



The Challenges in Well Abandonment for the Dual Casing Section Milling (DCSM) in a Deviated Gas Well.

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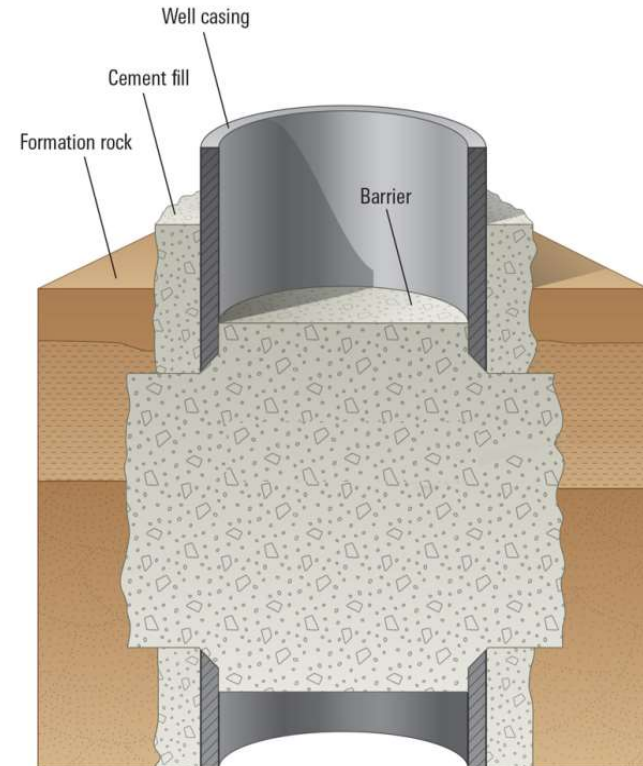
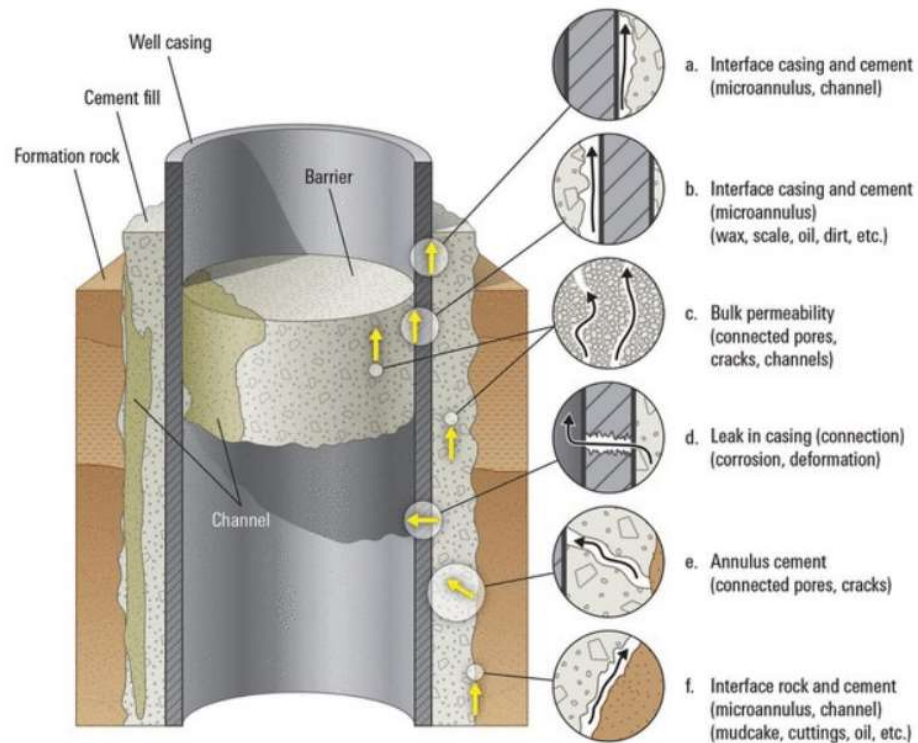
**SPE Aberdeen
Well Abandonment 2019**

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Agenda

- Overview
- Abandonment Scenario
- Conventional Vs DCSM Approach
- Challenges and Planning
- Benefits

Annular Cement Remediation Practices



Conventional Approach (Heavy Fishing Operation)



1. Cut and Pull Casing from Free Point

Dedicated Casing Cutter and Spear Run

2. Pilot Milling to desired Depth

Milling with Pilot mill using 9 5/8" Baracuda Mill (Multiple Trip)

