



# Incident review on a major NPT event during casing makeup

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APRIL 12, 2024

# Contents

- ▶ A little bit about casing
- ▶ The Timeline of Dropped Casing
- ▶ Fishing operations
- ▶ Key Take-Aways

# Casing

First used to stop formations from collapsing into the wellbore



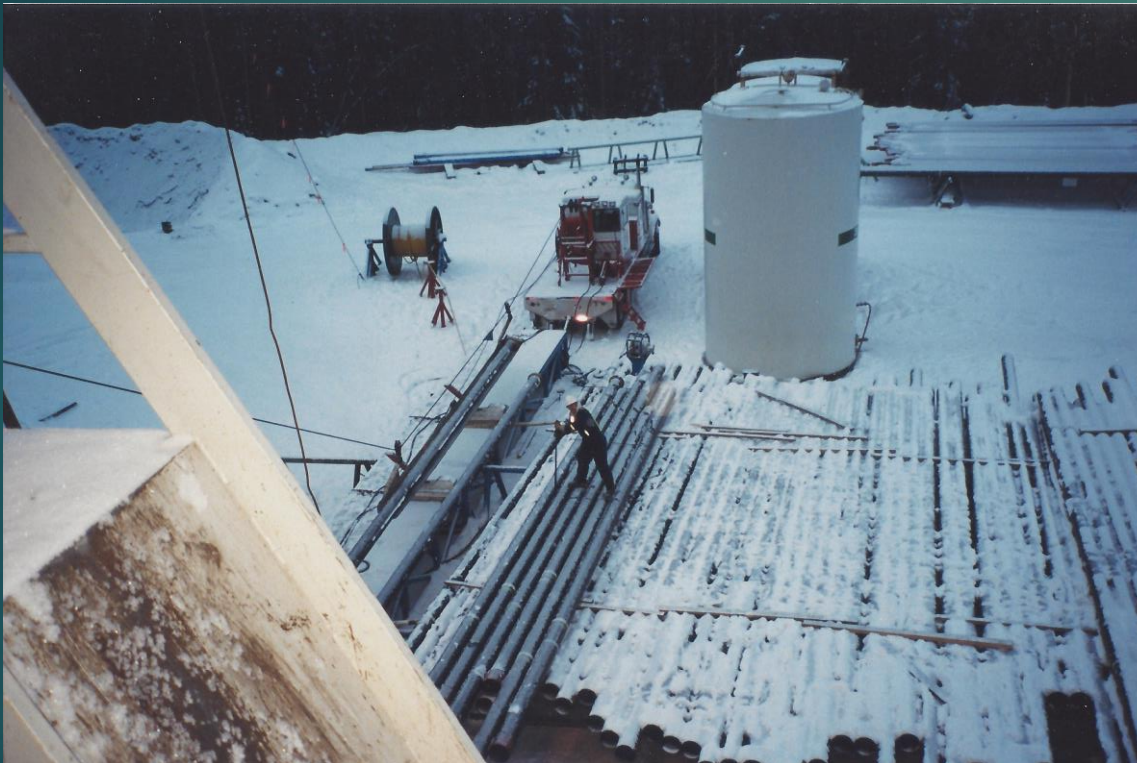
<http://history.alberta.ca/energyheritage/oil/the-leduc-era-1947-to-1970s/work-crews-on-the-oil-patch/default.aspx>



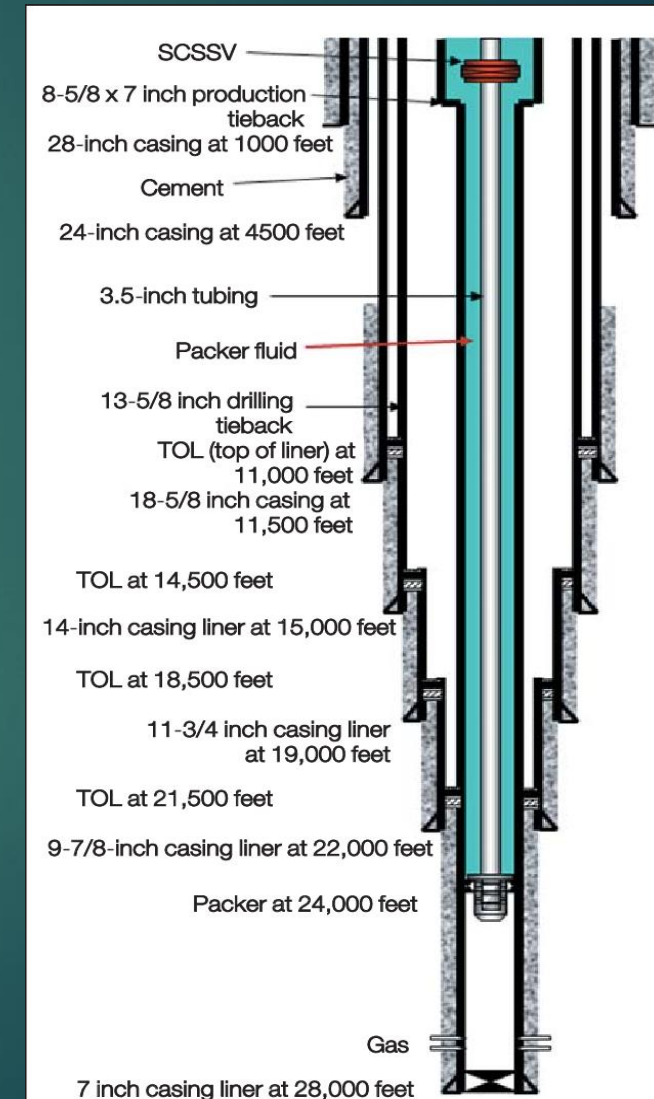
[http://www.sjvgeology.org/old\\_stuff/derricks.html](http://www.sjvgeology.org/old_stuff/derricks.html)

# Casing

Has evolved into its own discipline of engineering...



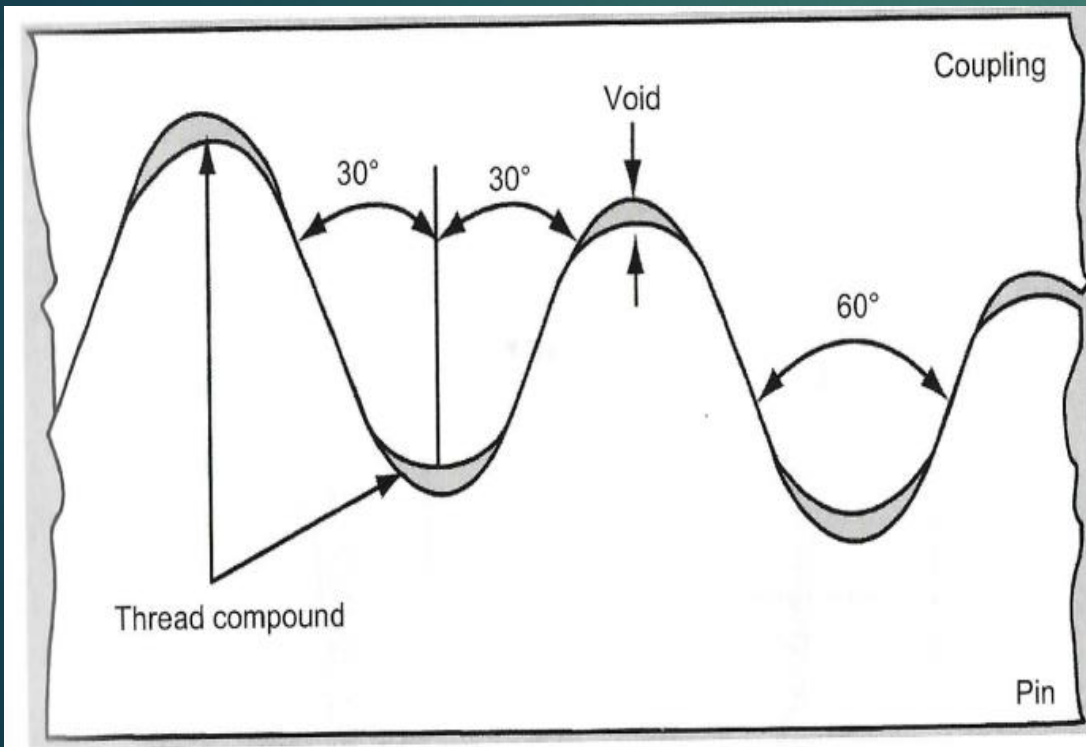
Incredibly good-looking rig hand, rolling 9 5/8" casing, Canada, circa 1999



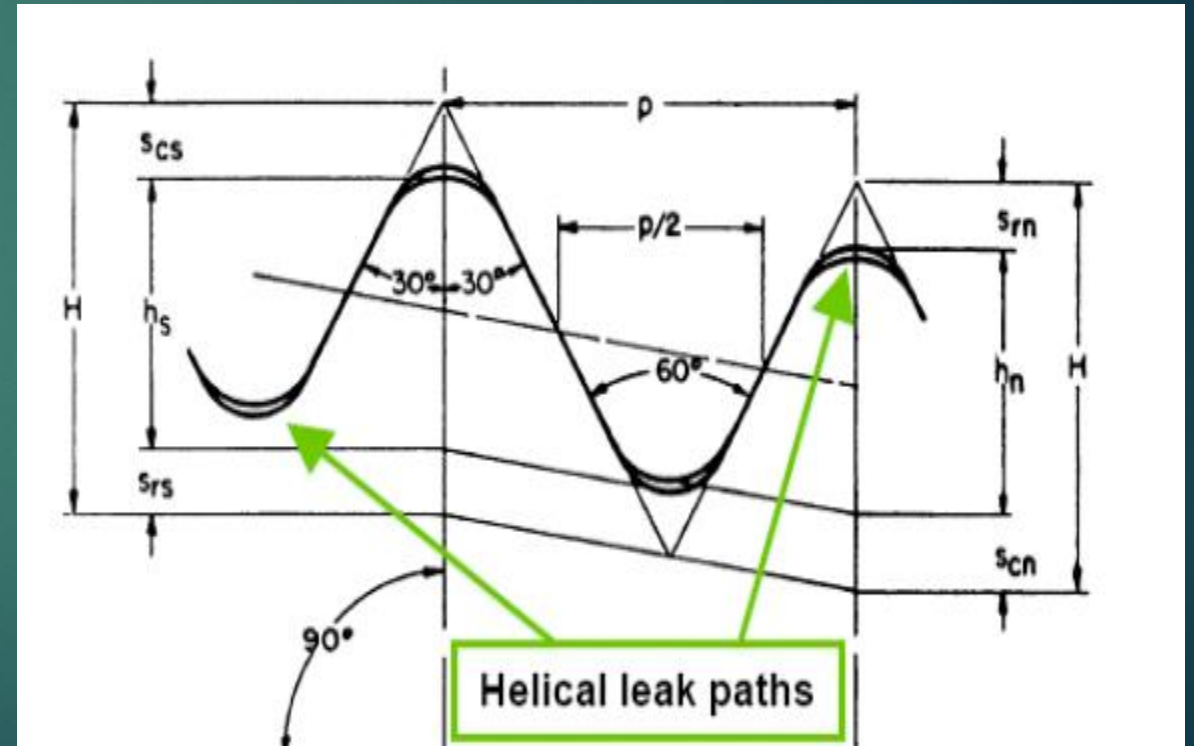
# Casing

Original old-school threads were only design to hold pipe together:

When subjected to high pressures, they leak!



