



Weatherford®

Unique Multi-lateral Orientation Tool Facilitates Coiled Tubing Intervention with a Motor

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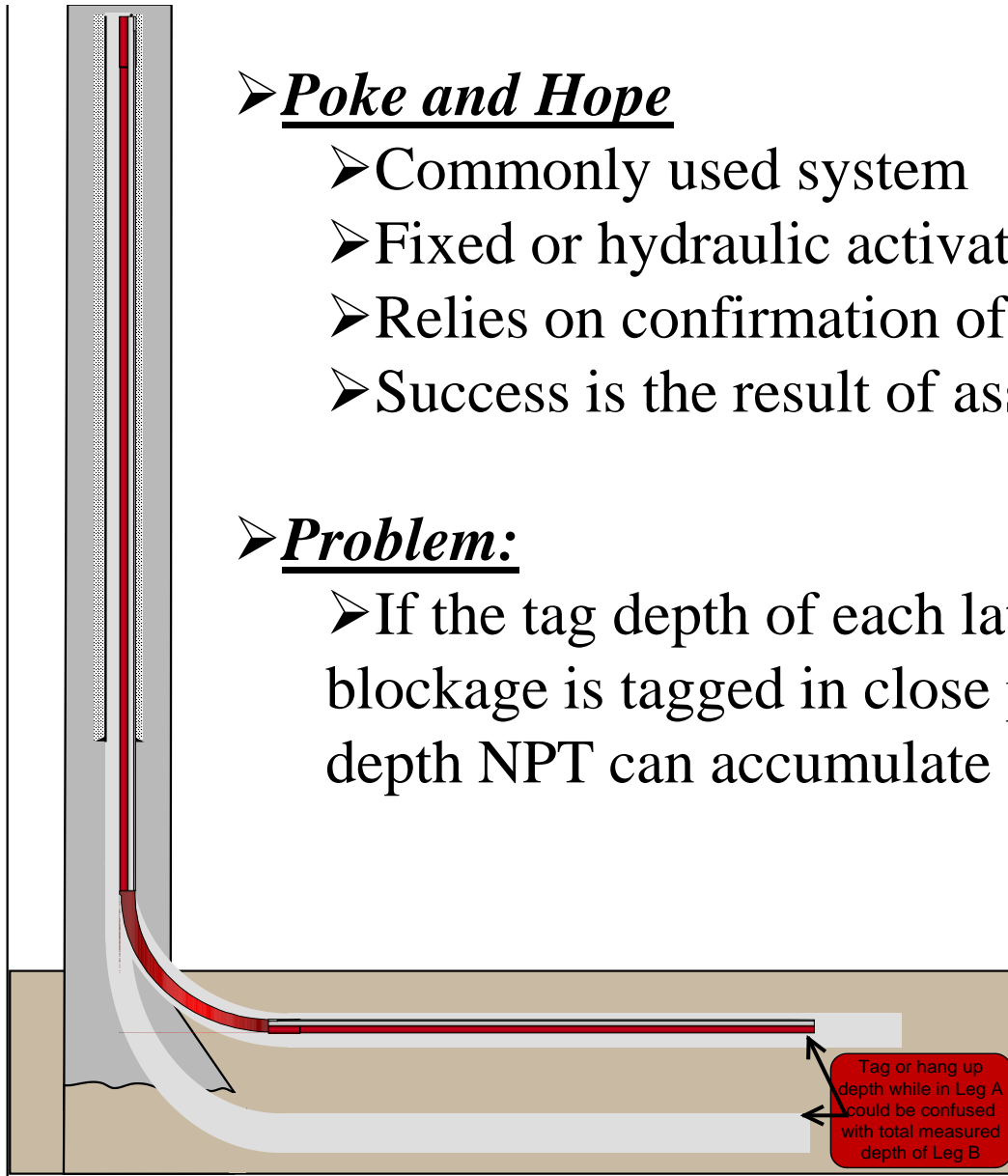
Overview of Lateral Leg Entry Methods

➤ Poke and Hope

- Commonly used system
- Fixed or hydraulic activation
- Relies on confirmation of point of refusal
- Success is the result of assumptions

➤ Problem:

- If the tag depth of each lateral are the same or if the a blockage is tagged in close proximity to as assumed depth NPT can accumulate