3. Clean Out Trip

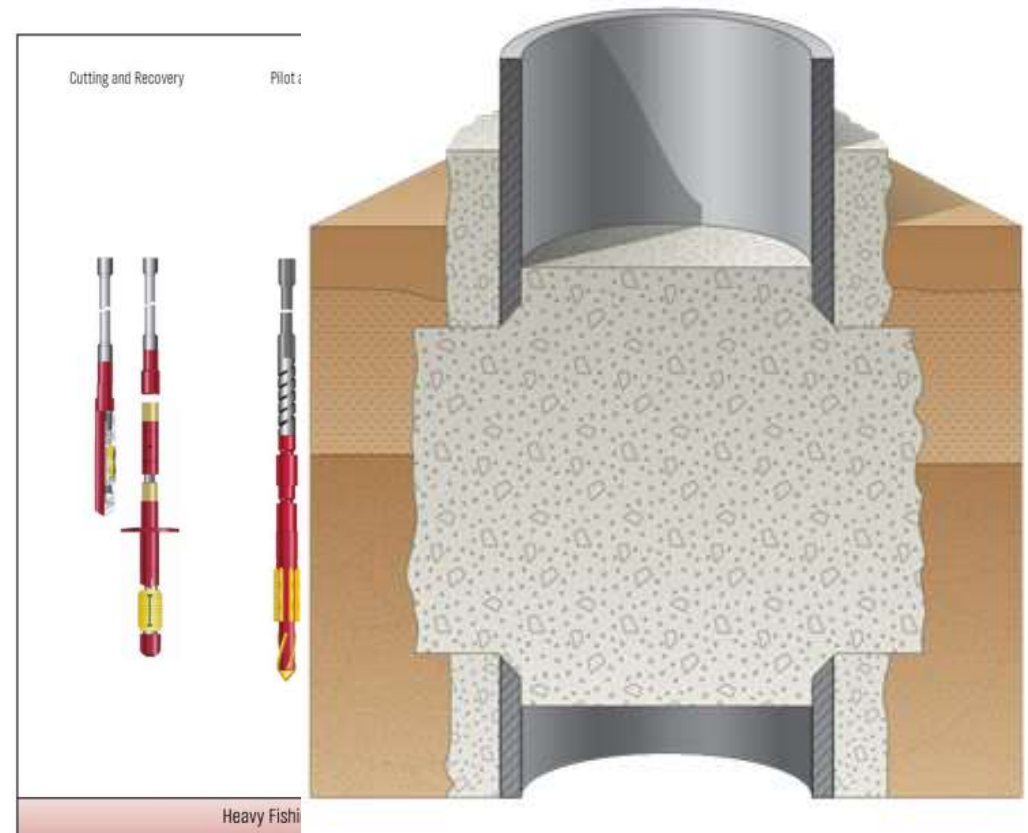
Due to Swarf, The Window is cleaned to minimize the possibility of being stuck

4. 13 3/8" Section Milling

Milling with outer Intermediate casing

5. Underream window

Remove excess cement and filtercake, and open hole to expose virgin formation to half an inch a side above the original wellbore size

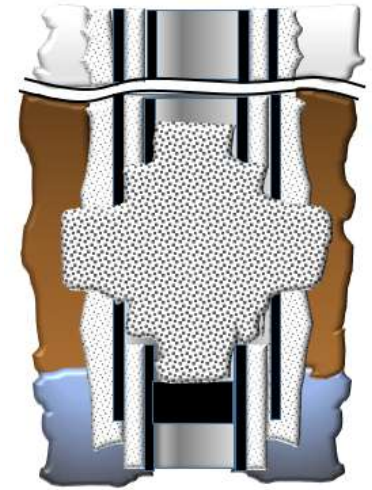
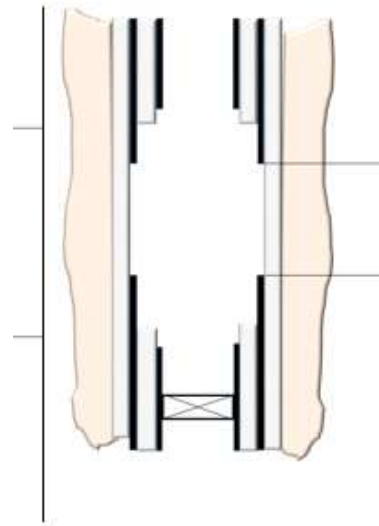
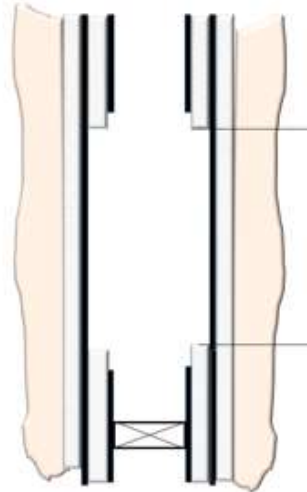
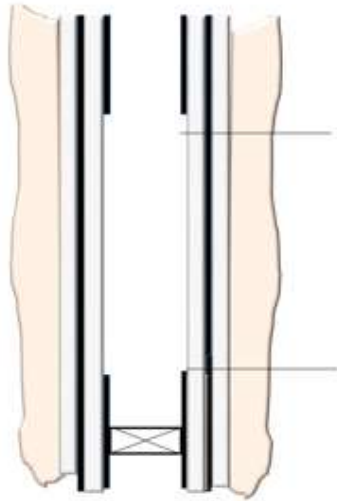
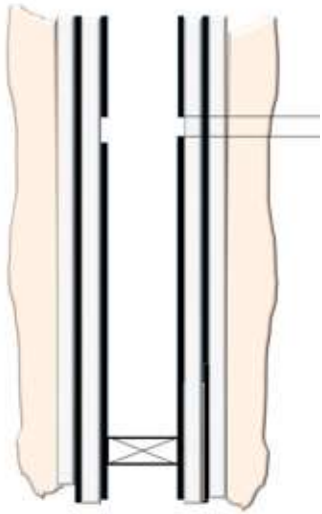


Dual Casing Section Mill.