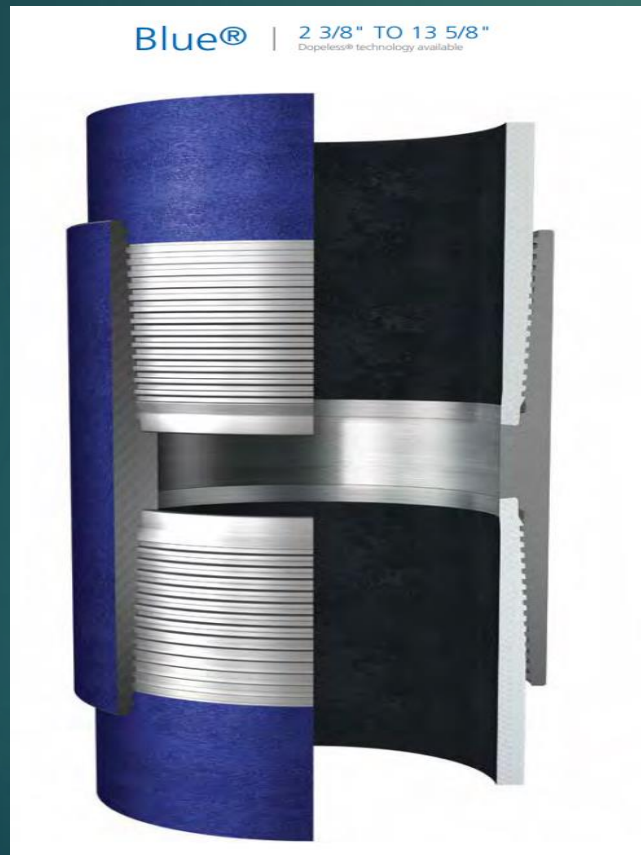
API Spec 5B (2008)



Bourne, D., Masters Thesis, Texas A&M, 2009

# Casing

“Premium” threads have been developed that are gas-tight and have a seal to maintain pressure integrity:



From Tenaris website: <https://dcp.tenaris.com/>



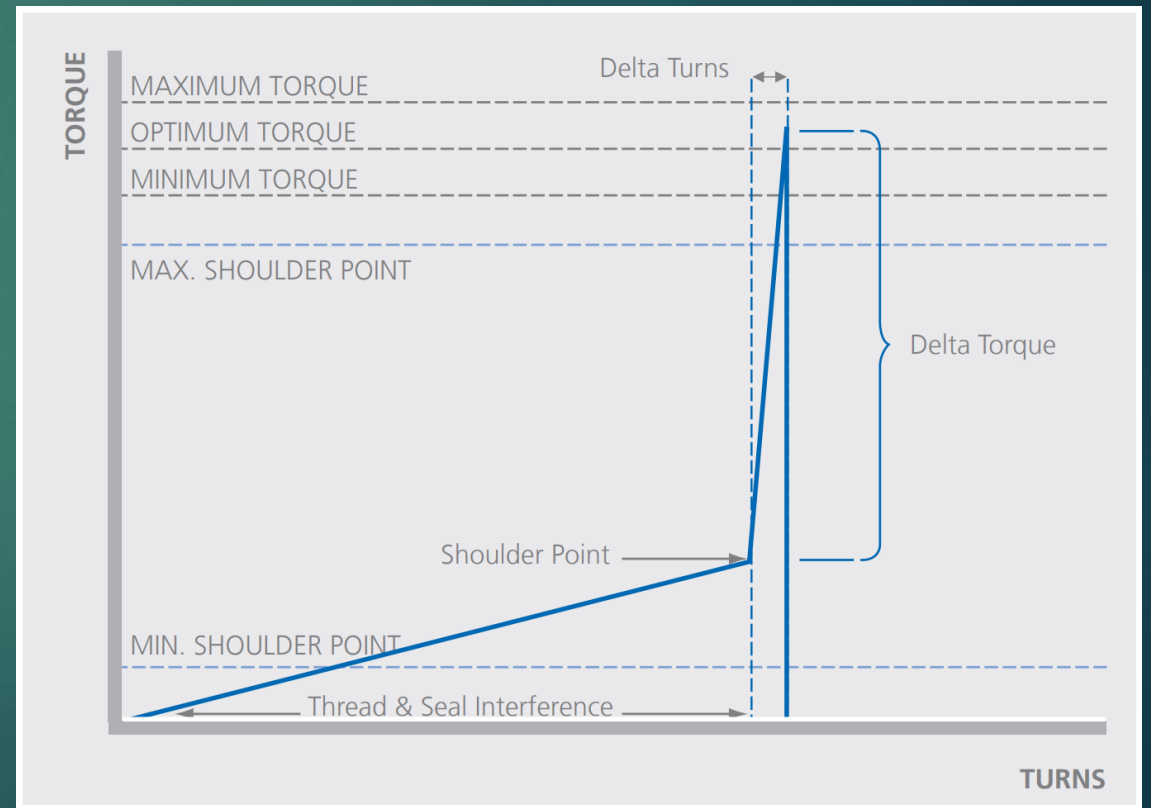
From VAM website: <https://solutions.vallourec.com/oil-gas/octg/products/connections/>

# Casing

“Premium” threads have two distinct torque profiles to be made up properly:

- 1) Thread Make up, and
- 2) Shoulder (Seal) engagement

This can be seen on a torque vs. turns chart:

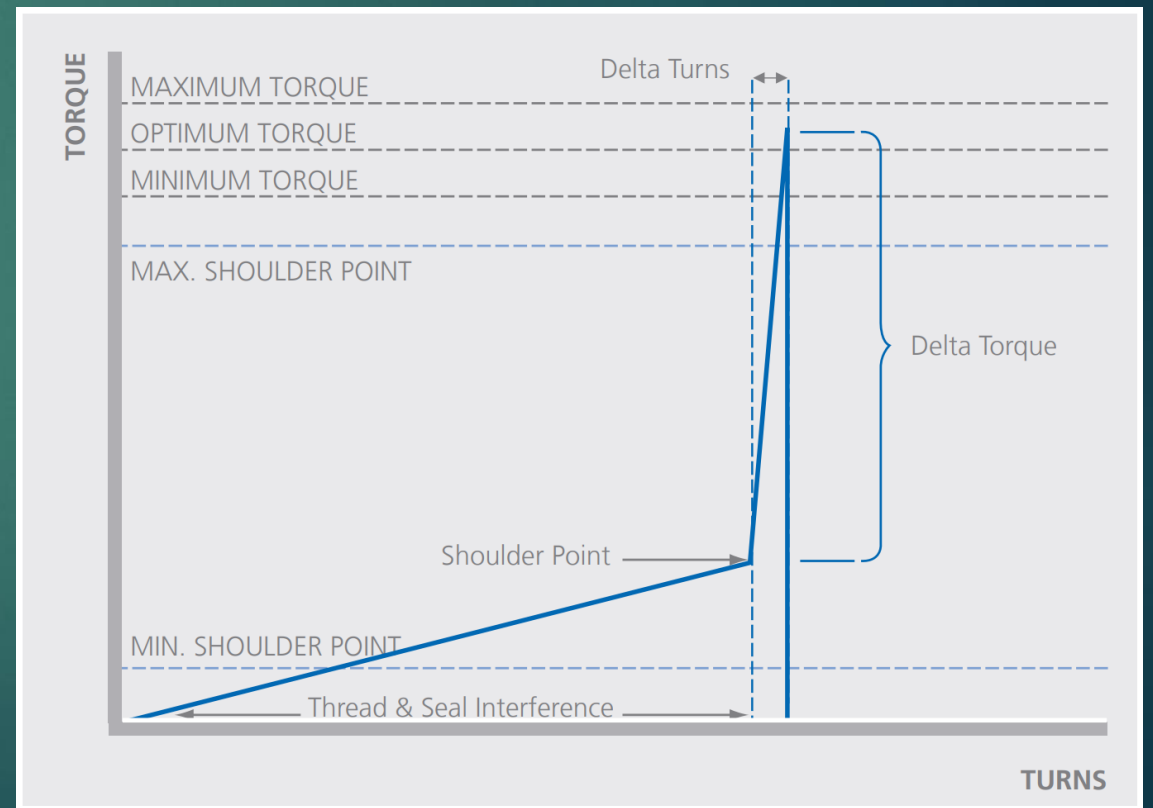


# Casing

Quick link to video of casing being made up:

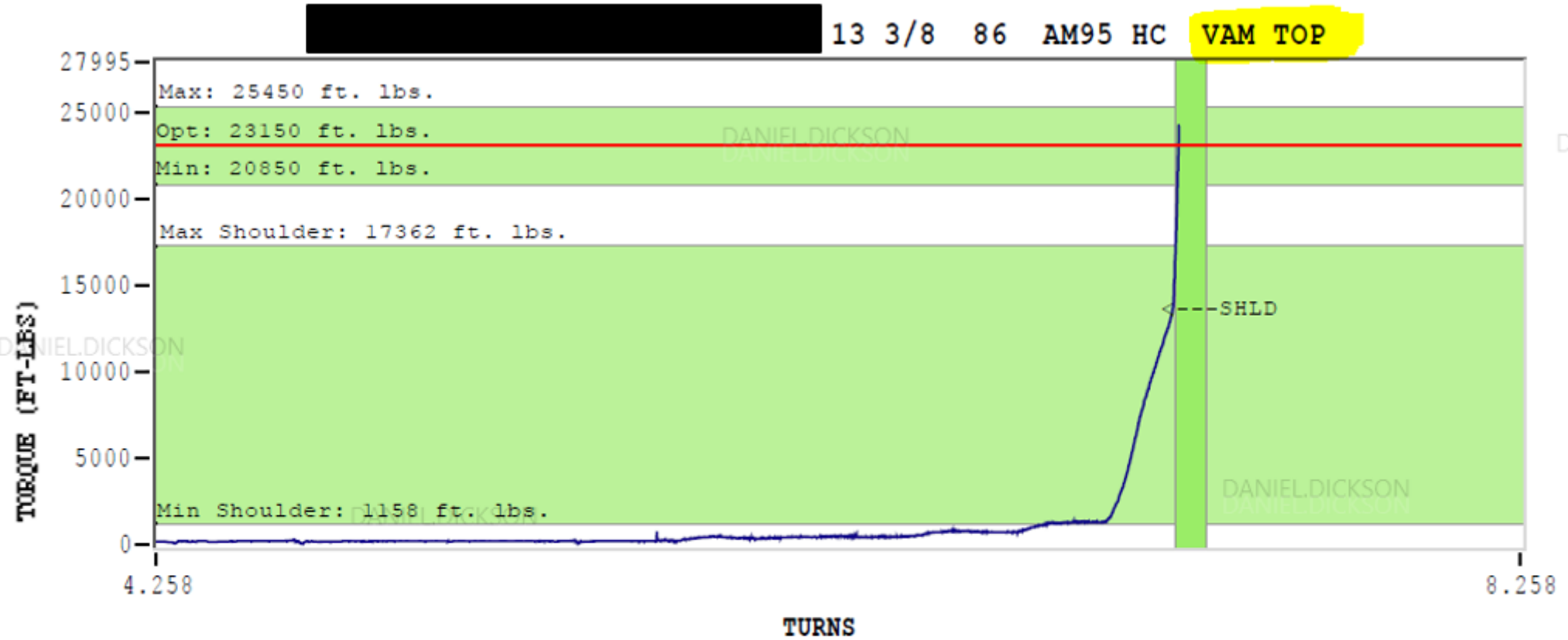
[https://youtu.be/67XesQLleyg?si=\\_H5af0xrra3RdgFg&t=508](https://youtu.be/67XesQLleyg?si=_H5af0xrra3RdgFg&t=508)