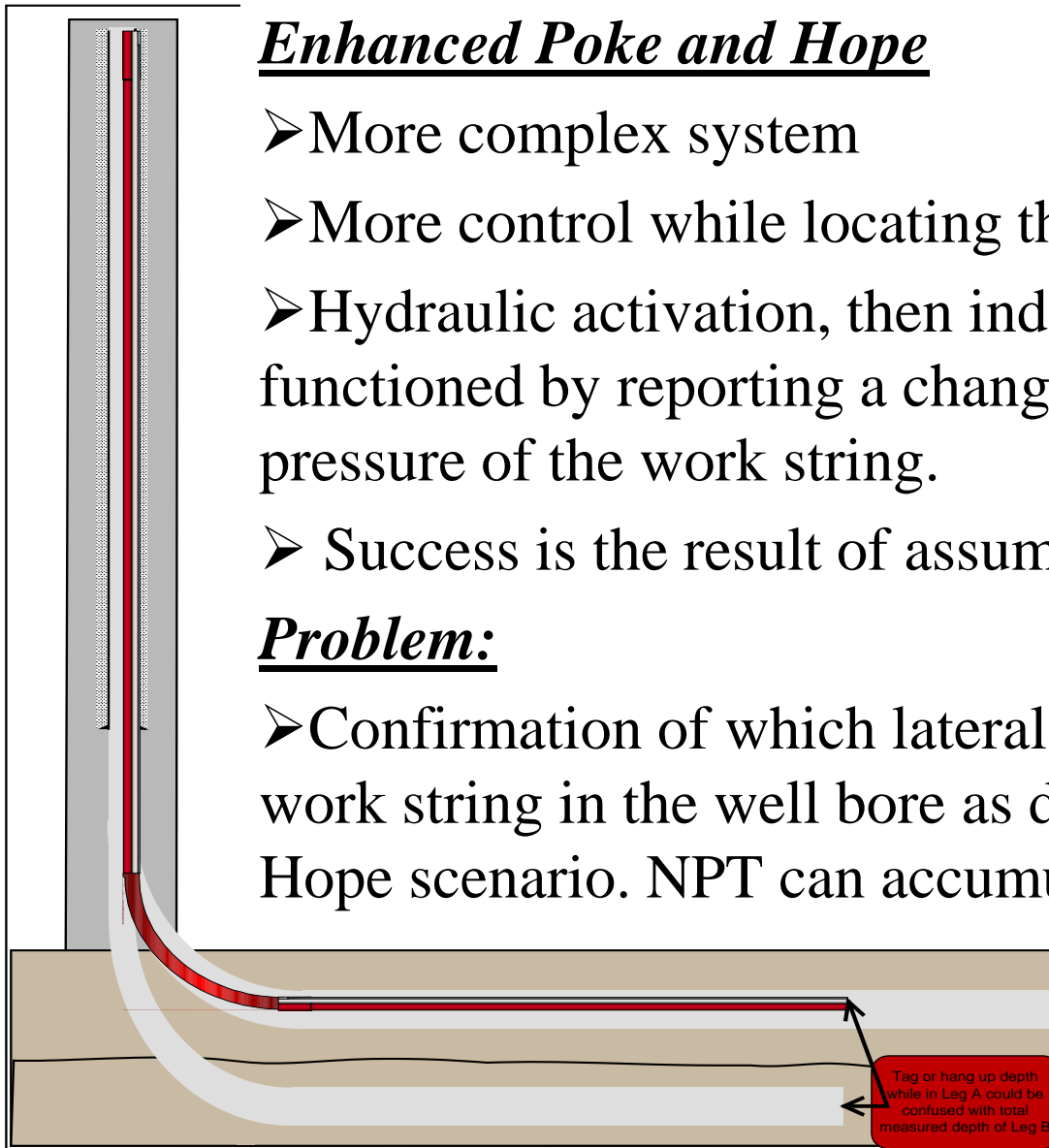
Overview of Lateral Leg Entry Methods

Enhanced Poke and Hope

- More complex system
- More control while locating the lateral exit.
- Hydraulic activation, then indicate the tool has functioned by reporting a change in the operating pressure of the work string.
- Success is the result of assumptions

Problem:

- Confirmation of which lateral still requires running the work string in the well bore as defined in the Poke and Hope scenario. NPT can accumulate.



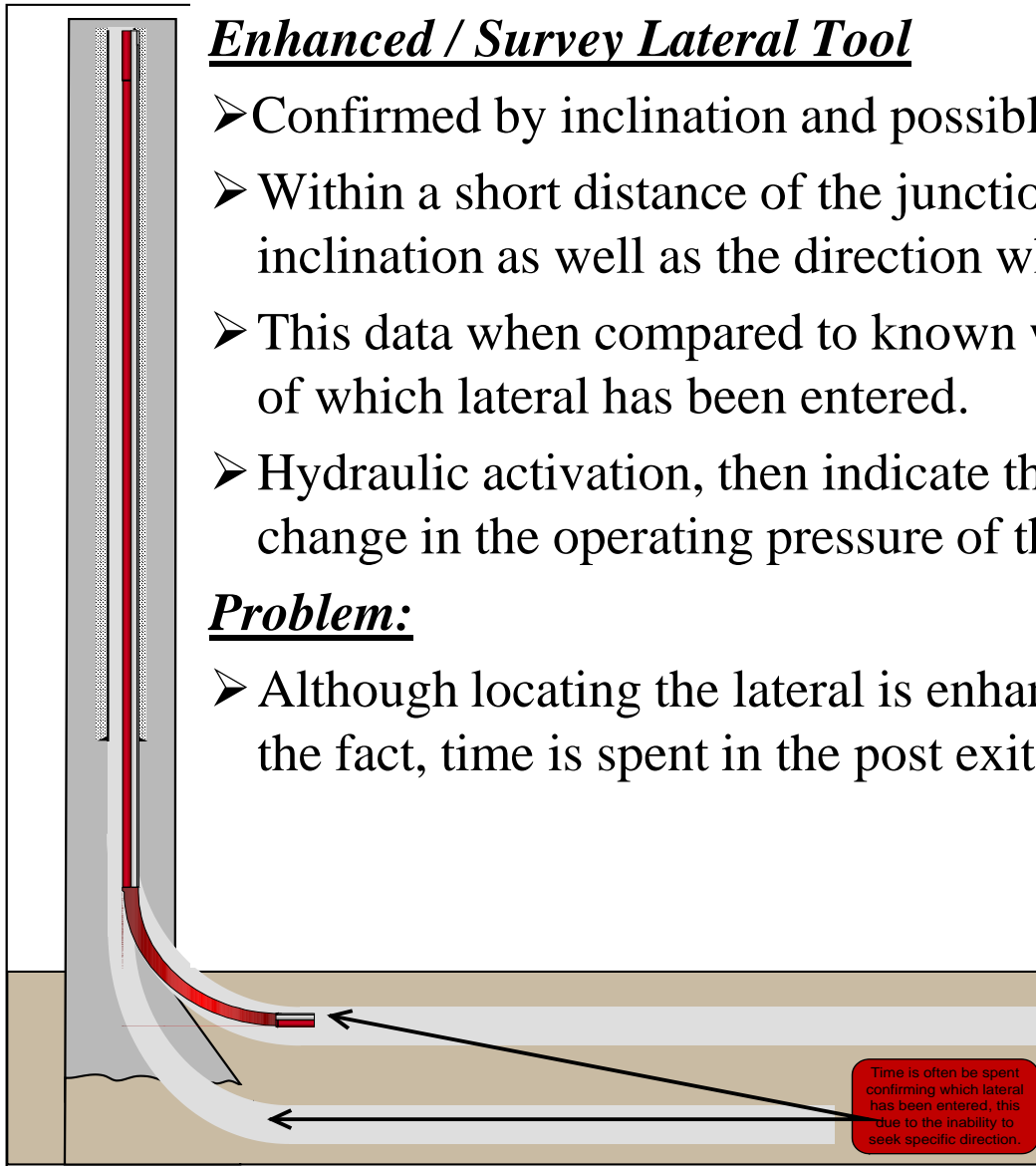
Overview of Lateral Leg Entry Methods

Enhanced / Survey Lateral Tool

- Confirmed by inclination and possibly azimuth using survey tools.
- Within a short distance of the junction the tool string can report its inclination as well as the direction which it is “heading”.
- This data when compared to known well surveys will provide certainty of which lateral has been entered.
- Hydraulic activation, then indicate the tool has functioned by reporting a change in the operating pressure of the work string.

Problem:

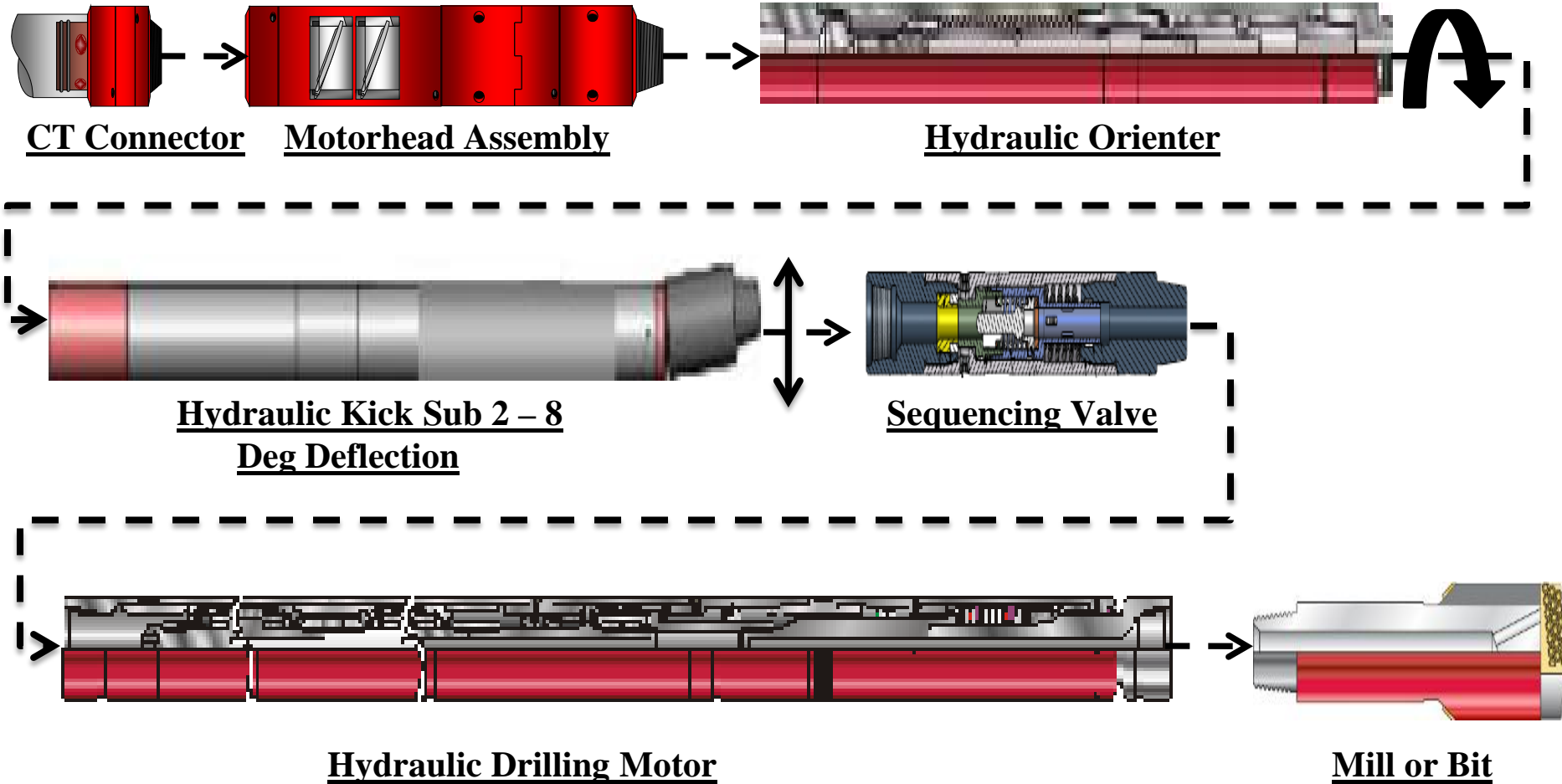
- Although locating the lateral is enhanced confirmation is only made after the fact, time is spent in the post exit evaluation.



Lateral Entry System – Design Features

- Coil tubing deployable
- Pump cycles function orienter and kick sub
- Kick sub is designed with the ability to kick a motor and other intervention tools
- Fully hydraulic system. Not drop balls needed.
- Repeatable function, no need to trip to reset.

Lateral Entry System – Design Features



Lateral Entry System – Design Limitations

- No pressure indication of leg location
- Mostly used as a Poke & Hope or Enhanced / Survey Lateral
- Non productive time can be cost prohibitive.
- No real control of the heading due to unknown tool face position.
- Not currently available in slimhole sizes (smaller than 2.875”)

Operational Details – Back Ground

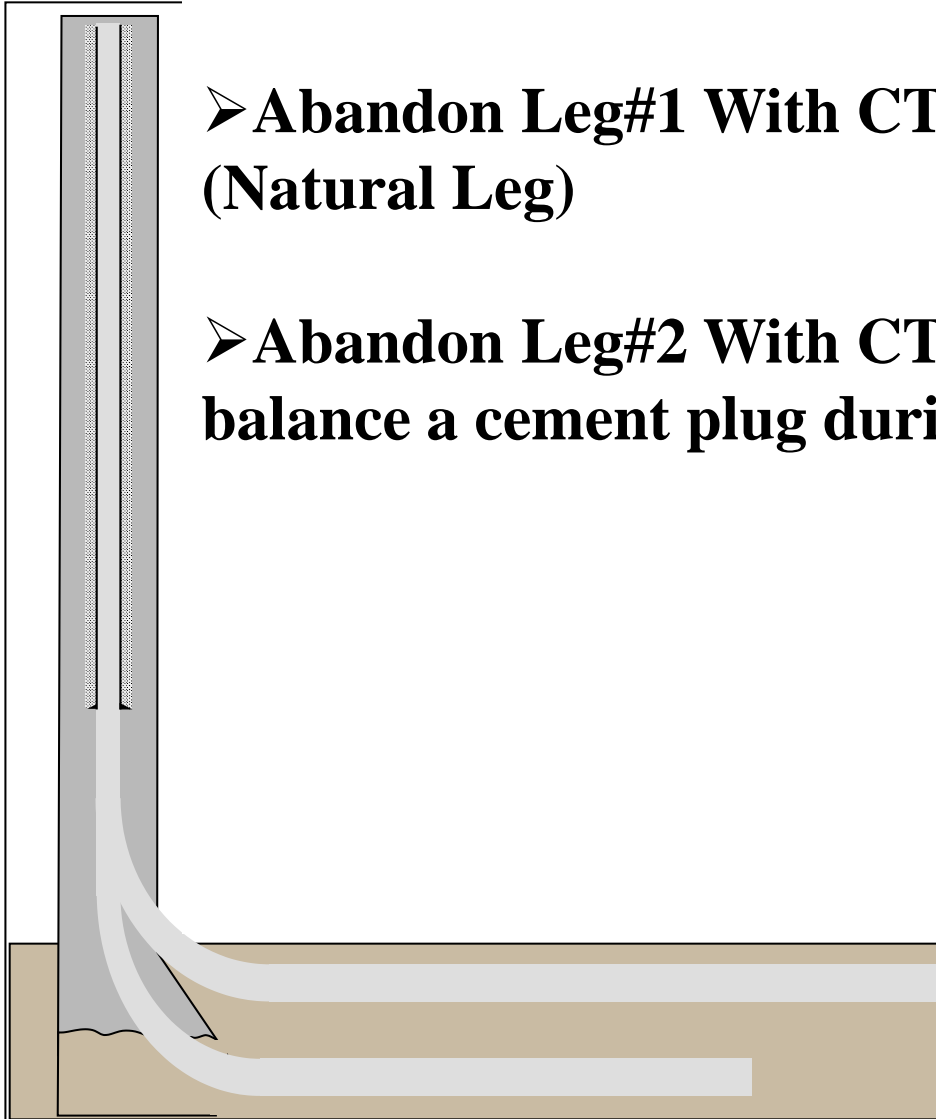
Objective

- Enter lateral leg and abandon with cement using 2 3/8" CT.