Summary of Runs

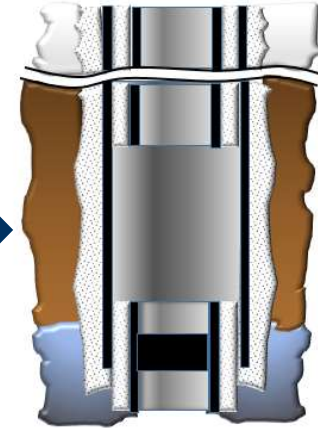
Run # 1	Runs # 2	Run # 3	Runs # 4	Run # 5
8250 Section Mill (K-Mill) w/ Rapid Cut Out Arms	8250 Section Mill (K-mill) w/ Flush Arms	8000 XTU @ 12.25"	Cut Out and Mill 13 3/8 Casing	Under-reamer (HRU) with 20" arms



Operation Sequence

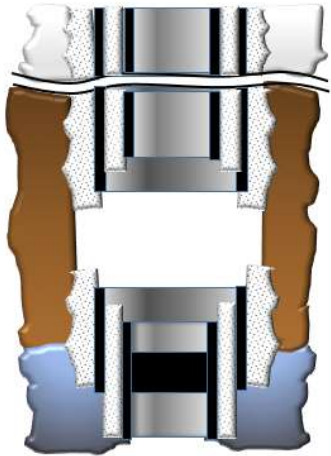
- Operation # 1 – Set Bridge Plug / Cement Plug
- Operation # 2 – Cut-Out into Inner Casing
- Operation # 3 – Mill Inner Casing Window
- Operation # 4 – Scrape Casing Cement with Under-reamer
- Operation # 5 – Clean Out

**9-5/8" Casing
Section
Milling Phase**



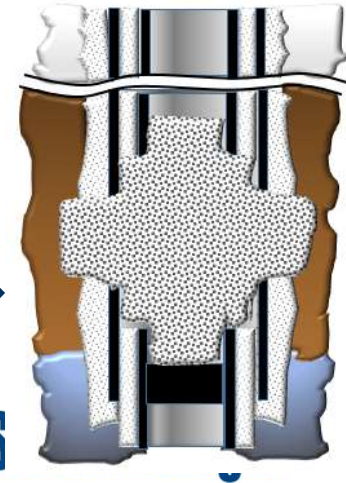
**13-3/8" Casing
Section
Milling Phase**

- Operation # 6 – Cut-Out into Outer Casing
- Operation # 7 – Mill Outer Casing Window
- Operation # 8 – Under-ream for final Plug
- Operation # 9 – Clean Out



Operation # 10 – Cement Plug and Abandon

**Cementing of
the Plug**



Evolution & Optimization of Remediation BHA with DCSM Approach

1. Section Milling 9 5/8" Casing

Small window of 9 5/8" Casing Milling (fewer Trips)

~~2. Pilot Milling to desired Depth~~

~~Milling with Pilot mill using 9 5/8" Baracuda Mill (Multiple Trip)~~

3. Clean Out Trip

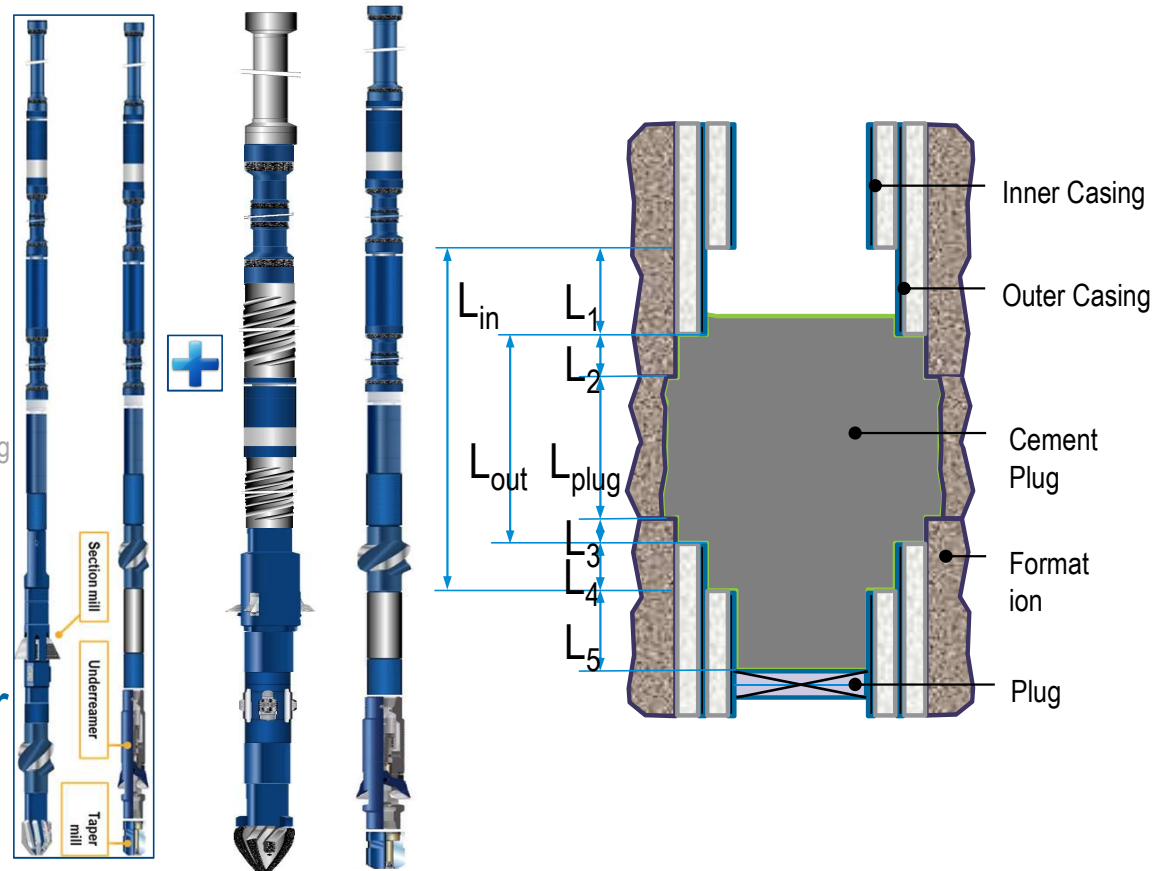
Due to Swarf, The Window is cleaned to minimize the possibility of being stuck

