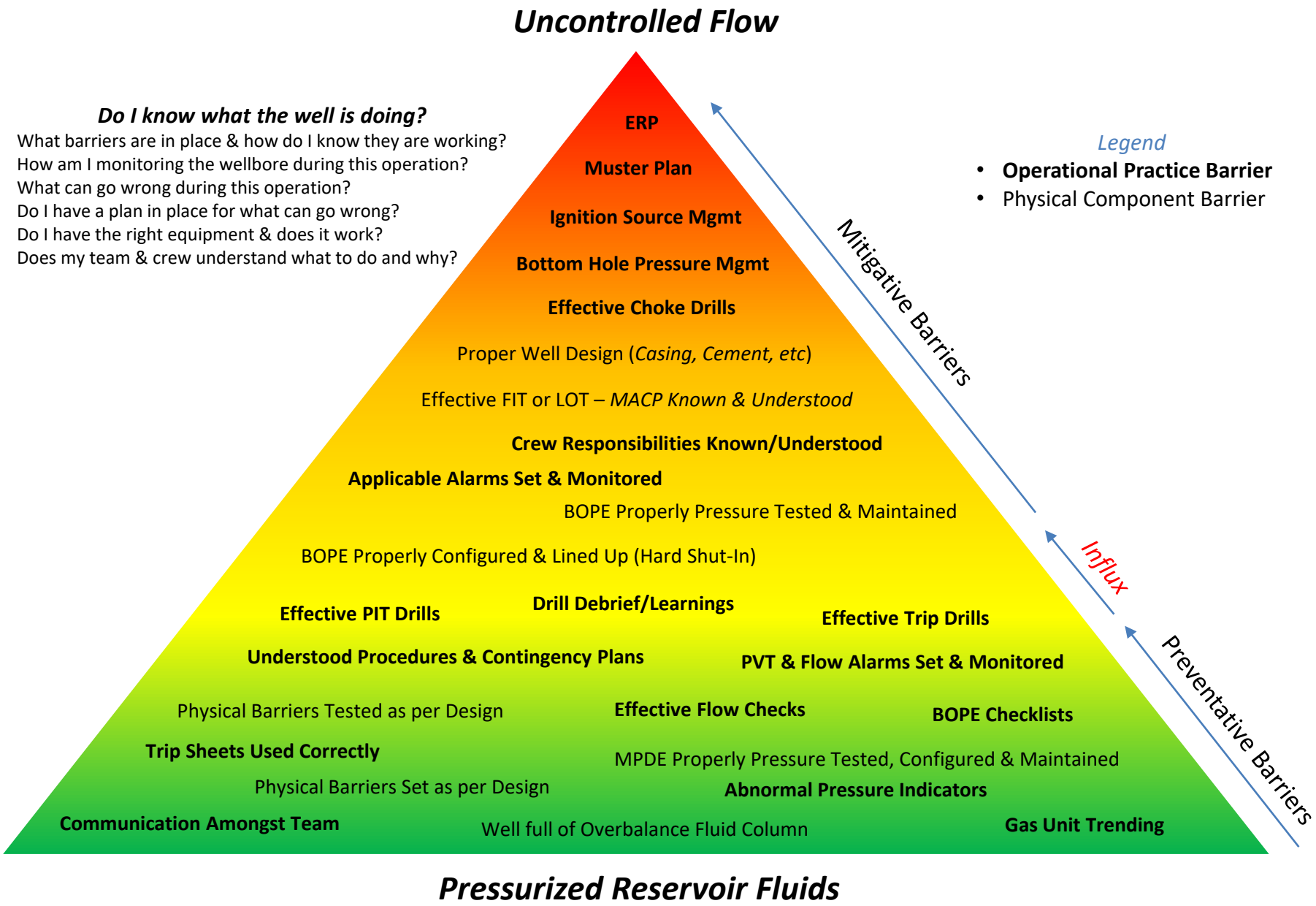
3.3 Testing & Verification of Physical Well Control Barriers

- Physical Barriers must be pressure tested & should be pressure tested in the direction of expected flow. Pressure test amounts must be greater than the expected wellbore pressures at the location of the Barrier & should be less than the working pressure rating of the Barrier.
  - ***Positive Pressure Test*** – 5 min minimum time, low & high test pressure, documented acceptable pressure drop over time, volume to pressure up & bleed back is monitored.
  - ***Negative Pressure Test*** – Acceptance criteria for a good negative test must be agreed upon prior to test & plan must include procedure for failed negative test.
- If a Physical Component Barrier is not able to be effectively pressure tested, its integrity & position must be verified by another means and documented.
- Physical Barriers or situations in which the above guidelines cannot be followed, must be risk assessed, documented & mitigating procedures effectively communicated to all involved parties.