Well Configuration

- Oil Well
- 139mm (5 1/2") Casing
- Single-Lateral Completion
- 120.6mm (4 3/4") Open hole lateral
- KOP ~1,300m
- TVD ~1,450m
- Inclination 92 Deg
- TD ~2,500m

Operational Details – Well Schematic



- **Abandon Leg#1 With CT & Cement Retainer – (Natural Leg)**
- **Abandon Leg#2 With CT & Lateral entry system, balance a cement plug during tripping out of hole.**

Operational Details – Back Ground

Equipment Used

- **2 3/8” CTU and associated support equipment**
- **C&A Pump**
- **Fluid storage tanks**
- **Test Vessel**
- **Lateral Entry System compatible with a motor**

Operational Details – Job Summary

- **Initial plans were to use the Lateral Entry System with only a mule shoe guide on the bottom.**
- **Multiple Runs were made to locate and enter leg#2.**
- **Entry was successful at various times, however the leg would not allow passage of the BHA due to wax obstruction.**
- **Multiple circulating techniques were used to wash the leg to gain passage to the target depth with out success.**
- **Daylight operations were limiting what could be achieved in a day, so, some runs were cut short due to short service hours.**

Operational Details – Job Summary

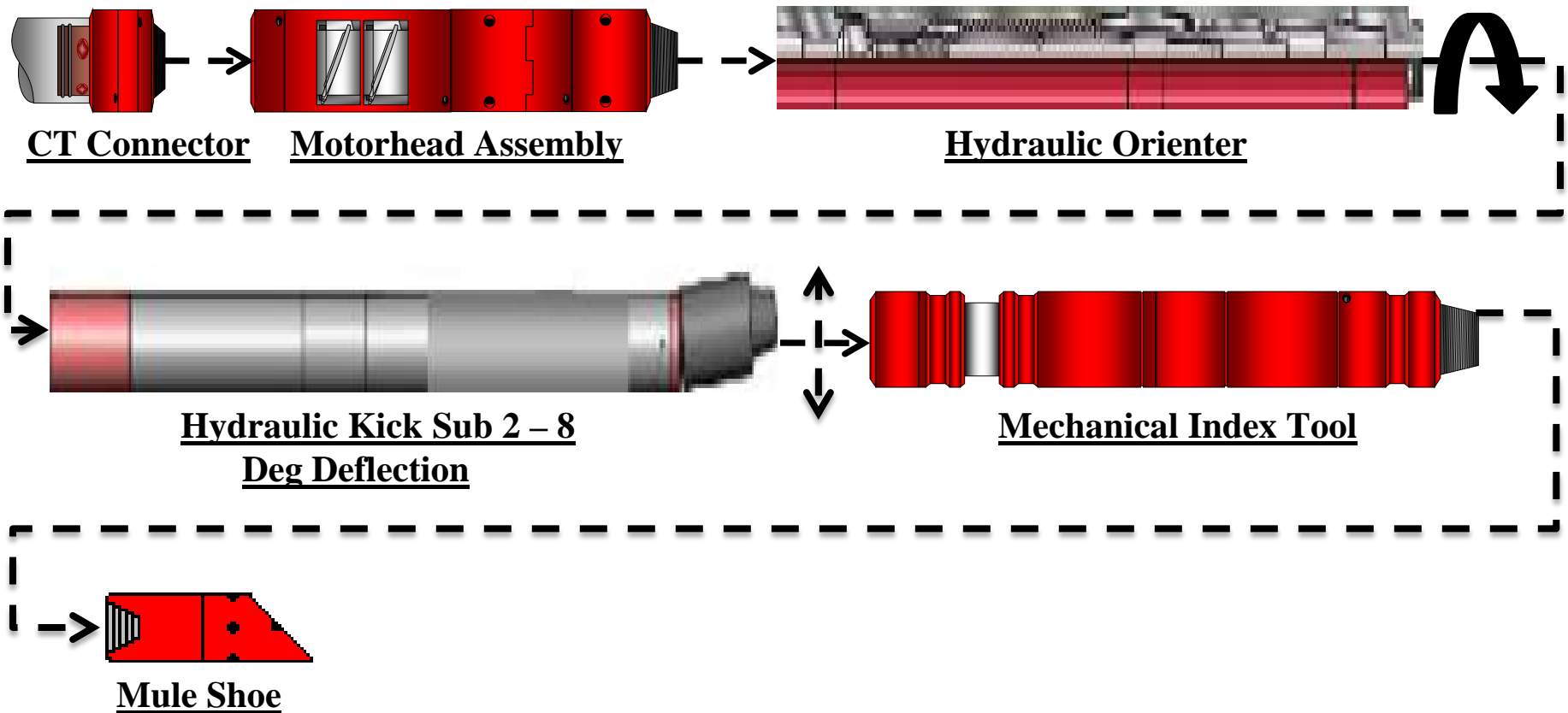
- **Eventually decided to pick up a motor and mill to use with the Lateral Entry System to clear leg #2 from obstructions.**
- **Located and enter leg #2, then tagged obstruction @ 1,755m**
- **Milled to 1,829m -74m of depth gained**
- **Decision was made that 1,829m would be an acceptable depth to place the cement plug. Pumped Xylene through motor and washed well while tripping.**
- **Trip out of hole with milling BHA**

Operational Details – Job Summary

- **Ran back in hole with the Lateral Entry system with mule shoe for cement.**
- **Located leg #2, trip into the leg to previously cleaned out depth (1,829m).**
- **Launch circulation sub ball and pump cement while tripping.**
- **Leg # 2 abandonment program complete.**