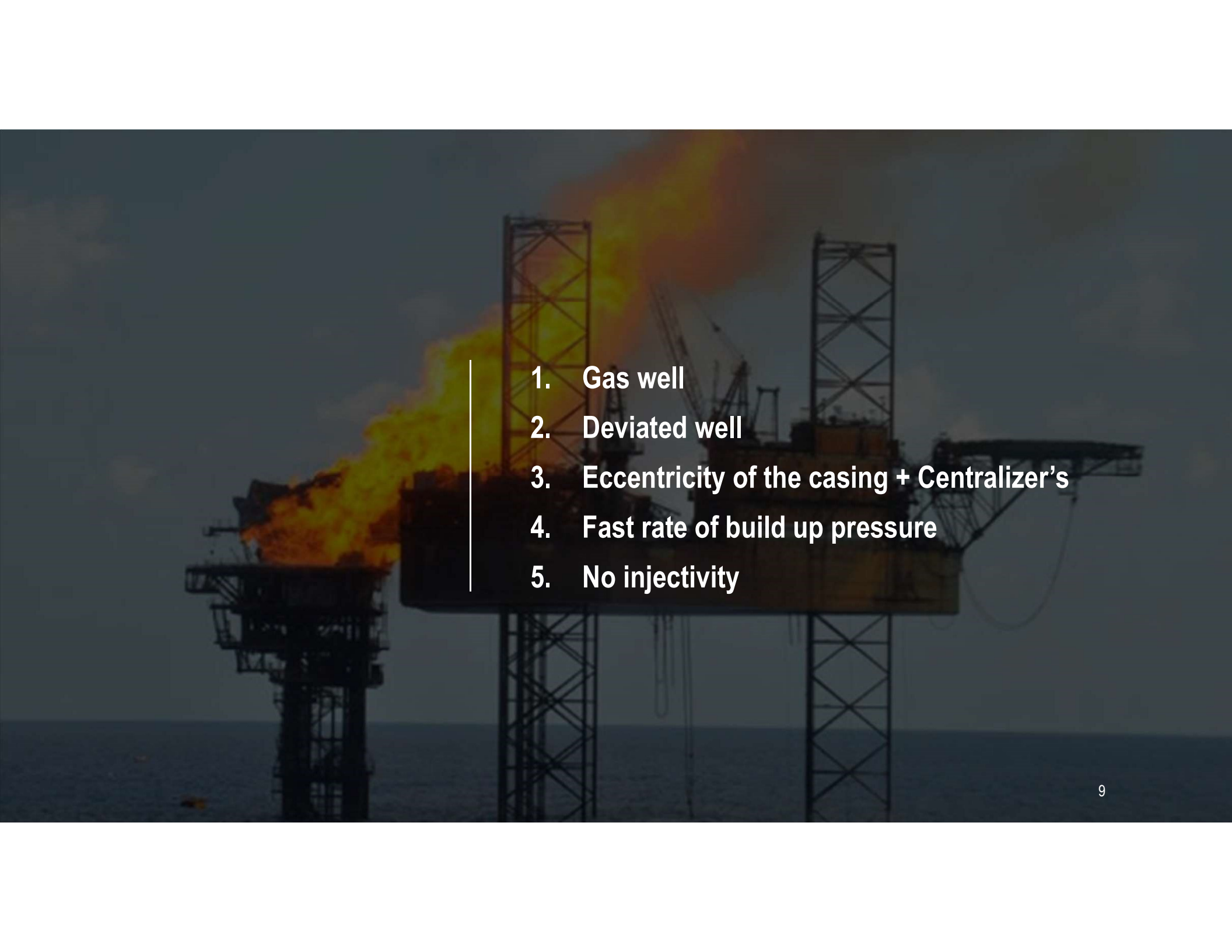
4. Dual Section Casing Milling

Milling with outer Intermediate casing

5. Underream with High Ratio reamer

Remove excess cement and filtercake, and open hole to expose virgin formation to half an inch a side above the original wellbore size