This can be seen on a torque vs. turns chart:





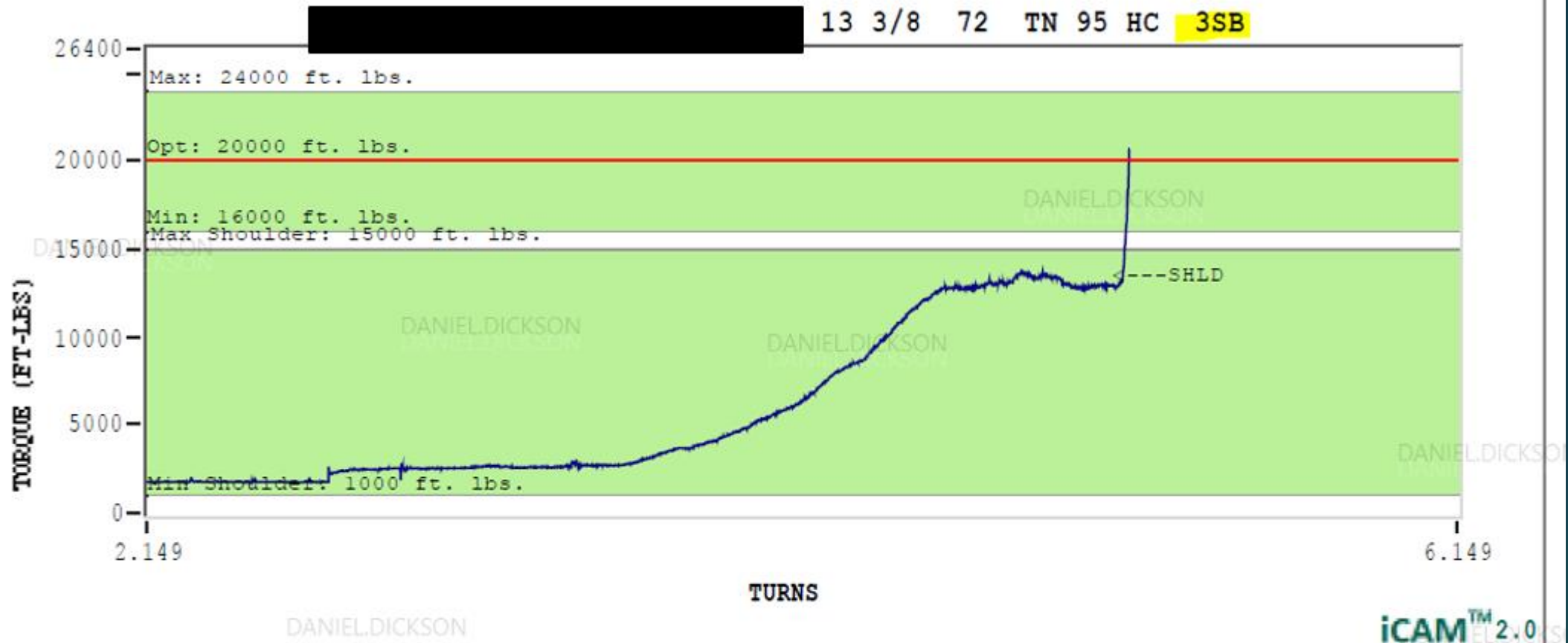
# Actual VAM TOP torque chart – perfect



iCAM™ 2.0

TIME OF MAKE UP :	06:05 AM	DATE OF MAKE UP :	06/JAN/2023
MAXIMUM TORQUE :	24331 FT-LBS	MAXIMUM TURNS :	7.258 TURNS
SHOULDER TORQUE :	13326 FT-LBS	SHOULDER TURNS :	7.236 TURNS
DELTA TORQUE :	11005 FT-LBS	DELTA TURNS :	0.022 TURNS
FILE NUMBER :	----->> 016	JOINT STATUS :	ACCEPT

# Joint 61 x 62 2<sup>nd</sup> attempt (Actual)



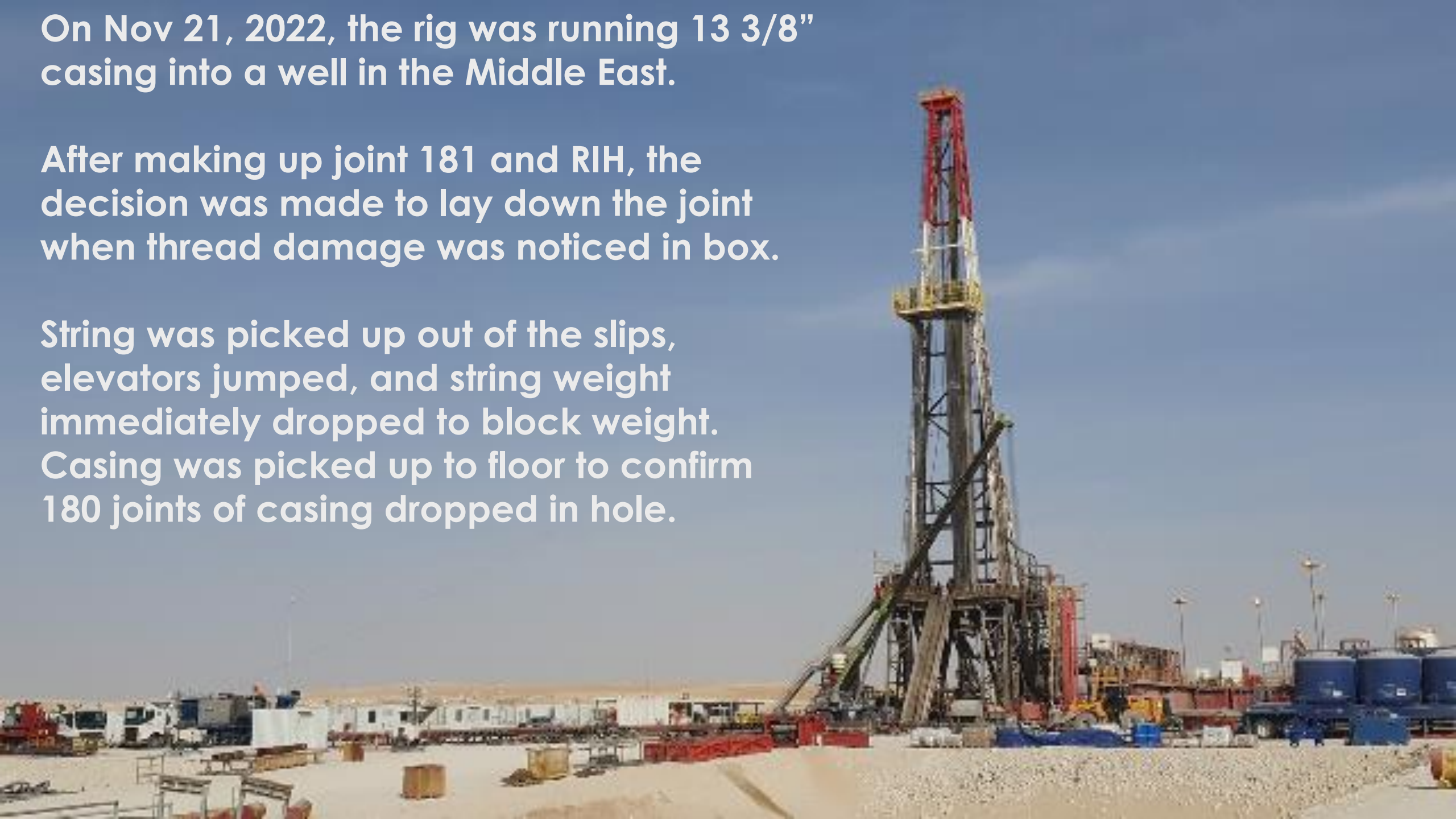
TIME OF MAKE UP :	05:10 PM	DATE OF MAKE UP :	06/JAN/2023
MAXIMUM TORQUE :	20687 FT-LBS	MAXIMUM TURNS :	5.149 TURNS
SHOULDER TORQUE :	13260 FT-LBS	SHOULDER TURNS :	5.127 TURNS
DELTA TORQUE :	7427 FT-LBS	DELTA TURNS :	0.022 TURNS
FILE NUMBER :	----->> 098	JOINT STATUS :	<b>REJECT</b>

TOP JOINT TALLY # 62; BOTTOM JOINT TALLY # 61; GENERAL COMMENTS: RE MAKUP ; CAM TECH INITIALS: HENDY

On Nov 21, 2022, the rig was running 13 3/8" casing into a well in the Middle East.

After making up joint 181 and RIH, the decision was made to lay down the joint when thread damage was noticed in box.

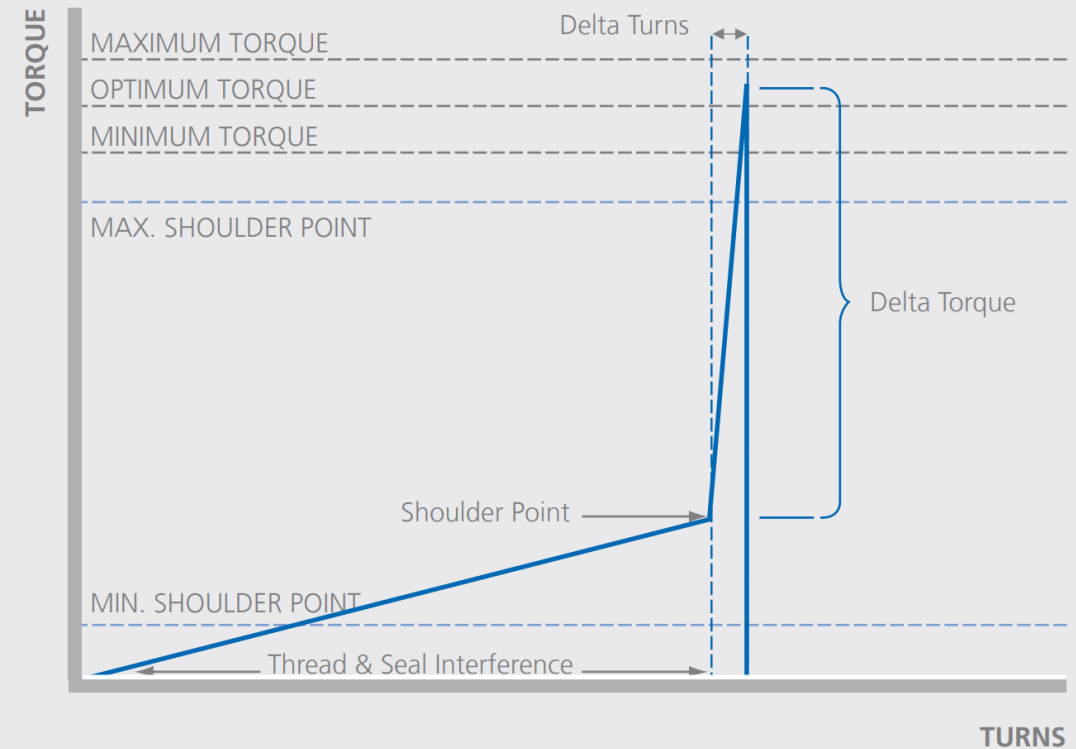
String was picked up out of the slips, elevators jumped, and string weight immediately dropped to block weight. Casing was picked up to floor to confirm 180 joints of casing dropped in hole.