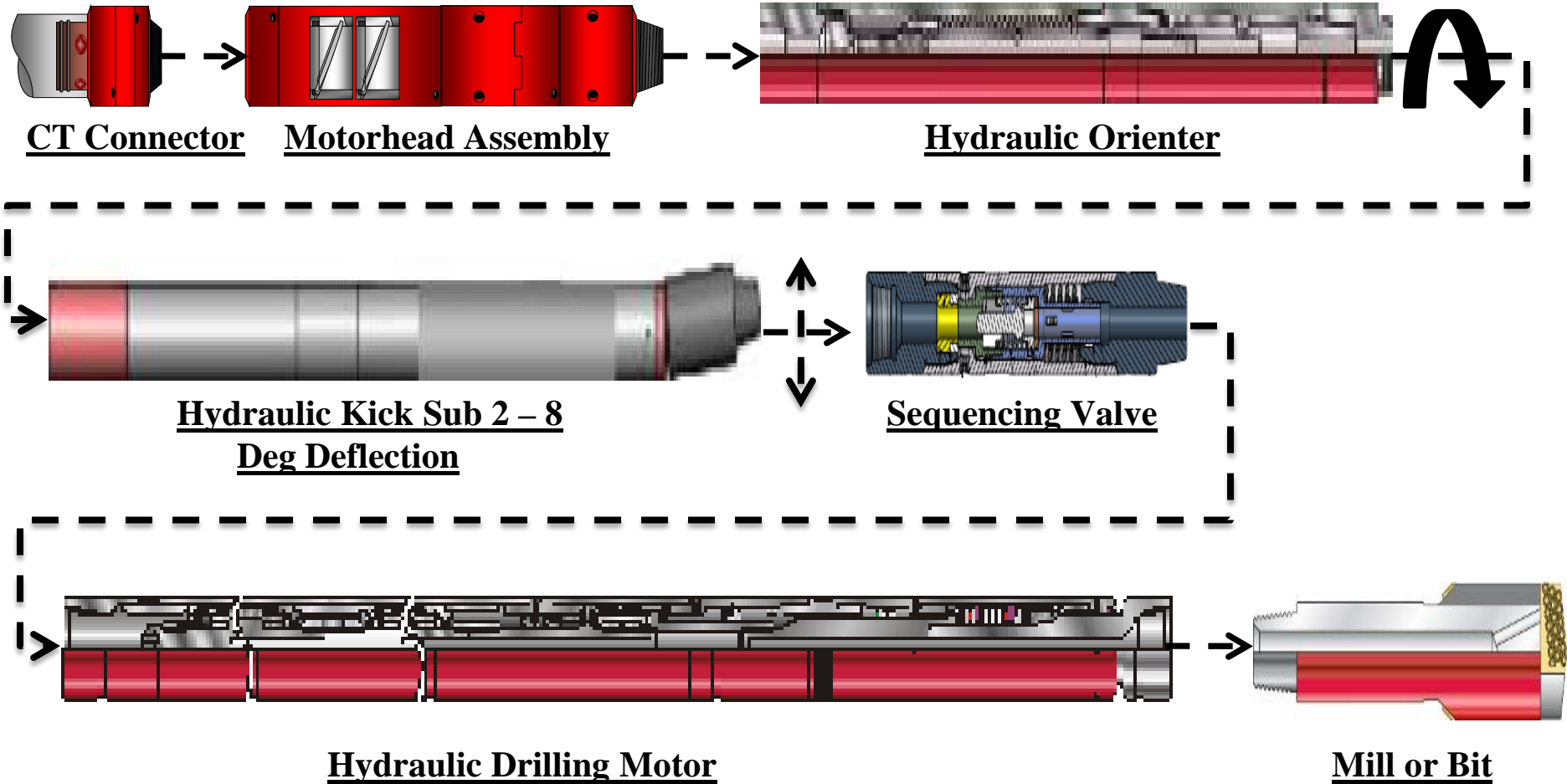
Operational Details – BHA Configuration

First & Last Runs



Operational Details – BHA Configuration

Clean out Run with motor



Operational Challenges

- Tripping and locating the leg was a time consuming process. Locating times ranged from 3 hours – 30 minutes pending orientation of the BHA and chance.
- A lot of confusion was found during the entry of the leg as there were times where the BHA would hang up just outside the window. So functioning the orienter to reposition the “bend” in the BHA was required to gain entry into the leg with out being overly forceful with it.
- Working daylight hours limited what could be achieved every day. Were tripping to surface every day to shut down for the night.

Keys Learning's and Improvements

- **Operate 24hr operations if possible. More effective use of time is then possible.**

- **Improve the Lateral Entry System to transmit to surface its location while in the well bore. Benefits of this include:**
 - **Reduced NPT while locating and confirming BHA entry into legs.**
 - **Remove chance from the equation of operationally / economically viable?**
 - **Align with the original well path to allow for less areas for BHA stresses due to improper alignment with the lateral exit point.**
 - **Allow for deployment of other tools beyond mule shoes & mills and motors. i.e. Packers, Logging tools etc.**

Evolution - Lateral Guidance Positioning System (LGPS)



Plan your multilateral intervention with LGPS from Weatherford



Our new LGPS system makes the typical method of locating lateral junctions a thing of the past. A commonly used system used to locate lateral junctions is either by tool function, hydraulic activation or by fixed bent assembly. Pressure signals are often used to diagnose functionality of the tool string and aid in determining the current placement in the wellbore. These systems are reciprocated through the junction area then lowered to the point of refusal. Once the point of refusal is tagged this depth is compared to the known measured drilled depth and assumptions are made based on the comparative values.

The LGPS solution allows your BHA to be oriented by design, rather than chance. A survey tool on the BHA allows precise parametric data to be related real time to surface, allowing for you to target a specific well path based off existing well survey data. The LGPS addresses the current trends for complex well designs where multiple laterals exists. The LGPS incorporates the ability to confirm the inclination and azimuth within close proximity to the junction, assuring the path plan is achieved.

- Reduce non-productive time
- Engineered approach to lateral re-entry
- No "poke and hope"
- Increased accessibility to complex well bores



Azimuth Measurement System

Total Survey
6
Azimuth (TRUE)
143
Angle
78.3
Depth
14239

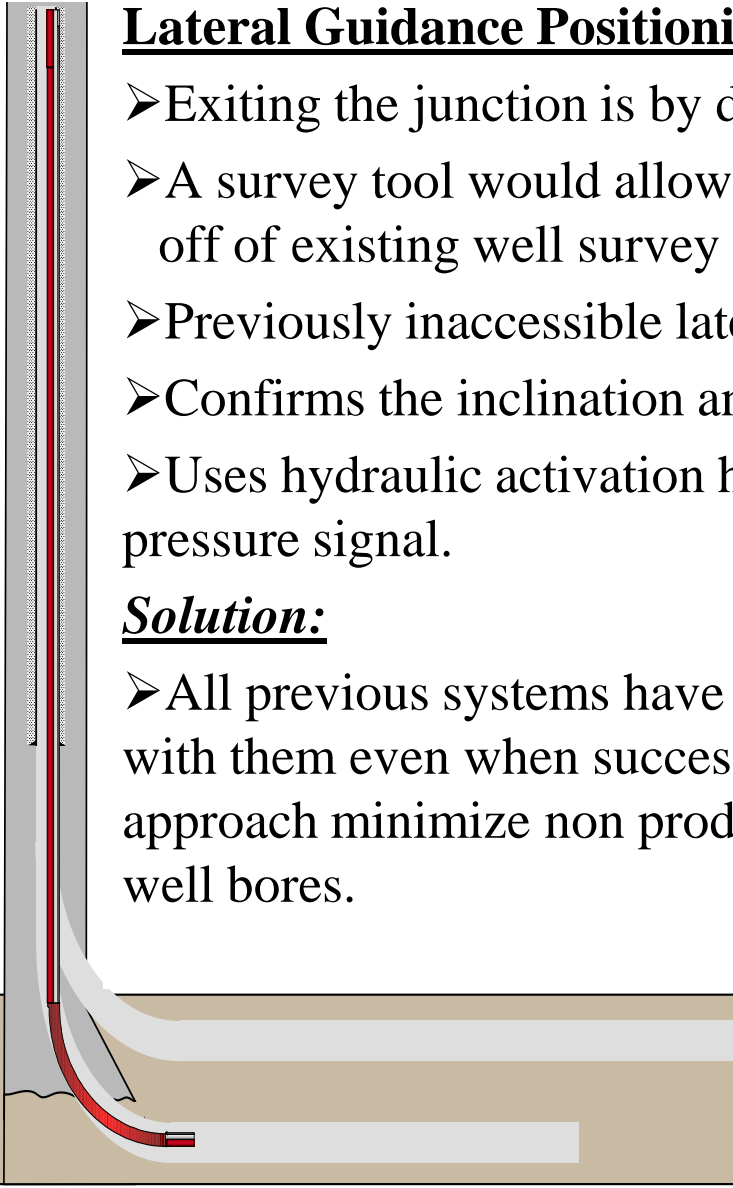
Evolution - Lateral Guidance Positioning System

Lateral Guidance Positioning System (LGPS)

- Exiting the junction is by design rather than chance.
- A survey tool would allow the work string to target a specific well path based off of existing well survey data.
- Previously inaccessible laterals could be accessed.
- Confirms the inclination and azimuth within close proximity to the junction.
- Uses hydraulic activation however does not report the functioning via pressure signal.