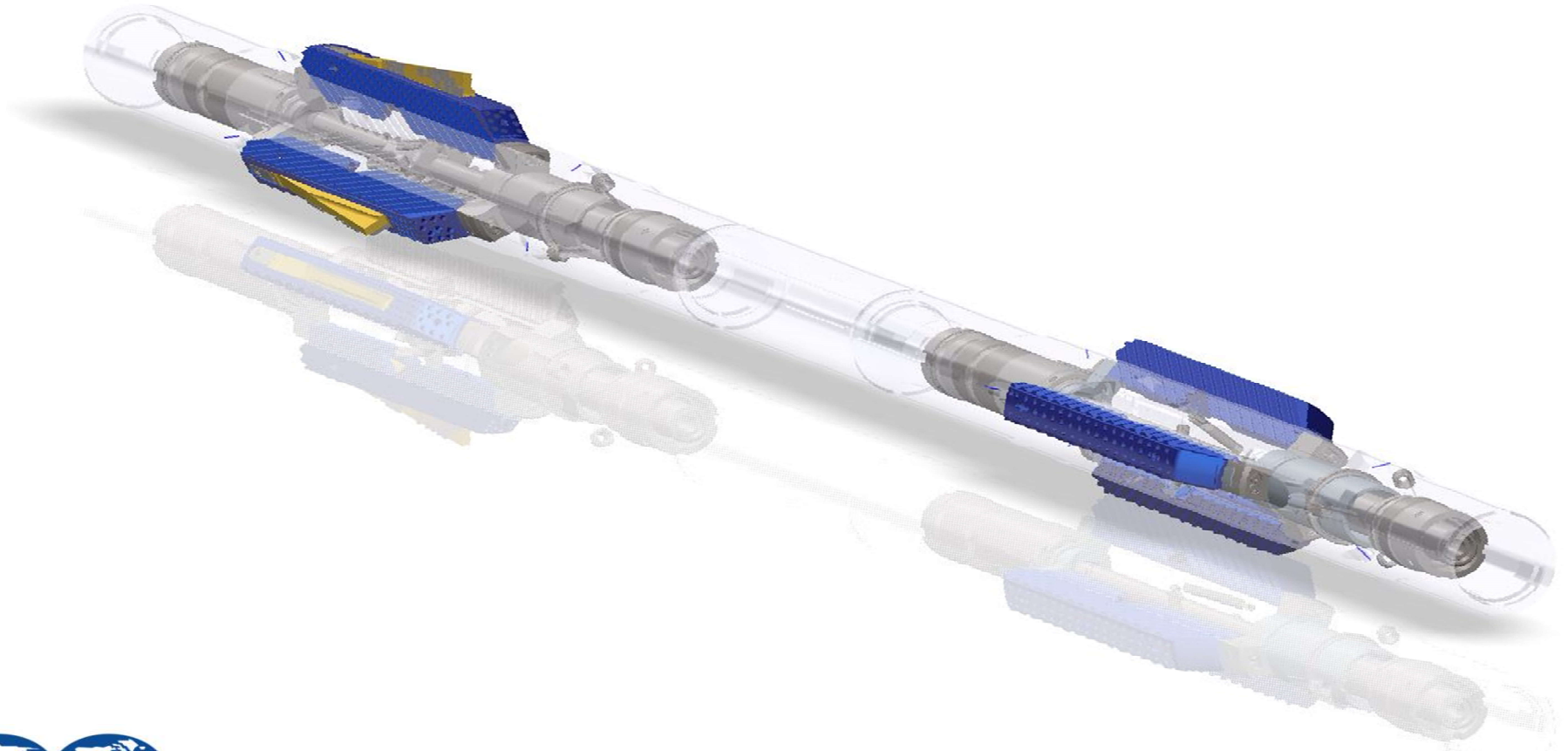
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- An offshore oil platform is shown against a dark, overcast sky. A large, bright orange and yellow flame is visible on the left side of the platform, likely from a flare. The platform's steel structure, including cranes and support legs, is silhouetted against the sky and the dark sea in the background.
1. Gas well
 2. Deviated well
 3. Eccentricity of the casing + Centralizer's
 4. Fast rate of build up pressure
 5. No injectivity