Understanding Well Control Barriers

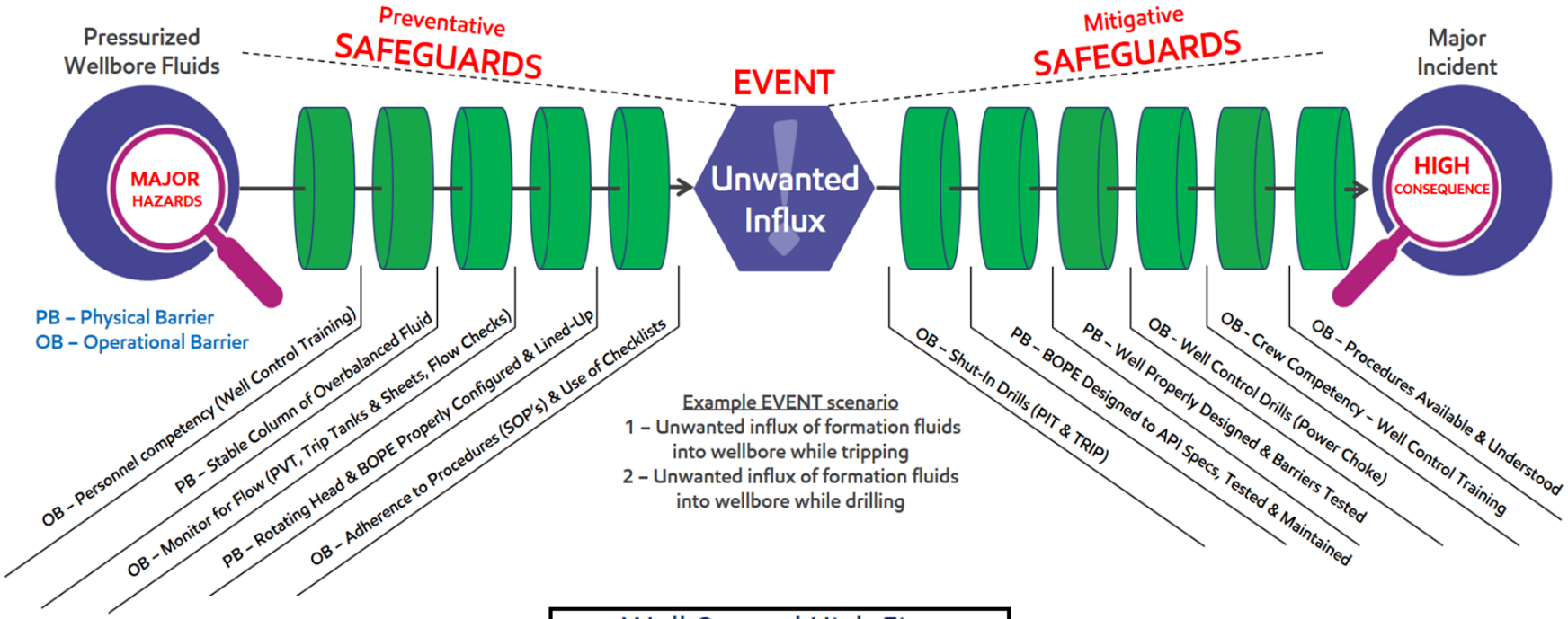
Do I know what the well is doing?

1) What barriers are in place & how do I know they are working?
2) How am I monitoring the wellbore during this operation?
3) What can go wrong during this operation?
4) Do I have a plan in place for what can go wrong?
5) Do I have the right equipment & does it work?
6) Does my team & crew understand what to do and why?



UNDERSTAND WHAT THE WELL IS DOING AT ALL TIMES

Major Incident Consequences
1 – Surface Blowout
2 – Underground Blowout
3 – Long duration spill/release to environment



Example EVENT scenario
1 – Unwanted influx of formation fluids into wellbore while tripping
2 – Unwanted influx of formation fluids into wellbore while drilling

Well Control High Five

1. How will the wellbore be properly monitored during this operation?
2. What can happen or go wrong during this operation?
3. Do I have a plan or the correct procedures in place for what can happen or go wrong?
4. Do I have the right equipment and does it work?
5. Have the hazards, procedures, and desired response been communicated to the crew?

Tripping in Hole Practices

- DSM to be on rig floor for initial circulation after reaching bottom for a minimum of one BU
- Prior to tripping in hole, discuss with Opt Supt plan for circulating during trip
- If hole not giving proper displacement, notify operations superintendent to discuss forward plans
- DSM to designate competent person to be on pits when circulating BU after trip
- CBU at end of build
- Trip tanks, with pump running, to be utilized during the trip in the hole

Tripping Out of Hole Practices

- Flowcheck prior to POOH
- DSM to be on floor for a minimum of first 10 stands, if the hole is not taking proper fill, go back to bottom and circulate bottoms up.
- POOH a minimum of 10 stands and perform flow check prior to pumping slug
- Additional flowchecks at base of curve, at the casing shoe, and prior to pulling BHA across BOP
- If hole not taking proper fill after the first 10 stands, notify operations superintendent to discuss forward plans
- Discuss with op supt on decision to pump out of hole in lateral on tight margin wells

Personnel and Documentation

- Well control topic to be reviewed EVERY pre-tour to develop crews and report topics in safety check summary in Wellview
- DSM to hold trip/pit/well control drills with all crews weekly or more frequently until deemed competent by DSM
- Verify Mud Weight in/out while drilling every 30 minutes, and post on Pason screen
- Well Control Readiness Checklist to be conducted each tour and filled out by DSMs.
  - Form to be kept on file
  - Take slow pump rates at tour change or mud weight change
- Well Control Kill sheet to be filled out with current hole section BHA and shoe depths and kept updated tourly or with any mud weight change
- Trip sheets to be reviewed by DSM while tripping and retained
  - Trip sheets to be kept when running all strings of pipe
  - Trip tanks, with pumps running, to be utilized anytime the rig pumps are not on. i.e if

Equipment

- Rotating Head is to be installed prior to drilling ahead
- FOSV (TIW) is to be installed below test plug in open position when BOP test is conducted
  - 5 stands of DP or 3 stands of HWDP below TIW for all tests
  - Well is to be monitored from cellar with open casing valve on the trip tank or a hose
- Hard shut in clearly labeled on choke manifold
- Ram locking hand wheels to be installed on all rams
- Casing crossover to FOSV required to be made up prior to running casing for intermediate and production hole.
- VBR utilization to be approved by op supt
- LEL sensors to be installed on rig floor
- When flare stacks are utilized, a properly installed check valve shall be installed and verified by DSM

KICK DETECTION & SHUT-IN METHODOLOGY