Solution:

- All previous systems have varying amounts of non-productive time associated with them even when successful. This system provides a drive to the target approach minimize non productive time and increasing accessibility to complex well bores.



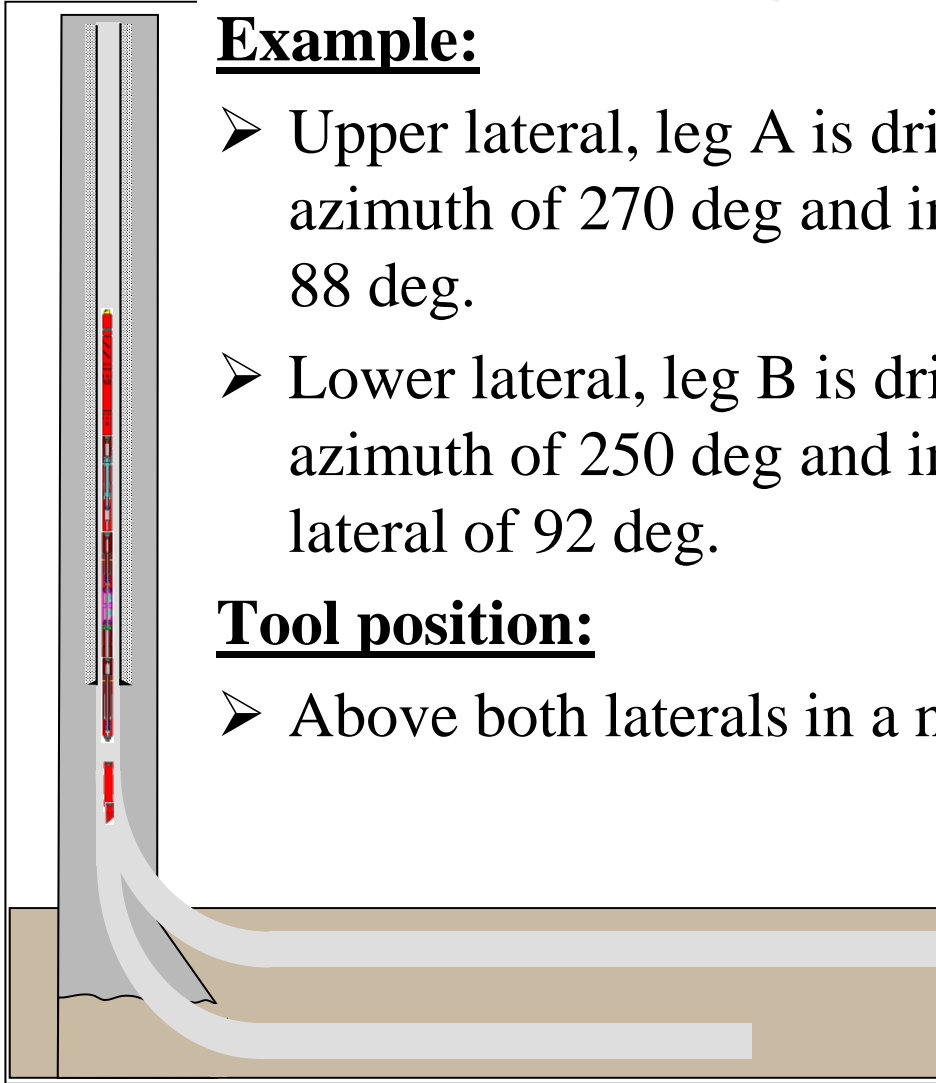
Evolution - Lateral Guidance Positioning System (LGPS)

Example:

- Upper lateral, leg A is drilled to a depth of X with an azimuth of 270 deg and inclination through the lateral of 88 deg.
- Lower lateral, leg B is drilled to a depth of Y with an azimuth of 250 deg and inclination through out the lateral of 92 deg.

Tool position:

- Above both laterals in a natural state.



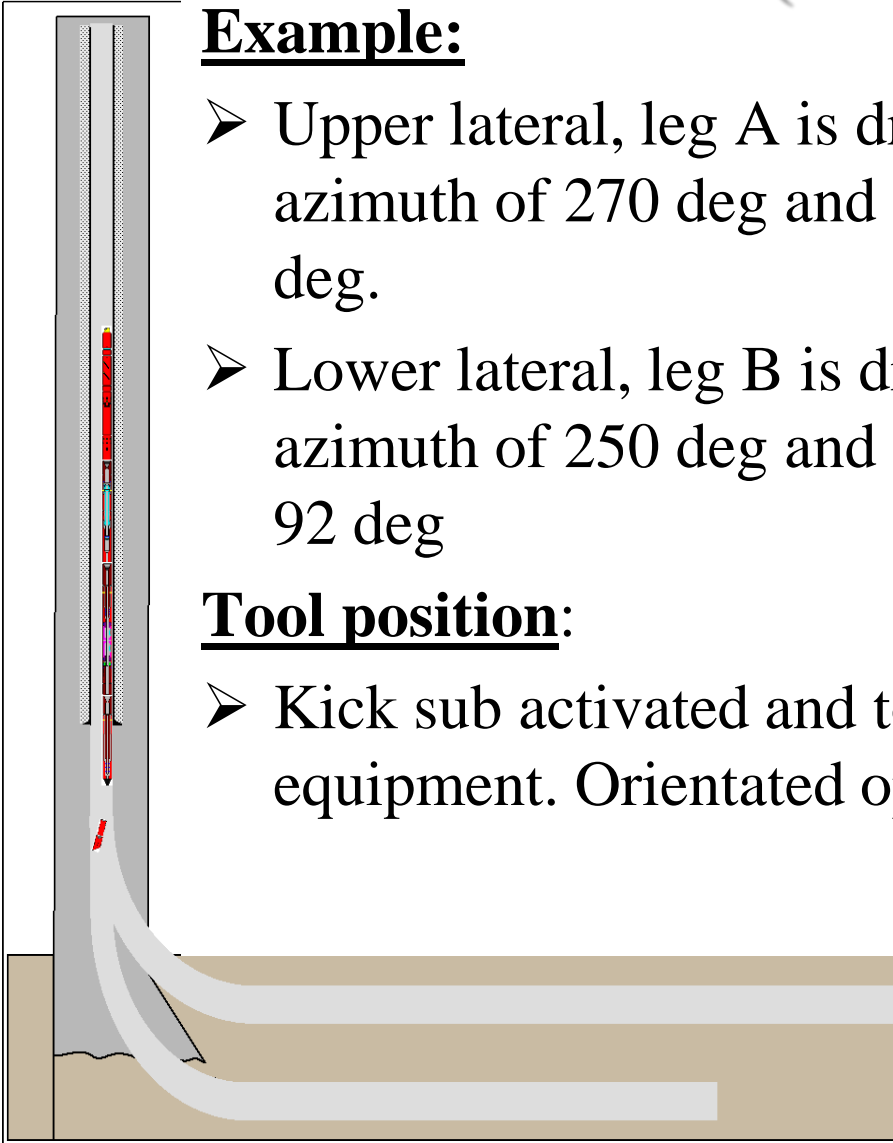
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Tool position:

- Kick sub activated and tool orientation provided by survey equipment. Orientated opposite the desired 270 deg.