# Timeline of Dropped Casin

- ▶ Joint 180 was set into the slips
- ▶ Joint 181 was screwed into joint 180 with the CRT.
- ▶ The torque did not make up properly as measured by jam unit.

	Client Name
	Job Location
	Job Creation
Client Company	
Connection Date	
2022-11-20 12:40:38	
Comment	
FAIL SHLDR	



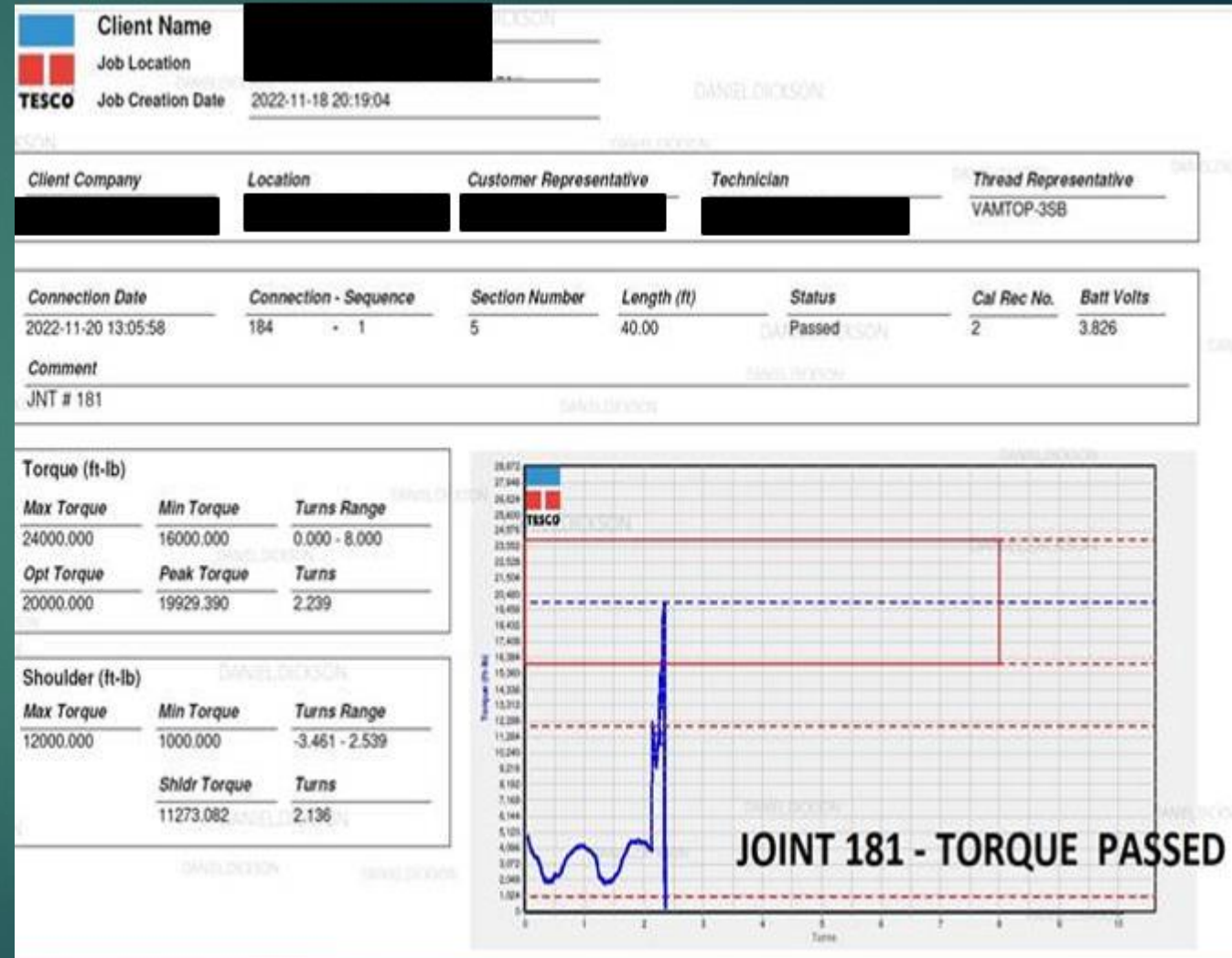
Torque (ft-lb)		
<b>Max Torque</b>	<b>Min Torque</b>	<b>Turns Range</b>
24000.000	16000.000	0.000 - 8.000
<b>Opt Torque</b>	<b>Peak Torque</b>	<b>Turns</b>
20000.000	20342.460	1.248

Shoulder (ft-lb)		
<b>Max Torque</b>	<b>Min Torque</b>	<b>Turns Range</b>
12000.000	1000.000	-4.752 - 1.248
<b>Shldr Torque</b>	<b>Turns</b>	
0.000	0.000	

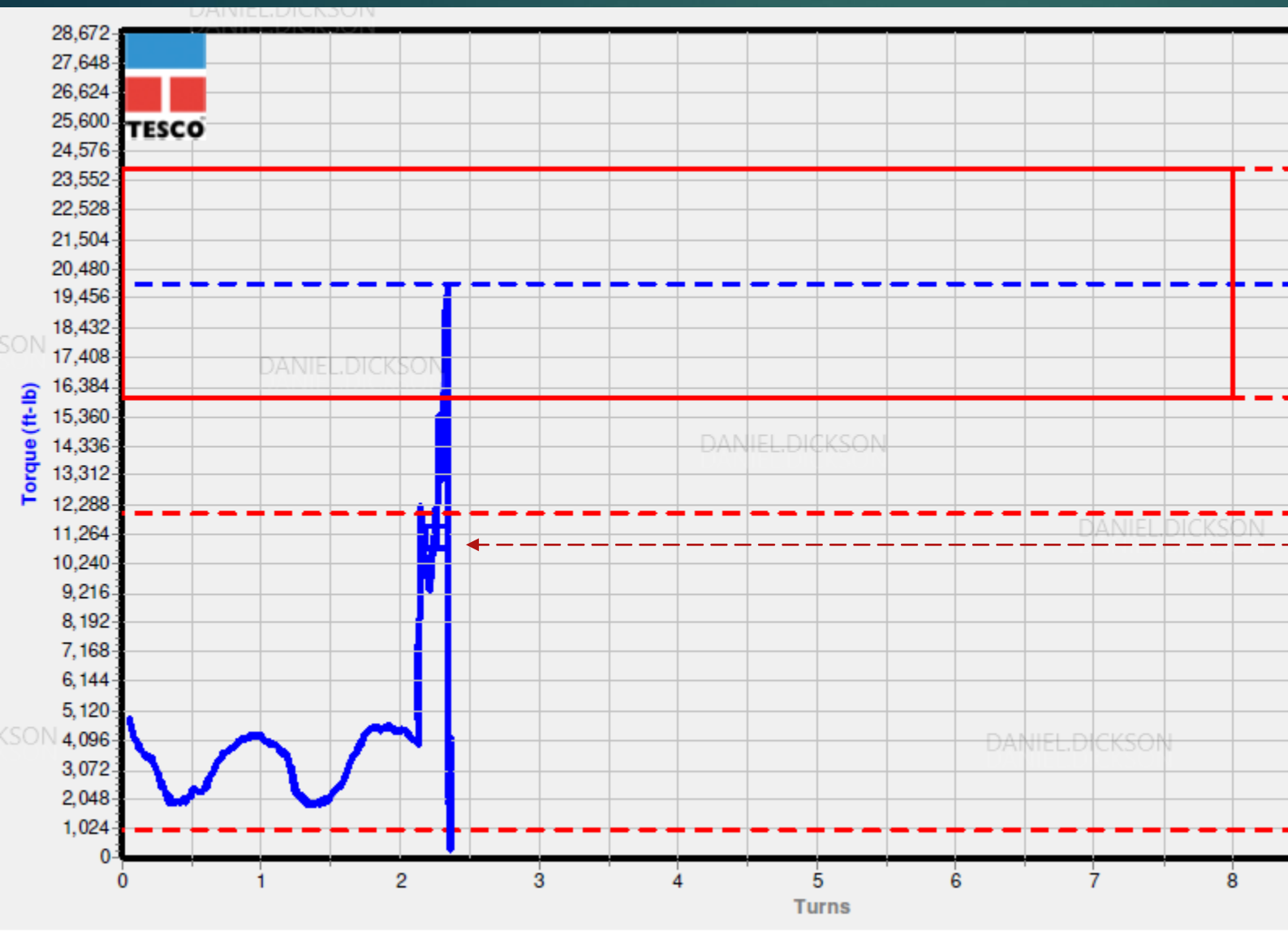


# Timeline of Dropped Casing

- ▶ Joint 181 was unscrewed from joint 180 and the threads cleaned
- ▶ Joint 181 was re-screwed into joint 180
- ▶ Again the torque did not make up properly when measured by the jam unit.
- ▶ Joint 181 was unscrewed from joint 180 again and threads cleaned, inspected again.
- ▶ Joint 181 was re-screwed into joint 180 by hand and then with the power tongs to verify no cross-threading
- ▶ CRT was then used to verify proper torque (CRT sensors are read by the Jam unit)
- ▶ **NOTE: Rig site determined joint 181 was properly torqued into joint 180 as per Jam unit measurement**