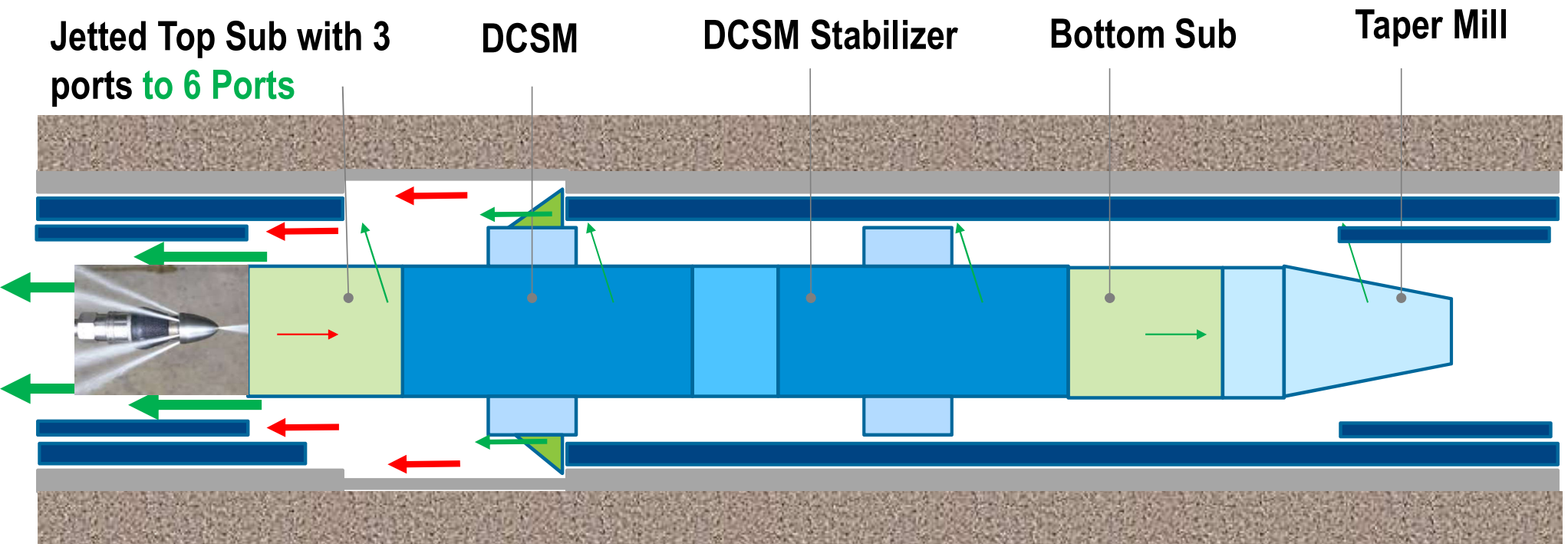
MAIN CHALLENGES ENCOUNTERED



Dual Casing Section Mill and Stabilizer



Hydraulics Optimization ($AV > 3000 \text{ ft/ Sec}$)



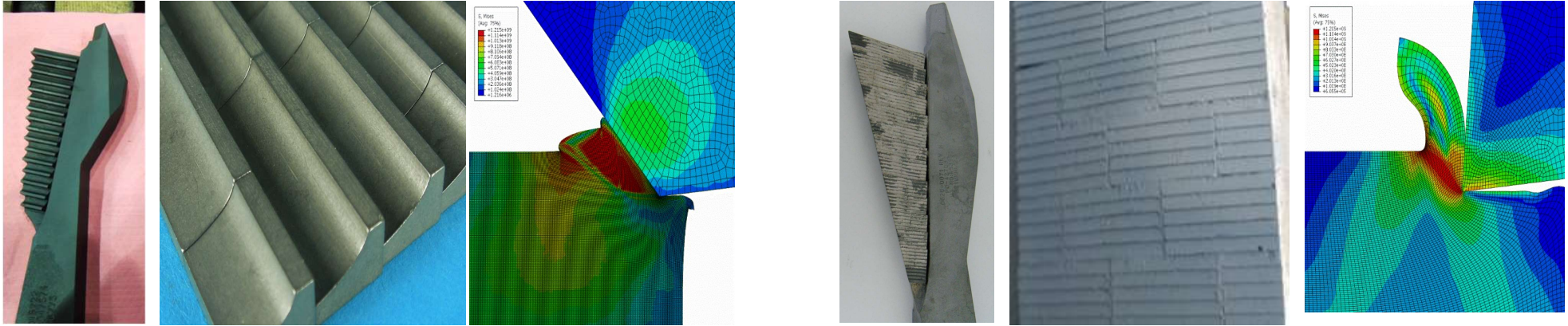
Reduced flow and high impingement zones make hole cleaning more challenging and require Hi-Viscosity Sweeps to clean. Higher flow Rate requirement need Jet Subs with 6 ports.

- Flow rate through the DCSM is limited to 300 GPM
- but Top Sub above the DCSM will divert additional flow of 400 GPM.

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Hole Cleaning via Knife Technology- Insert Shape, Knife Design , Cutting Charterstics



Insert Type	Footage	Comments
P5	32	<ul style="list-style-type: none"> Stopped due to surface inability to keep up with swarf. Control ROP
Wave Edge	83	<ul style="list-style-type: none"> Very Smooth Milling

Job Planning - iDRILL

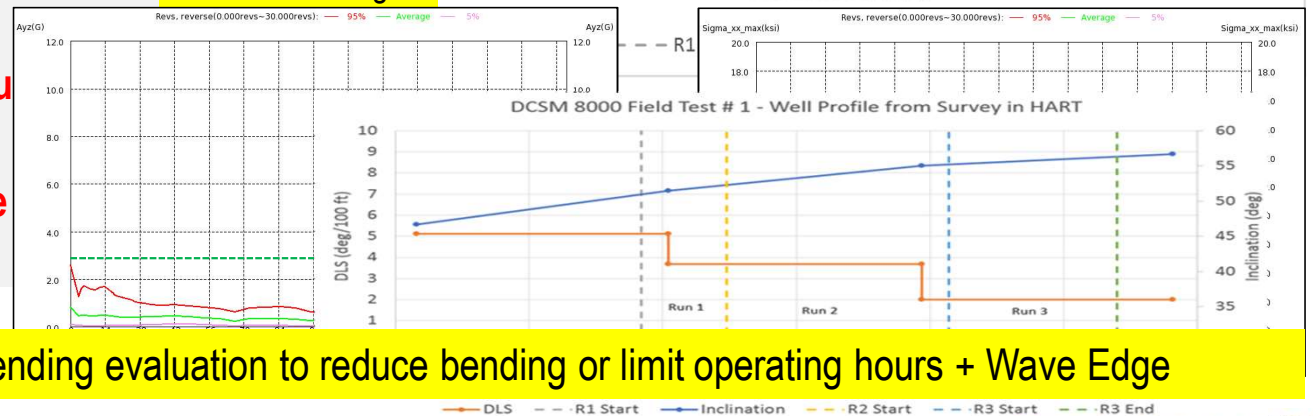
- IDEAS Integrated Dynamic Modelling system enables validation of job procedures for section milling and underreaming
- Parameter Roadmaps for improved performance, critical for higher ratio tools