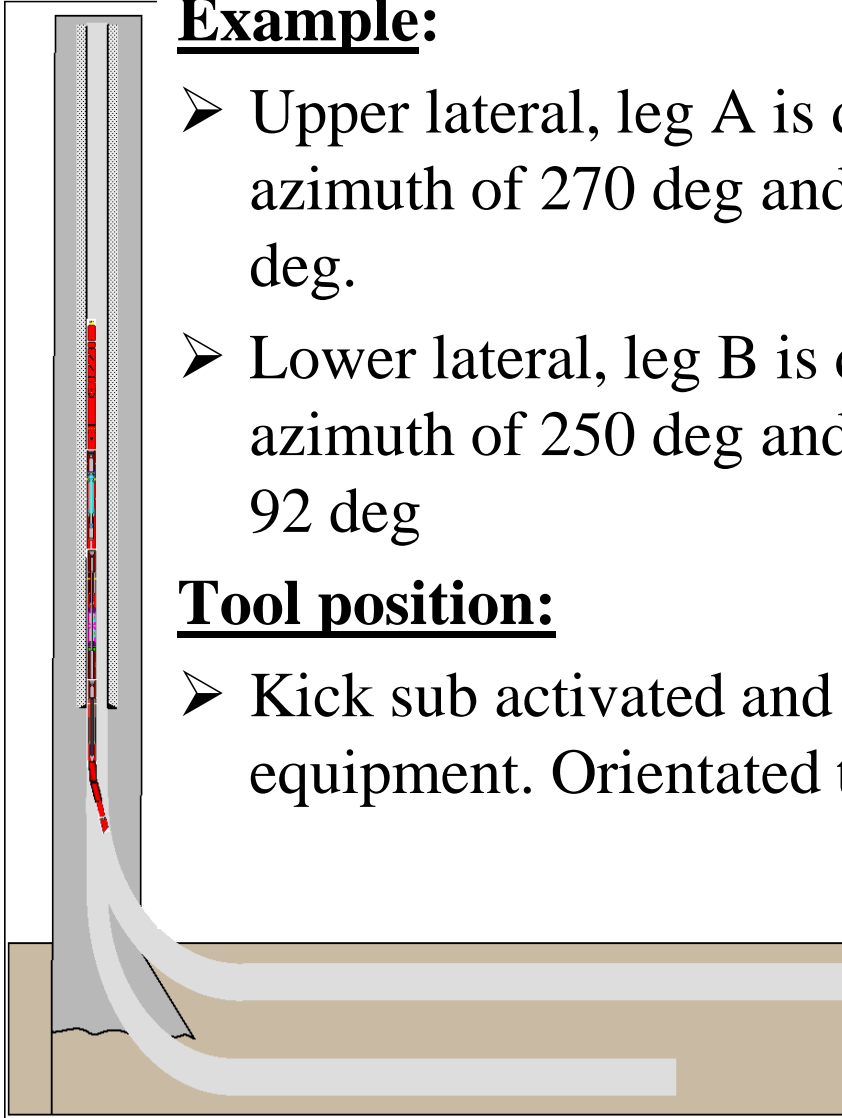
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Tool position:

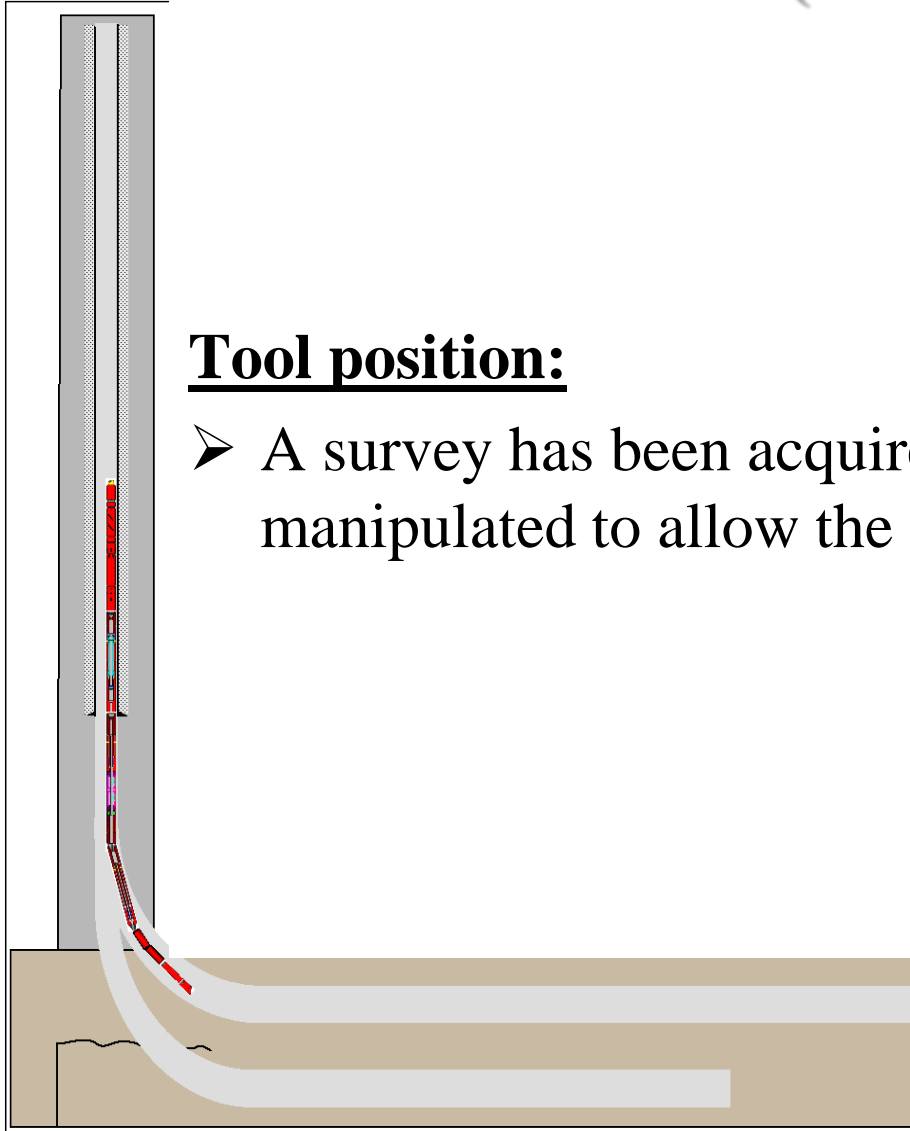
- Kick sub activated and tool orientation provided by survey equipment. Orientated to the direction of leg A.



Evolution - Lateral Guidance Positioning System (LGPS)

Tool position:

- A survey has been acquired and the tool string has been manipulated to allow the target lateral to be entered.