# Timeline of Dropped Casing



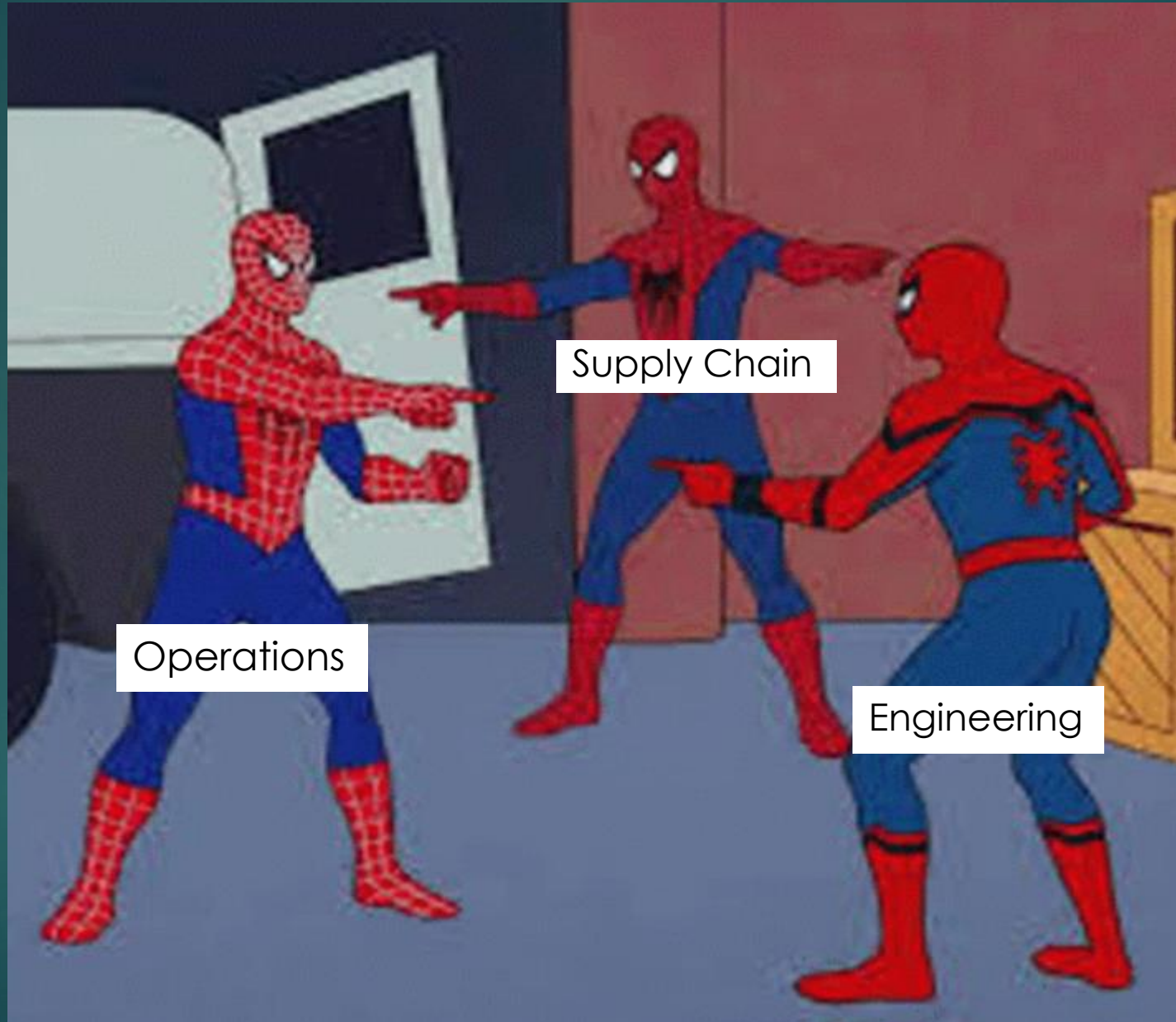
On the rig floor, this spike was attributed to the CRT just re-torquing to where the power tongs first screwed the joint to ~10,000 ftlbs.

# Timeline of Dropped Casing

- ▶ The string was lowered so joint 181 was at the table.
- ▶ It was noticed the threads on the box of joint 181 were damaged.
- ▶ Decision made to lay down joint 181.
- ▶ When the slips were opened and the string was picked up one foot, the string jumped with weight indicator showing loss of string weight.
- ▶ Joint 181 was pulled up through the slips and it was discovered that Joint 180 had parted from the bottom of joint 181.

*7,443' of 13 3/8" casing was dropped into the well.*

# Time to investigate the incident! (RCA)





# Timeline of Dropped Casing

- ▶ What does an engineer do to drill down to the root cause?
  - ▶ Make-up Equipment

PIPE & WELL SERVICES			
Tubing & Casing Inspection Summary Report			
Client:	[REDACTED]	DRSS No.:	1003734967
Work Location:	[REDACTED]	Date:	4-Nov-2022
Well No.:	[REDACTED]	Report No.:	Md-37
Rig No. / Code:	[REDACTED]	Well Charge:	66-22056-1003
Type of Material :	[REDACTED]	P.O. No.:	6511092686
		Rig Charge:	761350
<input type="checkbox"/> Tubing <input checked="" type="checkbox"/> Casing <input type="checkbox"/> Pip Joint <input type="checkbox"/> Other			
Size:	13 3/8" ( FBE )	Connection:	TN-3SB
Grade:	TN-95-HC	Drift OD:	12.250"
Weight:	72#	Range:	III
Inspection Standards		Material SAP No.:	
<input checked="" type="checkbox"/> API 5CT	<input type="checkbox"/> API 5B	G.C.Code :	WHITE
<input checked="" type="checkbox"/> API RP-5AS	<input type="checkbox"/> API RP-5B1	W.C.Code :	RED
<input type="checkbox"/> API RP-SC1	<input checked="" type="checkbox"/> Other	PWS Procedure:	QMW1-FY-15,16 & 18
Inspection Methods		Other Services	
<input type="checkbox"/> Full Body Visual Inspection	<input checked="" type="checkbox"/> Visual Thread Inspection	<input type="checkbox"/> Internal Hydroblast	
<input checked="" type="checkbox"/> API Full length Drift	<input type="checkbox"/> Other	<input type="checkbox"/> External Hydroblast	
INSPECTION SUMMARY			
Total Joints Inspected:	129	Total Joints Accepted:	129
Total Rejected Joints (Repairable):	0	Total Joints Scrap:	0
Repairable Joint Details			
Pin Damage:	0	Box Damage:	0
		Pin & Box Damage:	0

CERTIFICATE OF CALIBRATION	
ISSUED BY: <b>WASL AL SHOUMOUKH</b> INSPECTION & CALIBRATION DIVISION C.R. 2051214457   Zip Code: 34632-8694   Al Khobar   Saudi Arabia 013 890 3789   sales@wasl-ksa.com   www.wasl-ksa.com	
Item Received Date: 21-September-2022	
CUSTOMER DETAILS	
Customer :	Nabors Arabia Company Ltd
Address :	P.O Box 2862, Al Khobar, Kingdom of Saudi Arabia.
PRODUCT SPECIFICATION	
Instrument Manufacturer :	Pressure Gauge WINTERS
Model :	PFQ Series
Device ID/SN :	PG-121-08
Range :	0-5000 psi
CALIBRATION RESULT	
Test Result :	Passed (see next page)
Certificate Number :	20220921-16R
Calibration Date :	21-September-2022
Recommended Next Calibration Date :	20-September-2023
<b>Note :</b> <ul style="list-style-type: none"> <li>&lt; Calibration and Verification are performed at an ambient temperature of 23 +/- 5°C and relative humidity of less than 70%.</li> <li>&lt; The collective measurement uncertainty of the standards used will not exceed 25% of the listed tolerance.</li> <li>&lt; WASL calibration procedures are designed to provide a test uncertainty ratio of 4:1 i.e. the calibration equipment (standard equipment) used is four times or more accurate than the test equipment being calibrated.</li> </ul>	

# Timeline of Dropped Casing

It was observed that several of the casing joints on surface – including joint 181 – did not have the minimum 6.16” of blanking dimension as required by OEM.

Several joints – including joint 181 – did not have threads cut to the make-up loss of 5.508”

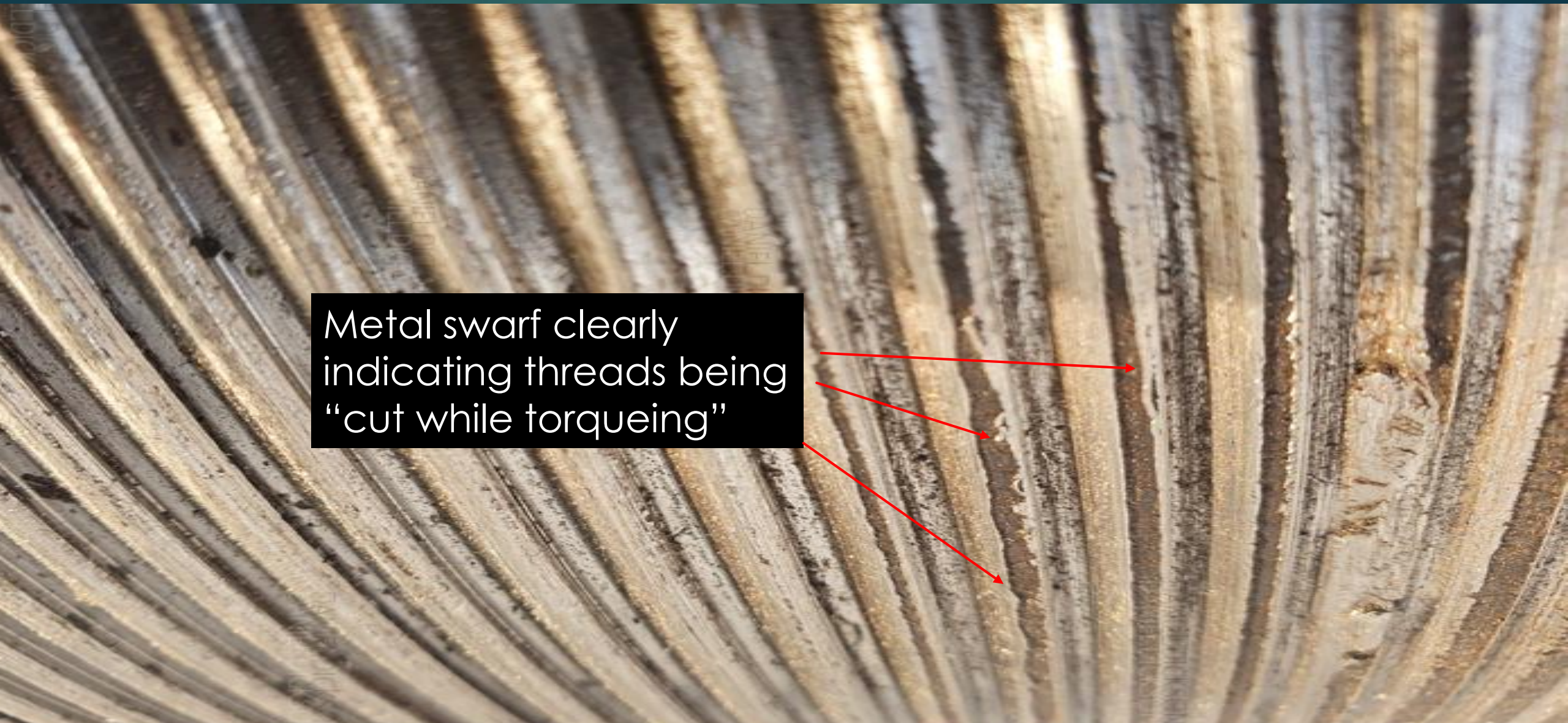
CONNECTION							PIN						COUPLER							
SIZE (IN)	WEIGHT (LB/FT)	WALL (IN)	PRODUCT	TAG	DRIFT (IN)	DRIFT TYPE	LENGTH		INSIDE DIAMETER		OUTSIDE DIAMETER		LENGTH		RECU		COUPLING LENGTH		INSIDE DIAMETER	
							MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
13.375	72.00	0.514	TenarisHydril 3SB™	Standard (CASING)	12.191	Standard API Drift	6.16 in (156.4 mm)	2.56 in (65.0 mm)	12.339 in (313.42 mm)	12.355 in (313.80 mm)	13.375 in (339.74 mm)	13.509 in (343.12 mm)	6.16 in (156.4 mm)	2.56 in (65.0 mm)	11.693 in (297.02 mm)	11.929 in (302.98 mm)	12.512 in (317.82 mm)	12.528 in (318.20 mm)		
13.375	72.00	0.514	TenarisHydril 3SB™	Standard (CASING)	12.250	Alternative API Drift	6.16 in (156.4 mm)	2.56 in (65.0 mm)	12.339 in (313.42 mm)	12.355 in (313.80 mm)	13.375 in (339.74 mm)	13.509 in (343.12 mm)	6.16 in (156.4 mm)	2.56 in (65.0 mm)	11.693 in (297.02 mm)	11.929 in (302.98 mm)	12.512 in (317.82 mm)	12.528 in (318.20 mm)		
13.375	77.00	0.550	TenarisHydril 3SB™	Standard (CASING)	12.119	Standard API Drift	6.16 in (156.4 mm)	2.56 in (65.0 mm)	12.267 in (311.60 mm)	12.283 in (311.98 mm)	13.375 in (339.74 mm)	13.509 in (343.12 mm)	6.16 in (156.4 mm)	2.56 in (65.0 mm)	11.693 in (297.02 mm)	11.929 in (302.98 mm)	12.512 in (317.82 mm)	12.528 in (318.20 mm)		