- **Critical Damage to extreme Torque**
- **Tools found to be damaged Why?**

WOB 5klbs
RPM 60

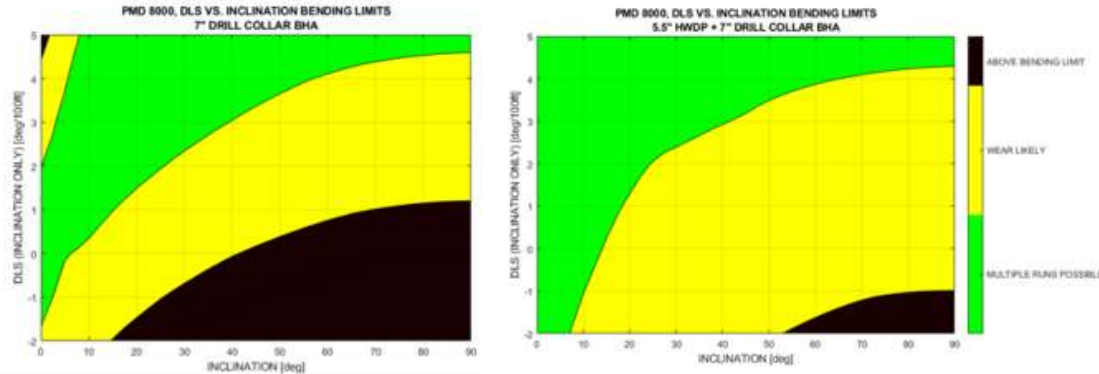
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Pre Job Bending



This iDrill analysis will now include Bending evaluation to reduce bending or limit operating hours + Wave Edge

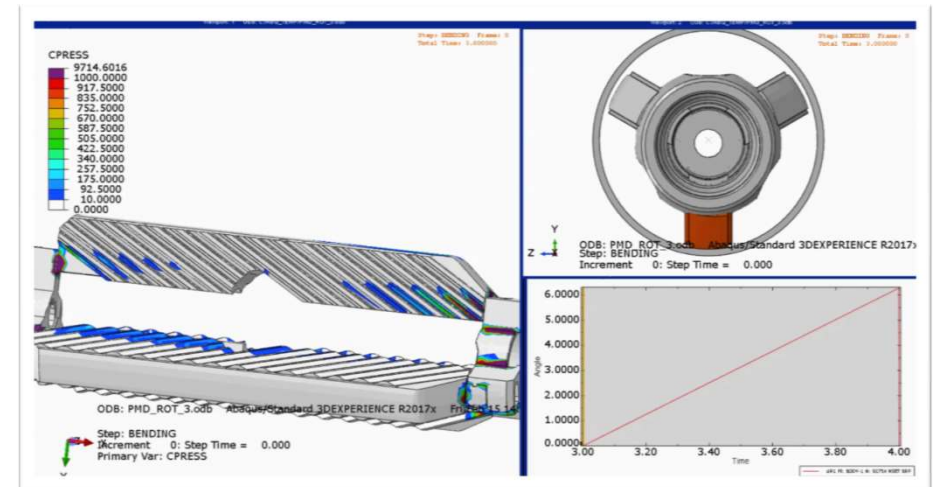
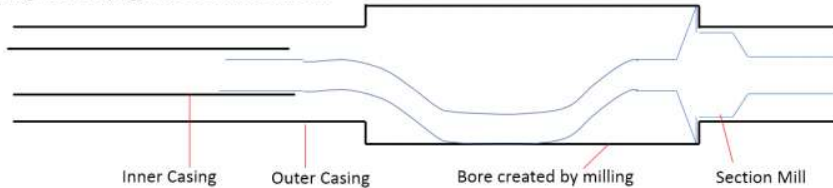
BHA Planning based on Well Profile



Building DLS bends with the tool string and lowers bending moment at the mill (changes contact points)

