P & A Workshop

Dual String Section Mill (DSSM)
Used in Conjunction with Innovative Technology for more Effective Well Abandonment

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June 9, 2011
In recent years plug and abandonment (P&A) technologies are receiving greater attention around the world as more and more fields reach the end of their productive life. Permanent P&A is done with the objective of the well being sealed and isolated forever. This long term sealing requirement is one of the principle parameters to measure the success of abandonment.

Several operators mainly in the North Sea sector would like to have the capability to section mill both inner and outer casing strings thus allowing cement plugs to be set across the formation for a permanent Rock to Rock barrier.

Various methods have been used to section mill dual casing strings either one string at the time or both at the same time with results ranging from costly multiple trips to total failures.
Project Scope & Design Goals

- Develop a milling system that permits the removal of two strings of casing 7” 32# inside 9-5/8” 47# with only one full trip into and out of the well. Other casing combinations are also a consideration.

- The system may require multiple tools or subsystems.

- If milling of both strings in one trip proves not feasible, milling of the inner string on one trip and then milling of outer string on the next trip could be accepted.

- Capable of handling flow rates to operate tool and clean hole.
Project Scope & Design Goals

- Objective is to mill up to 100m (330ft) section of 7" and 9-5/8" preferably achieved during one trip in and out of hole.
- Reach of blades shall be sufficiently large enough to mill casing couplings of 7" & 9 5/8"
- DSSM will have integral stabilizer to drift ID of 7" & 9-5/8" casing string.
- Work in highly deviated wells
- Future additional sizes 9-5/8" inside 13-3/8"
Why DSSM - Benefits

- Safety
  - Eliminate/minimize trips and BHA handling

- Cost Savings
  - Reduced trips, One trip removal of longer outer string was not achievable prior to new concept
  - Two stages with 17” per stage of full gauge blades
  - New concept design is to removal of up to 100m section of 7” & 9-5/8” casing

- Design
  - All body stages are interchangeable
DSSM BHA Basic Schematic for Dual Strings in One Trip

9-5/8” Stage 1 Casing Radial Cutout & Downhole Milling Window Tool

7” Stage 1 Casing Radial Cutout & Downhole Milling Window Tool

7” Stage 2 Downhole Section Mill

7” Stage 3 Downhole Section Mill

9-5/8” Stage 2 Downhole Section Mill

9-5/8” Stage 3 Downhole Section Mill

7” Casing

9-5/8” Casing

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DSSM BHA Basic Schematic for Single String

- 9-5/8" Stage 1 Casing Radial Cutout & Downhole Milling Window Tool
- 9-5/8" Stage 2 Downhole Section Mill
- 9-5/8" Stage 3 Downhole Section Mill
- Drill Collars
- 7” Casing
- 9-5/8” Casing
- Optional Joint of DP
DSSM Design Concept

Stage 1 Cutout & Section Milling Setup

Stage 2 & 3 Section Milling Downhole Setup

Typical Section Mill Blade Length: 4-6 inch

DSSM Stage 1 Blade Length 4 inches
DSSM Stage 2 & 3 Blade Length: 17 inch of full gauge blades
Conventional mills would require several runs
DSSM Design Concept for 100 meters sections

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DSSM Operation Procedure for Inner Casing String

Steps:

1. Run DSSM BHA through inner casing (7”) with blades fully retracted.
3. When Stage 1 tools wears out, activate Stage 2 tool. Mill downward till stage 2 tool wears out.
4. Activate Stage 3 tool and mill down rest of the required casing length.
5. Trip out the tool. Blades will retract to entry into 7” casing.
DSSM Operation Procedure for Outer Casing String

Steps:

1. Run DSSM BHA into the section milled in casing (7”) blades fully retracted.
3. When Stage 1 tools wears out, activate Stage 2 tool. Mill downward till stage 2 tool wears out.
4. Activate Stage 3 tool and mill down rest of the required casing length.
5. Trip out of the hole. Blades will retract at the entry into 7” casing.
Smaller Running OD Enables Going Through

- Collapsed casing
- Severe dog leg
- Parted casing
The design concept of milling both strings at one time delayed due to additional design work to cover:
   1. The sweep required for dual string maximum eccentricity .
   2. The possibility of movement between the inner and outer string .

Patented Design

Engineering design, analysis and simulations complete

Prototype being manufactured for testing
Hydraulic Pulling & Jacking Unit

Design Capability

- Rigless
- Modular
- Small footprint / lightweight
- Maintain pulling capability
- Innovative
- Versatile & Flexible
- Quick mobilization
- Carry out many of the “intervention” operations traditionally carried out by drilling units and/or HWU
Innovative Technology for more Effective Well Abandonment

Hydraulic Pulling & Jacking Unit Capabilities

- Plug and Abandon Wells
- Set plugs & packers
- Slot Recovery
- Cut and Pull Tubing & Well Conductors
- Fishing operations
- Set Whipstock
- Perform Section Milling
- Repair Well Conductors
- Change Out Tubing / Completion Components
- Support Coiled Tubing and Well Diagnostics Operations, Wireline / Slickline
- Run Internal Casing and Tubing Patches
- Run and retrieve ESP’s
Innovative Technology for more Effective Well Abandonment

Gulf of Mexico Case Studies

1. Hurricane damaged platform leaning at 15 degrees, 10 live producing wells, 1 partially drilled conductor
299 days on location / 60 days under AFE / Cost Savings $6.7MM

2. Offshore platform, Gulf of Mexico, 10 well P&A and 1 well Intervention campaign
540 days on location / 108 days under AFE / Cost Savings $10.8MM

3. Offshore platform, Gulf of Mexico, 6 well P&A operations in 750’ water
450 days on location / Under AFE & Cost
Saving not available

4. Offshore platform, Gulf of Mexico
66 days on location / 24 days under AFE / Cost Savings $ 2.2MM
Thank You!

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Questions?

& Discussion

Thank You!