# Timeline of Dropped Casing

- ▶ What does an engineer do to drill down to the root cause?
  - ▶ *Make-up Equipment*
  - ▶ *Casing*



# Picture of Pin 181 close up of threads:



Metal swarf clearly indicating threads being "cut while torqueing"



Picture of another joint  
of the same casing:



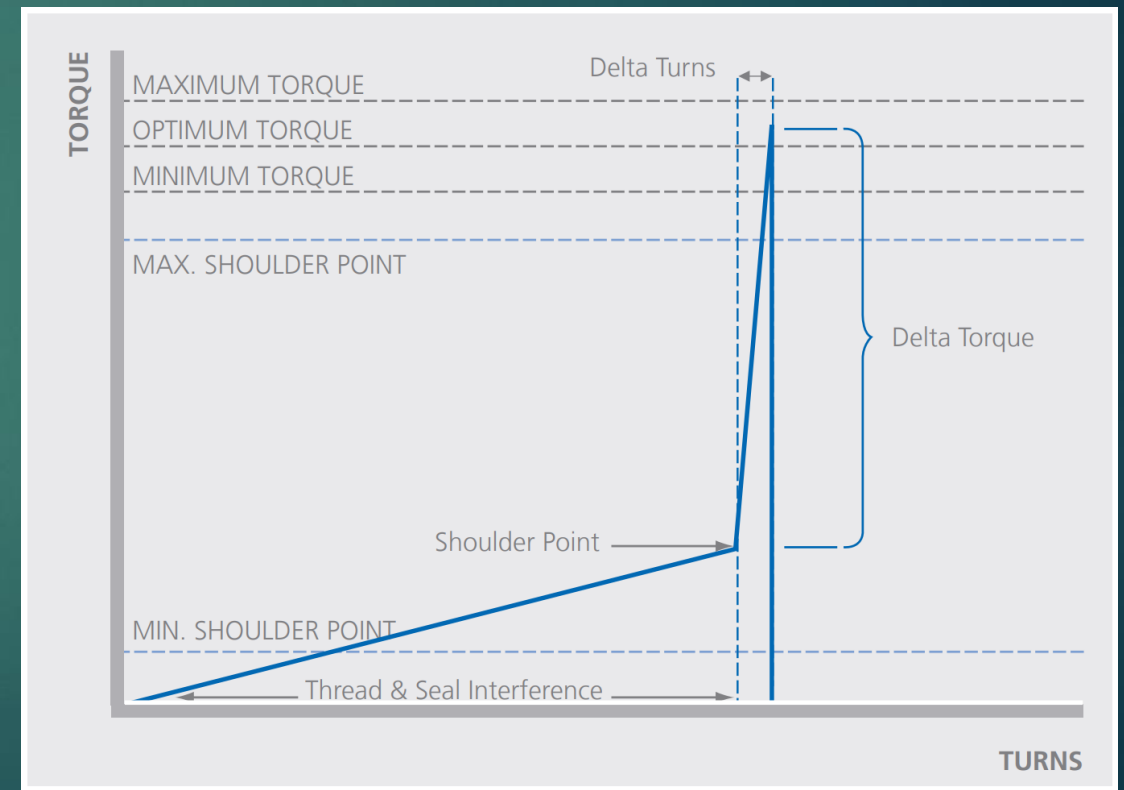
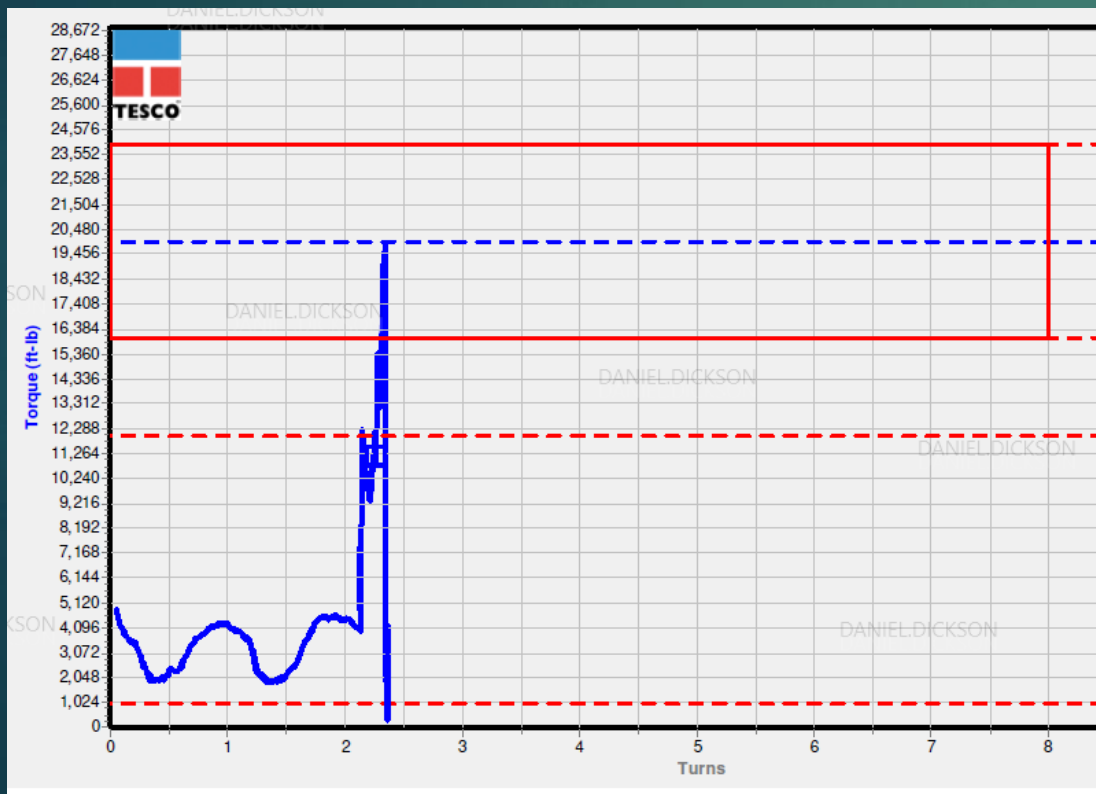
Only 3 ½" of fully cut  
threads and less than  
5" of *any* threads

# Timeline of Dropped Casing

- ▶ What does an engineer do to drill down to the root cause?
  - ▶ *Make-up Equipment*
  - ▶ *Casing*
  - ▶ *Procedures*

# Timeline of Dropped Casing

## Actual $\neq$ OEM Template



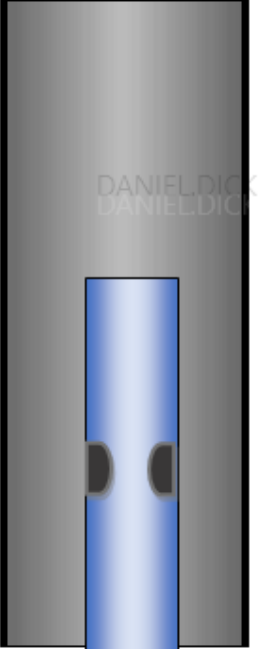

# Fishing Operations





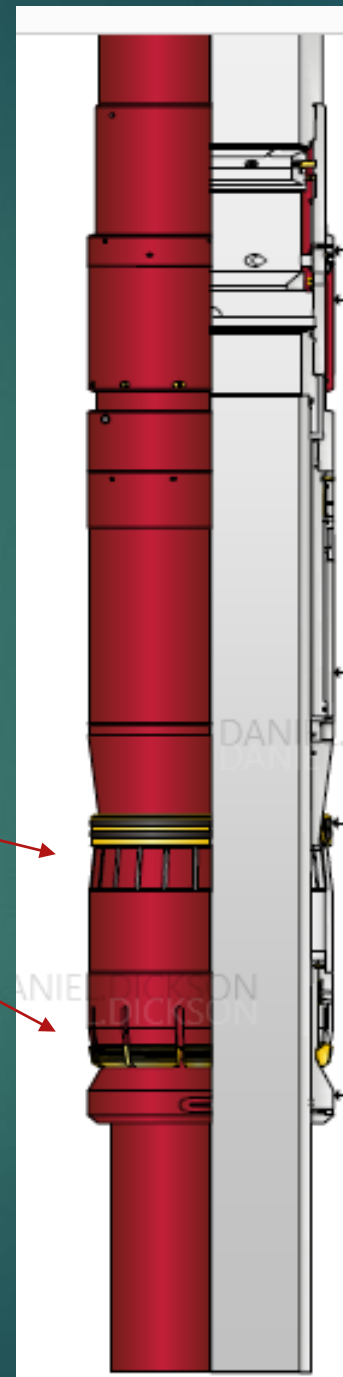
# About the fish:

- ▶ 7,443' of casing was dropped in hole.
- ▶ KOP was at 7500' with bottom INC of 35°.
- ▶ Many centralizers were used per cement simulation (137 in open hole)
- ▶ The Weatherford Cementing Stage tool (DV) was already made up into the string and 13 joints from top of fish (top calculated inside previous casing string)
- ▶ The stop collar on the top of the DV tool was our smallest ID (10.25")
- ▶ **There were two open oil production zones with differing pressure profiles – could not be left comingled!**

Hole Size (in)	Casing Size (in)	Casing Program	Depth (ft.)	ID	Notes
	18 5/8"		TOF at 3,622' DV at 4,200'	18 5/8" ID = 17.437"	TOF at 3,622' (72#, 3SB threads) DV is 13 joints below TOF ~4,200'
			18 3/8" Shoe 4,533' / 4,533'		DV ID = 10.25"
16"	13 3/8"		KOP at 7500'	13 3/8" 72# = 12.347"	13 3/8" Centralized casing with MANY centralizers
			11,070' / 10,740'	13 3/8" 86# = 12.125"	Bottom hole INC 34.5 degrees at 10,262' Max DLS = 2 degrees
					Fish on bottom

# About the fish:

- ▶ The Weatherford Cementing Stage tool (DV) was already made up into the string and 13 joints from top of fish.
- ▶ The DV tool slips are bi-directional, hydraulically set mechanical slips
- ▶ The slips **may** have set from the force of the dropped string



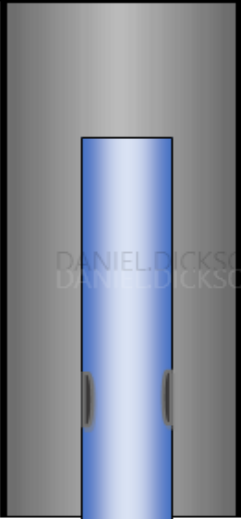

# Fishing Plan Forward:

- ▶ Plan to cut casing string right above KOP and pull out string in vertical section (2,838' of open hole).
- ▶ **Manual cutter was too large to RIH below DV (ID restriction).**
- ▶ DV Tool needed to be manually closed prevent slips from setting during fishing. (Needed set-down weight of 134Klbs.)
- ▶ Plan to close DV tool and mill out restriction in same run.