High inclination with low or dropping DLS is the worst case for bending

Bending due to laying in the sectioned window



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13 3/8" Casing Skimming

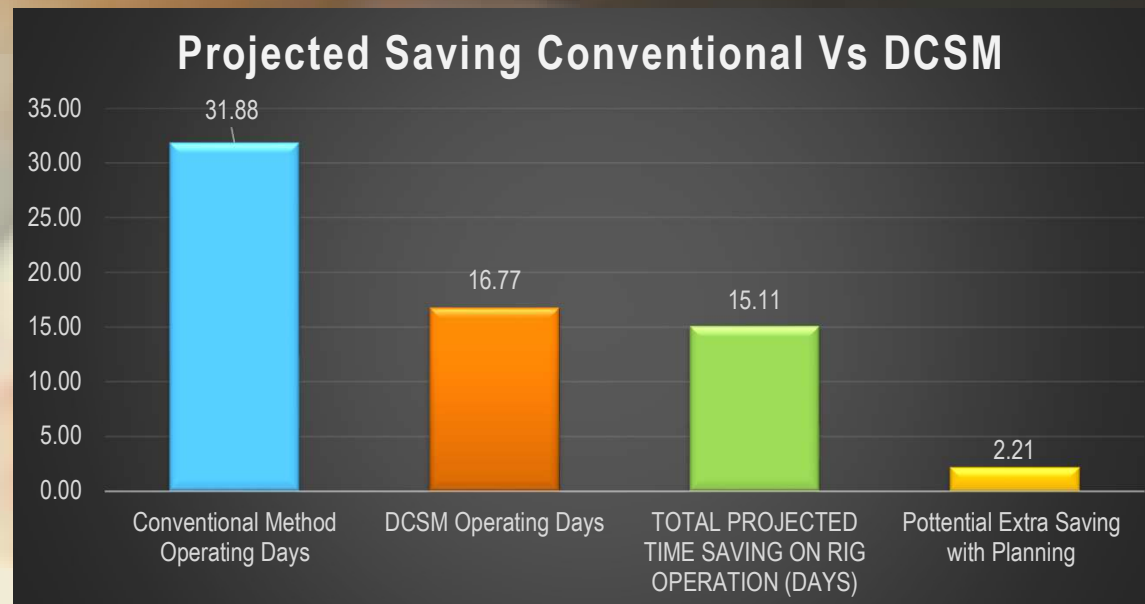


- 9 5/8" Lying on low side of well (Eccentric in nature)
- No cement in between the casing

Eccentric Casing		Inches
A	Section Mill Knife OD	11.75"
B	Clearance between 9 5/8" and 13 3/8"	0.5"
C	Clearance of BHA inside 9 5/8	0.255"
D	Total Skimming using 11.75" Knives	0.3075"
E	Total Skimming using 11" Knives	-0.07"

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Projected Saving 15.1 Days with Potential saving of 2.21 Days



- ❖ Efficiently section mill a 235-ft long window in 9-5/8" inner casing and 178-ft long window in 13-3/8" outer casing.
- ❖ 164-ft long final cement plug.

Conventional Method Operating Days	31.88
DCSM Operating Days	16.77
TOTAL PROJECTED TIME SAVING ON RIG OPERATION (DAYS)	15.11
Pottential Extra Saving with Planning	2.21

DCSM Sizes

6000 Dual Casing Mill

APPLICATIONS

- P&A operations

ADVANTAGES

- As part of the ProMILL® system, the Dual Casing Mill greatly improves efficiency and reduces cost in a dual string application by eliminating the need to mill up the inner string from the surface or top of cement, when a section needs to be milled in the outer casing for setting a cement plug.
- Multiple trips to mill up the inner casing are eliminated, due to the small drift of this tool and the high expansion ratio.
- A High Ratio Under-reamer can be run in the same trip as the Dual Casing Mill

CASING RANGE SUPPORTED

- Inner Casing - 7" (20.29 lb/ft)
- Outer Casing - 9-5/8" (43.0-53.5 lb/ft)

Dual Casing Mill

The Dual Casing Mill features a high expansion ratio (>85%) and is run in a separate trip with an Expandable Stabilizer to drift through a smaller casing (7") and mill a section in the outer casing (9-5/8").

DETAILS:

Tool Series:	6000
Opening Diameter:	11.37 in
Activation System:	No activation
Body OD:	6.00 in
Fishing Neck OD:	5.25 in
Fishing Neck Length:	12.9 in
Body Connections:	4 1/2 Reg Box x 4 1/2 Reg Box
Top Sub Connections:	TBC
Weight (Mill):	340 lb
Weight (including Stabilizer):	800 lb
Overall Length (Section Mill):	65 in
Overall Length (including Stabilizer):	154 in
Tool Tensile Yield Limit:	500,000 lb _f

*The tool is currently under development. Some of the values stated may change in the final design



8000 Dual Casing Mill

APPLICATIONS

- P&A operations

ADVANTAGES

- As part of the ProMILL® system, the ProMILL Duo greatly improves efficiency and reduces cost in a dual string application by eliminating the need to mill up the inner string from the surface or top of cement, when a section needs to be milled in the outer casing for setting a cement plug.
- Multiple trips to mill up the inner casing are eliminated, due to the small drift of this tool and the high expansion ratio.
- A High Ratio Under-reamer can be run in the same trip as ProMILL Duo.

CASING RANGE SUPPORTED

- Inner Casing - 9-5/8" (47.0/53.5SD lb/ft)
- Outer Casing - 13-3/8" (68.0-72.0 lb/ft)

Dual Casing Mill

The ProMILL Duo features a high expansion ratio (>85%) and is run in a separate trip with an Expandable Stabilizer to drift through a smaller casing (9-5/8") and mill a section in the outer casing (13-3/8").

DETAILS:

Tool Series:	8000
Opening Diameter:	15.7 in
Activation System:	Ball Drop Activation available
Body OD:	8.44 in
Fishing Neck OD:	7.75 in
Fishing Neck Length:	16 in
Body Connections:	6-5/8 Reg Box x 6-5/8 Reg Box
Top Sub Connections:	6-5/8 Reg Pin x 6-5/8 Reg Pin (NC50 Box Up also available)
Weight (Section Mill only):	891 lb
Weight (Mill BHA, including Stabilizer):	2,311 lb
Overall Length (Section Mill):	81 in
Overall Length (including Stabilizer):	210 in
Tool Tensile Yield Limit:	1,000,000 lb _f



Thankyou

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