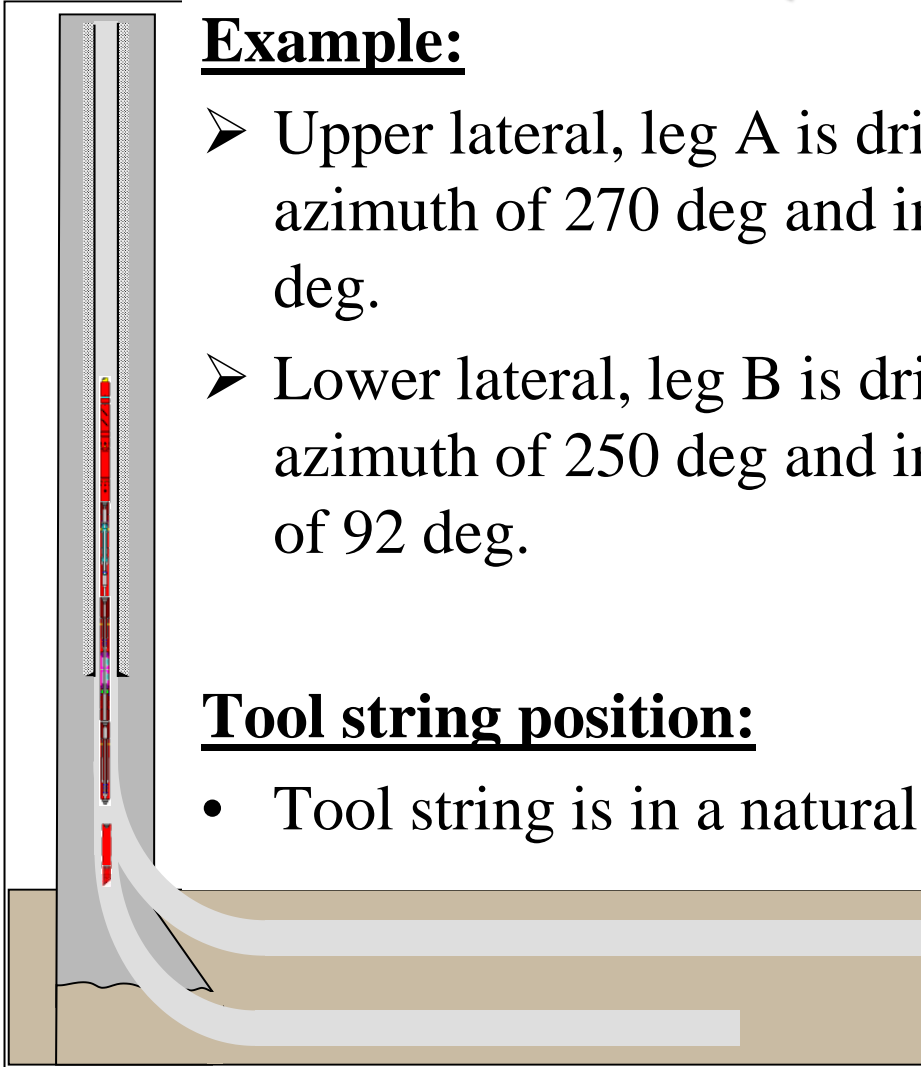
Evolution - Lateral Guidance Positioning System (LGPS)

Example:

- Upper lateral, leg A is drilled to a depth of X with an azimuth of 270 deg and inclination through the lateral of 88 deg.
- Lower lateral, leg B is drilled to a depth of Y with an azimuth of 250 deg and inclination through out the lateral of 92 deg.

Tool string position:

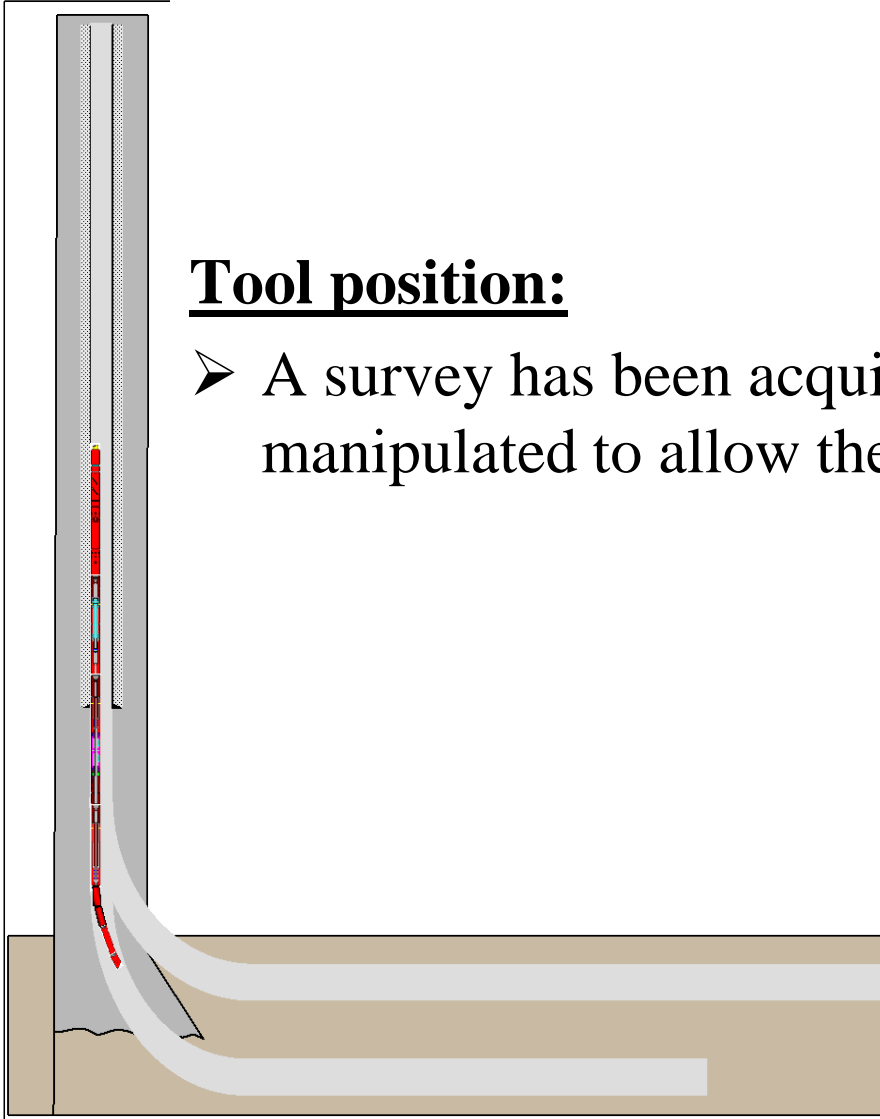
- Tool string is in a natural state in an attempt to enter leg B



Evolution - Lateral Guidance Positioning System (LGPS)

Tool position:

- A survey has been acquired and the tool string has been manipulated to allow the target lateral to be entered.



Conclusion

- Overall, jobs using the Lateral Entry System have been successful, improvement areas have been identified and acted on.
- The development of the Lateral Guidance Positioning System improves operational efficiencies which enables the use of today's intervention techniques in complex wellbores.
 - Still in field trial stage. Testing has been completed.

Questions?