# Fishing Continued

- ▶ With DV milled out, cutters were run in hole and 13 3/8" casing cut at 7,361' above KOP
- ▶ Spear was RIH and max overpull applied (8-1/4" ITCO Spear with Spear Grapple to catch 13-3/8" Casing - Assy No 9283)
- ▶ Spear suddenly released causing drill line to jump and damaging the rig's deadline anchor – 37 hours of NPT

ANDR-1003  
Wellbore Schematic for Fishing Operations, Fishing Run #1 and #2 – Nov 27

Hole Size (in)	Casing Size (in)	Casing Program	Depth (ft.)	ID	Notes
	18 3/8"		TOF at 3,622'	18 5/8" ID = 17.437"	TOF at 3,622' (72#, 3SB threads)
			DV at 4,227'	13 3/8" 72# ID = 12.347"	DV is 13 joints below TOF ~4,227'
			<b>18 3/8" Shoe</b> <b>4,533' / 4,533'</b>	<del>DV ID = 10.25"</del> DV ID milled to 12.25"	
			<b>7361'</b> <b>casing cut #1</b>		<b>First casing cut in</b> <b>Joint 90 at 7361'</b> <b>(blade depth / cut)</b>
16"	13 3/8"		KOP at 7500'	13 3/8" 86# = 12.125"	13 3/8" Centralized casing with MANY centralizers
			<b>11,070' / 10,740'</b>		Bottom hole INC 34.5 degrees at 10,262'
					Max DLS = 2 degrees
					12 1/4" mill run to 10,900' (1 jnt above Baffle)
					Fish on bottom

# Fishing Continued

- ▶ With the rig repaired, a spear was re-run into fish and latched

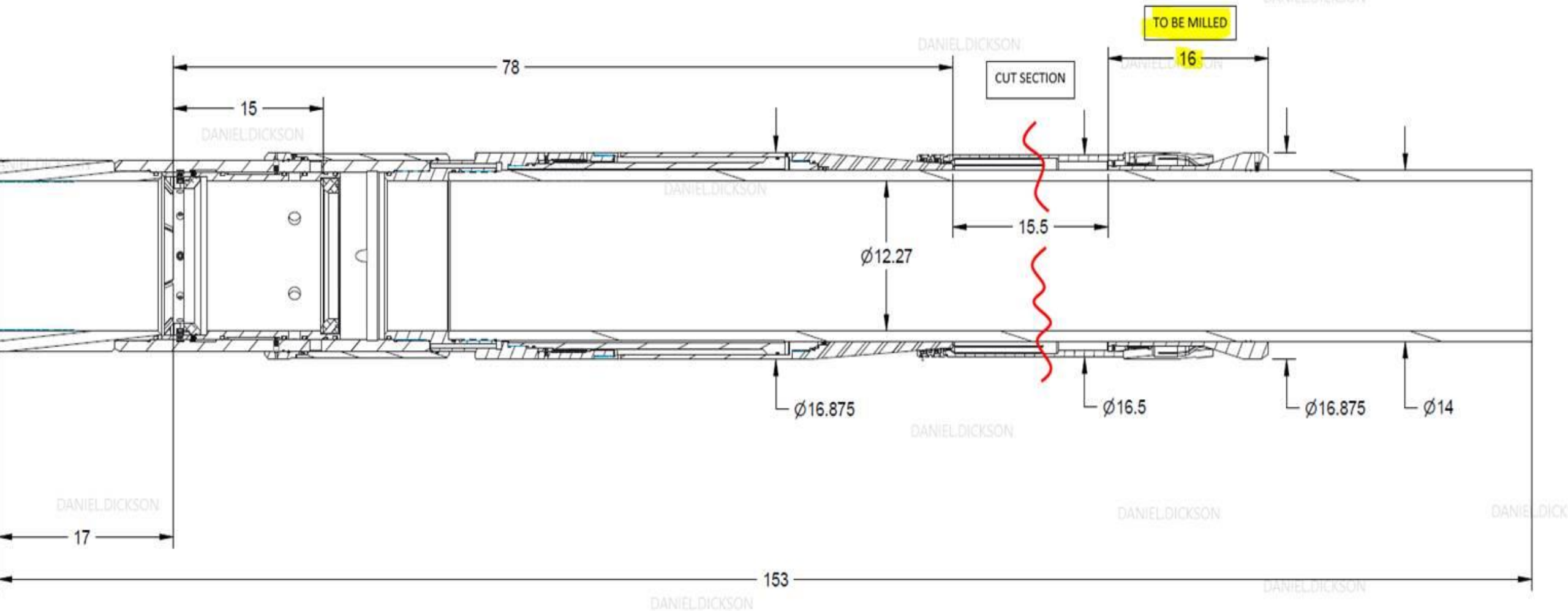
*pictures of spear →*

- ▶ Fish did not pull free
- ▶ Decision made to isolate DV slips



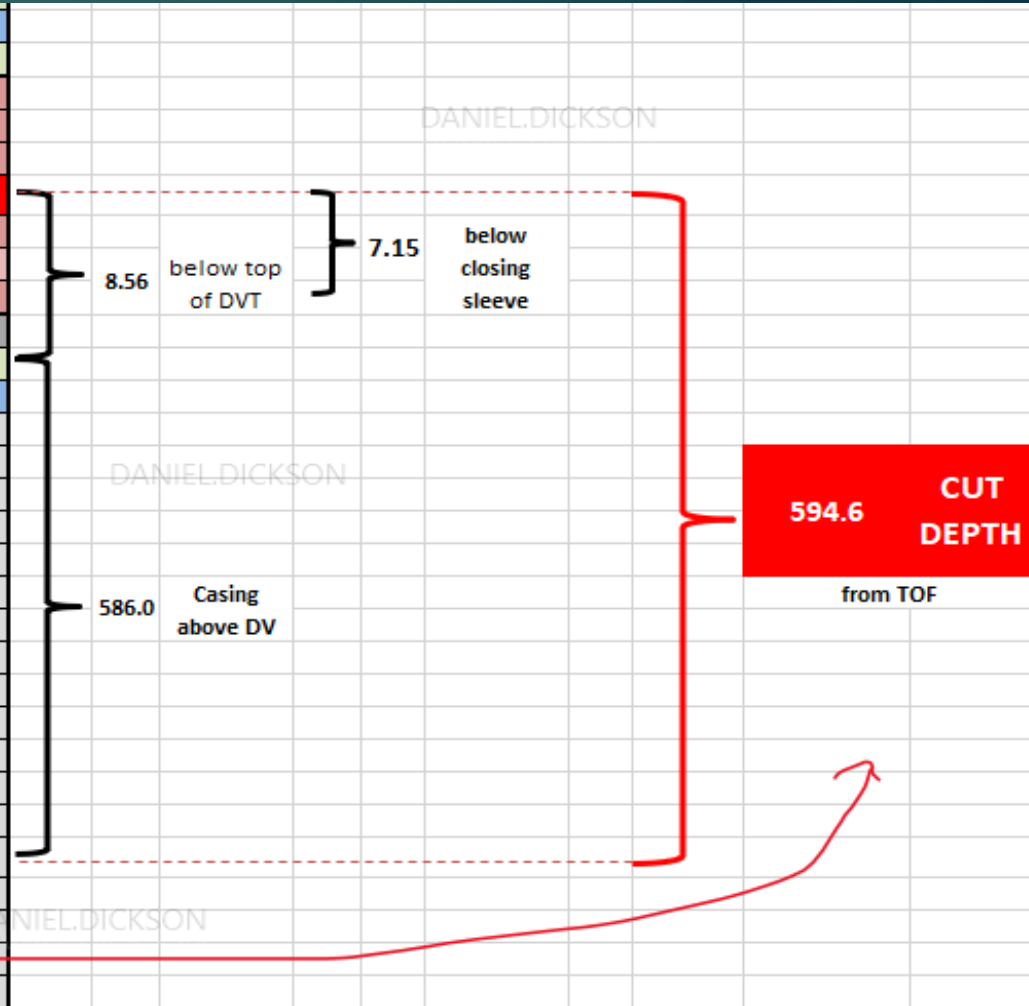
# Fishing Continued – Remove DV Slips

The DV tool required a very precise cut within a 15.5" window:



# Fishing Continued – Remove DV Slips

	X.O.S (B)	5.68	6839.89	4245.57	4239.88	478157.13	1188.65	72# V.TOP BOX X 72# 3SB PIN	
	Pup joint	5.63	6845.52	4239.88	4234.26	478495.94	1189.62	72# AM-HBC BARE PJ	BOW
W F D	lower tool	3.03							
	DV slips	1.25							
		lower cut limit	7.79	4231.25				from closing sleeve	
	<b>CUT HERE</b>		<b>7.15</b>	<b>4230.60</b>				<b>from closing sleeve</b>	
		upper cut limit	6.50	4229.96				from closing sleeve	
D V T	opening seat	1.25							
	closing sleeve	1.42		4223.46					
	WFD DVT (tally)	12.22	6857.74	4234.26	4222.04	479231.99	1191.75	WFD 5K DVT	
	Pup joint	11.70	6869.44	4222.04	4210.34	479936.71	1193.78	72# AM-HBC BARE PJ	BOW
	X.O.S @	5.74	6875.17	4210.34	4204.60	480282.15	1194.78	72# V.TOP PIN X 72# 3SB BOX	
1	joint no# 167	40.57	6915.74	4204.60	4164.03	482725.85	1201.83	72# 3SB BARE CSG	BOW 41.03
2	joint no# 168	40.62	6956.36	4164.03	4123.41	485172.57	1208.89	72# 3SB BARE CSG	BOW 41.08
3	joint no# 169	39.37	6995.73	4123.41	4084.04	487544.00	1215.73	72# 3SB BARE CSG	BOW 39.83
4	joint no# 170	40.82	7036.55	4084.04	4043.22	490002.77	1222.82	72# 3SB BARE CSG	BOW 41.28
5	joint no# 171	40.71	7077.27	4043.22	4002.51	492454.91	1229.90	72# 3SB BARE CSG	BOW 41.17
6	joint no# 172	41.86	7119.13	4002.51	3960.65	494976.32	1237.17	72# 3SB BARE CSG	BOW 42.32
7	joint no# 173	41.84	7160.97	3960.65	3918.81	497496.53	1244.44	72# 3SB BARE CSG	BOW 42.30
8	joint no# 174	41.82	7202.79	3918.81	3876.99	500015.53	1251.71	72# 3SB BARE CSG	BOW 42.28
9	joint no# 175	40.02	7242.81	3876.99	3836.97	502426.11	1258.67	72# 3SB BARE CSG	BOW 40.48
10	joint no# 176	41.22	7284.03	3836.97	3795.74	504908.97	1265.83	72# 3SB BARE CSG	BOW 41.68
11	joint no# 177	39.06	7323.09	3795.74	3756.68	507261.72	1272.62	72# 3SB BARE CSG	BOW 39.52
12	joint no# 178	40.91	7364.00	3756.68	3715.77	509725.91	1279.73	72# 3SB BARE CSG	BOW 41.37
13	joint no# 179	41.65	7405.65	3715.77	3674.12	512234.67	1286.97	72# 3SB BARE CSG	BOW 42.11
14	joint no# 180	38.12	7443.77	3674.12	<b>3636.00</b>	514530.81	1293.59	72# 3SB BARE CSG	BOW 38.58



THIS TALLY MEASURES THE STRING FROM TOF.

