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COMPLETIONS

White Paper: Understanding Perforation Orientation in Real-Time

Oriented perforating is an increasingly adopted practice for new well completions. But how to ensure these perforations are correctly aligned? Impact Selector's Relative Bearing Tool focuses on downhole tool orientation and has an outstanding track record in identifying gun direction prior to shooting.

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Impact Selector's Relative Bearing Tool (RBT) is a sub-module of its Reel-Time Data Series™ CO2evoidance™ solution platform. The RBT is a new level of diagnostic technology for the evaluation of all elements of oriented perforation.

The Reel-Time Data Series platform is designed to be the most efficient, straightforward, robust, capable, and scalable host, for an array of sensors that are combinable with ballistic services and allow for the real time determination of equipment performance and wellbore/formation diagnostics. Currently the Platform is capable of real-time head tension, compression, inclination, orientation, shock, temperature, and pressure.

The RBT component of the platform focuses on much needed downhole tool orientation. It features ruggedized assembly of sensors that output discrete orthogonal components and derived roll and inclination computations. The system is enabled by a plug & play interface to the Warrior surface acquisition system, that requires no additional paneling or cabling.

During unconventional stage perforating, the RBT has shown that repeatable and predictable movements of perforating assemblies occur during the pumping down process. These result from consistent interactions between the wellbore and the pump-down assembly and are areas where perforation orientation has been shown to be more problematic and are also areas where operational risks are heightened.

Figure 1: Repeatable tool roll behavior on separate runs in the well

During unconventional resource stage perforating operations, the alignment of each gun (or cluster) is a significant parameter to understand.

In completions featuring advanced in-well technologies, such as permanent optical fiber, the alignment of each shot must be confirmed within a narrow window to avoid expensive hardware damage. The real-time RBT tool has been used by multiple operators for their 'Shoot-with-Confidence' applications and to date the service has a 100% record in correctly identifying gun direction prior to shooting.

Many other oriented perforating operations have simply assumed successful downhole orientation based upon a predetermined hardware configuration. These assumptions have been shown to be unsubstantiated from post perforating analyses using camera and other imaging technologies, including the RBT.

Using the RBT over the course of hundreds of runs, surprising trends have emerged in real-time, that have allowed operational changes to be made to improve orientation performance. The RBT has shown that as the number of clusters in a stage increases, there is a direct correlation to later cluster orientations becoming skewed and "off-target." In some cases, later cluster orientation accuracy was less than half as good as earlier clusters. Understanding this gun orientation parameter on a cluster-by-cluster basis, is an important benchmark for the subsequent evaluation of treatment performance.

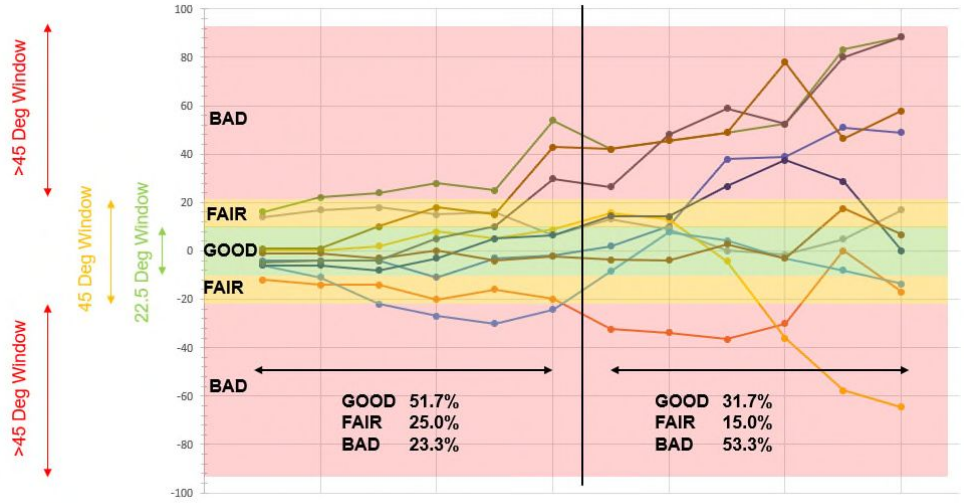

Figure 2: Individual cluster orientations show greater scatter in the latter half of stage perforating. This trend was observed across 100's of stages.

Impact Selector has developed the RBT Tool as an important technology within its Reel-Time Data Series and to further enhance its proprietary SMART Planner™ modeling package, that can further enable appropriate tool and gun configurations. Furthermore, Impact Selector's industry leading risk mitigation solutions, such as Spitfire® ballistic release tool and I-Wheel friction reduction solutions can be included to ensure success during oriented perforating and/or shoot with confidence results.

The simplicity of the Reel-Time Data Series, including the RBT allows for efficiency and ease of use throughout your operations, allowing you to reduce and avoid emissions as part of Impact Selector's CO2evoidance™ solutions. In conventional oil and gas applications the RBT has enabled safe and efficient oriented perforation, even in remote locations under lockdown restrictions, where the ease of training, setup, use, and success were fundamental to the operational planning and execution of a complex intervention.

For more information on the RBT, oriented perforating equipment solutions, SMART Planner™ Modeling, or the entire Reel-Time Data Series Platform, please contact Chris Morgan (chris.morgan@impactselector.com).