Valkyrie™ Abandonment System

Technical Summary

The *Valkyrie*™ abandonment system is part of a comprehensive well abandonment strategy that can help you safely and efficiently abandon a well. Using high-frequency hydraulic pulses, the tool vibrates free-hanging production tubing to consistently propagate cement around the annulus.

Cement samples tested in the lab have confirmed that pumping cement through the Valkyrie abandonment system improves its rheology, and this solution has been proven to provide higher quality cement bonds, minimizing channeling and microannulus development.

With the *Valkyrie* abandonment system, you can reduce the amount of pipe that must be retrieved from the well, create a positive environmental impact, and minimize costs without sacrificing the integrity of the abandoned well.

Benefits

- **Innovative design** – Based on our industry-leading *Agitator*™ systems that have been used more than 50,000 times around the world
- **Improved rheology** – Lab-tested and proven to improve cement rheology
- **Higher quality cement bonds** – Better propagation of cement, minimizing channeling and microannulus development

Technical Specifications

Tool size (OD)	3 ½ in.
Length	52 in.
Weight	114 lbs
Recommended mud weight	8-12 ppg
Recommended flow rate	110-210 gpm
Temperature range	150°-320°F
Operational frequency	7.7 Hz @ 210 gpm
Pressure rating (static)	10,000 psi
Operational pressure drop generated	300-750 psi
Stator/sub makeup torque (@62.5% of yield)	6,060 ft-lbs
Max tensile	190,800 lbs
Rig connections	2 ⅜ in. API Reg
Rig connections makeup torque (@62.5% of yield)	5,300 ft-lbs
Rotor type	Chrome plate

NOV Wellbore Technologies

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Proof of Performance

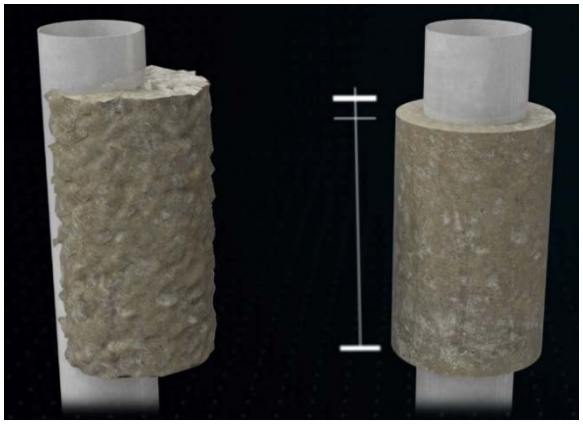
NOV *Valkyrie*™ abandonment system deployed successfully across broad set of North Sea P&As

Challenge:

Leaving as much of a well's architecture in place during a permanent P&A yields the most cost effective abandonment. Pulling tubulars is time consuming and expensive, as it typically requires a rig. Effectively cementing annular areas within tubulars in the well is therefore desirable. Well deviation, however, will often preclude cementing as an option because the inner string will often lay to the low-side and prevent an effective barrier from being set.

NOV Solution:

The *Valkyrie* abandonment system is set via wireline at the end of tubing through a specially designed packer anchoring system. Bullheading cement through the tubing string creates both axial and radial acceleration that helps centralize the tubing, providing an effective barrier of approximately 84% of the total volume of cement pumped. In addition to centralization, the *Valkyrie* system's axial oscillation has lead to better cement properties when analyzed against cement not set with the *Valkyrie* method.

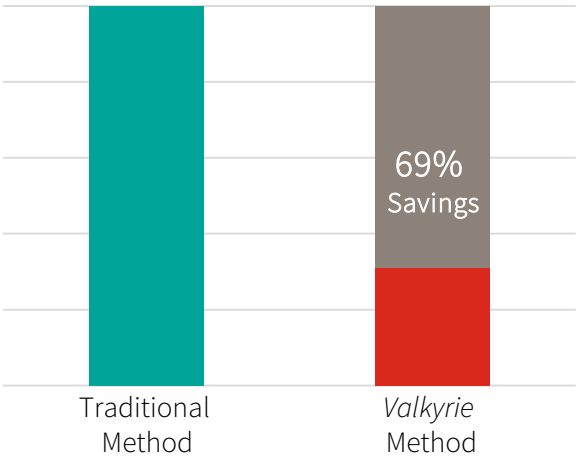


Traditional Method | *Valkyrie* Method

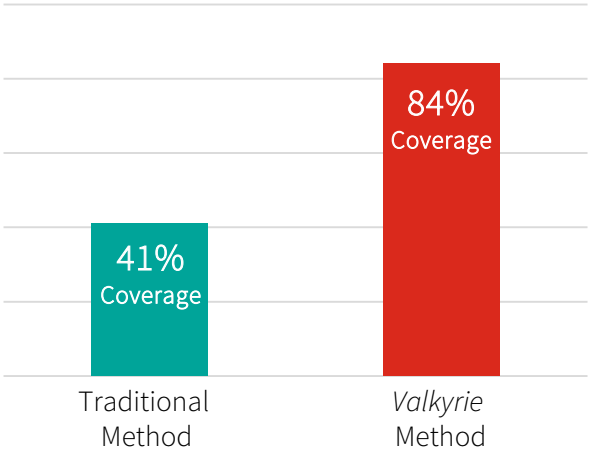
Results:

- Successfully abandoned an entire platform of wells for a major operator in the North Sea
- Eliminated the need to remove over 10,000 feet of tubular from those wellbores

Operational Cost



Cement Bond/Coverage



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