ENTER TOF TAG DEPTH AND THE OTHER DEPTHS WILL BE CALCULATED.

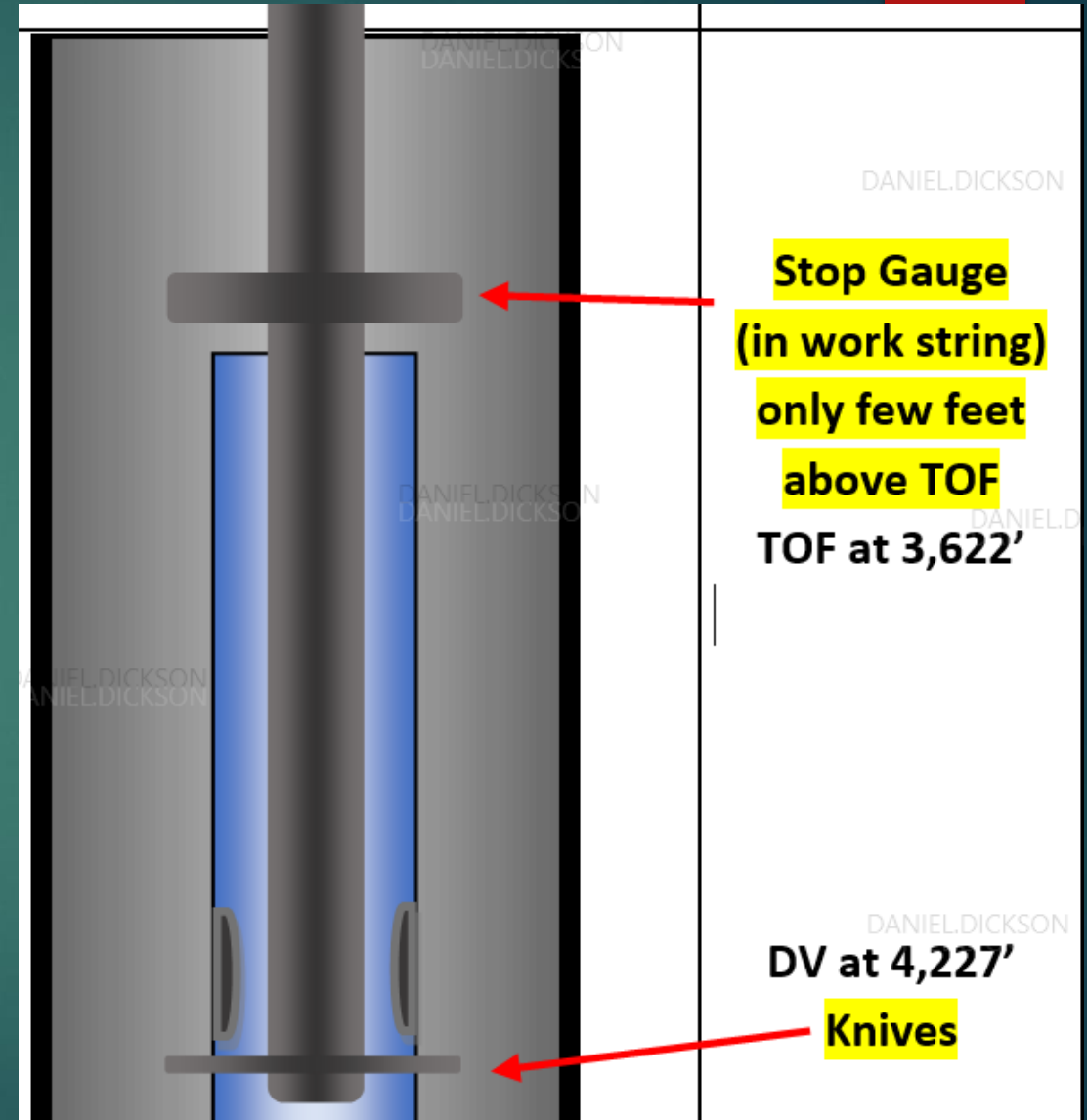
NOTE - WE HAVE LOST 7' OF STRING LENGTH AFTER THE DROP..... (FROM TD TO TOF)

# Fishing Continued – Remove DV Slips

4,227' to Top of DV provides too much depth to confirm accurate cut

How we verified precise cut depth:

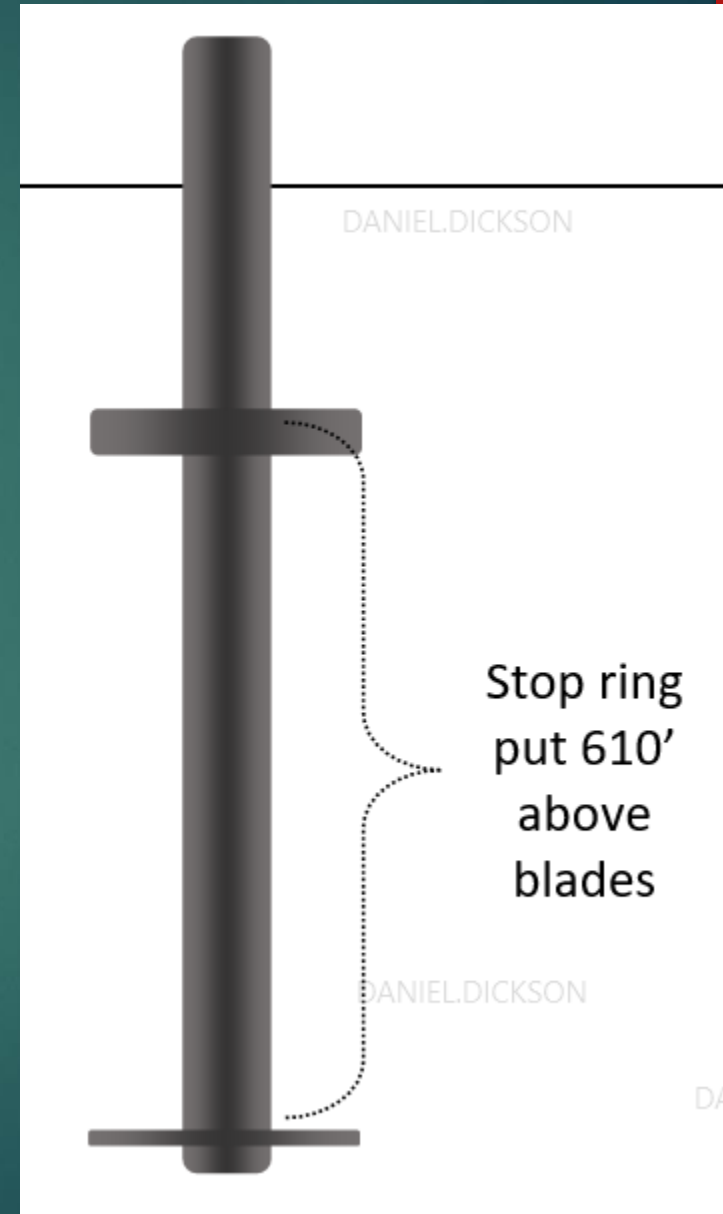
- 1) Tally length above DV is known
- 2) DV dimensions are known
- 3) Added a stop gauge into fishing string a few feet above TOF length.
- 4) RIH with cutters until stop gauge tagged TOF
- 5) Pulled up exact amount to place cutters in precise window





# Fishing Continued – Remove DV Slips

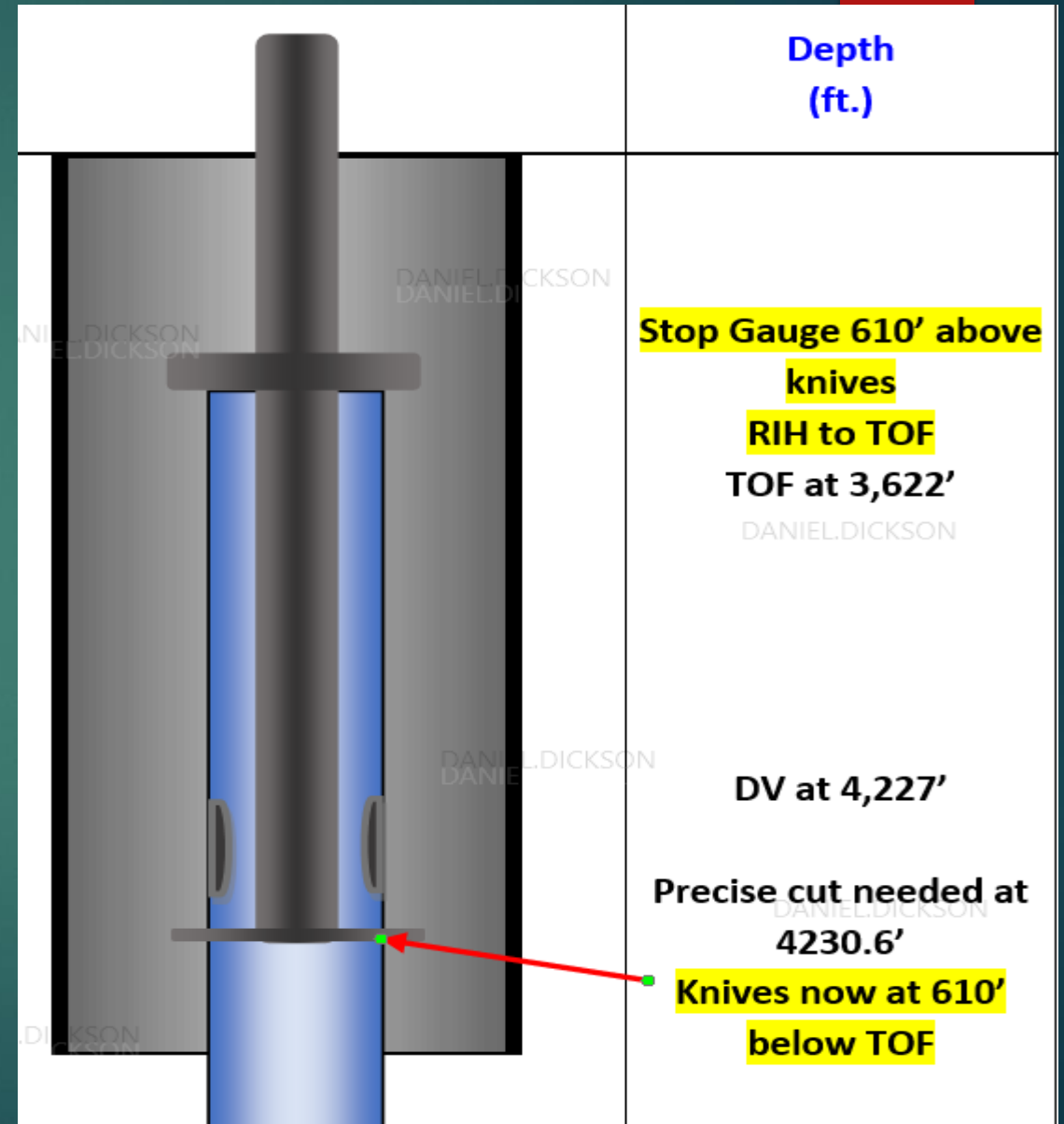
3) Stop gauge (large OD) put into work string at 610' above cutting blades



# Fishing Continued – Remove DV Slips

4) RIH with cutters until stop gauge tagged TOF.

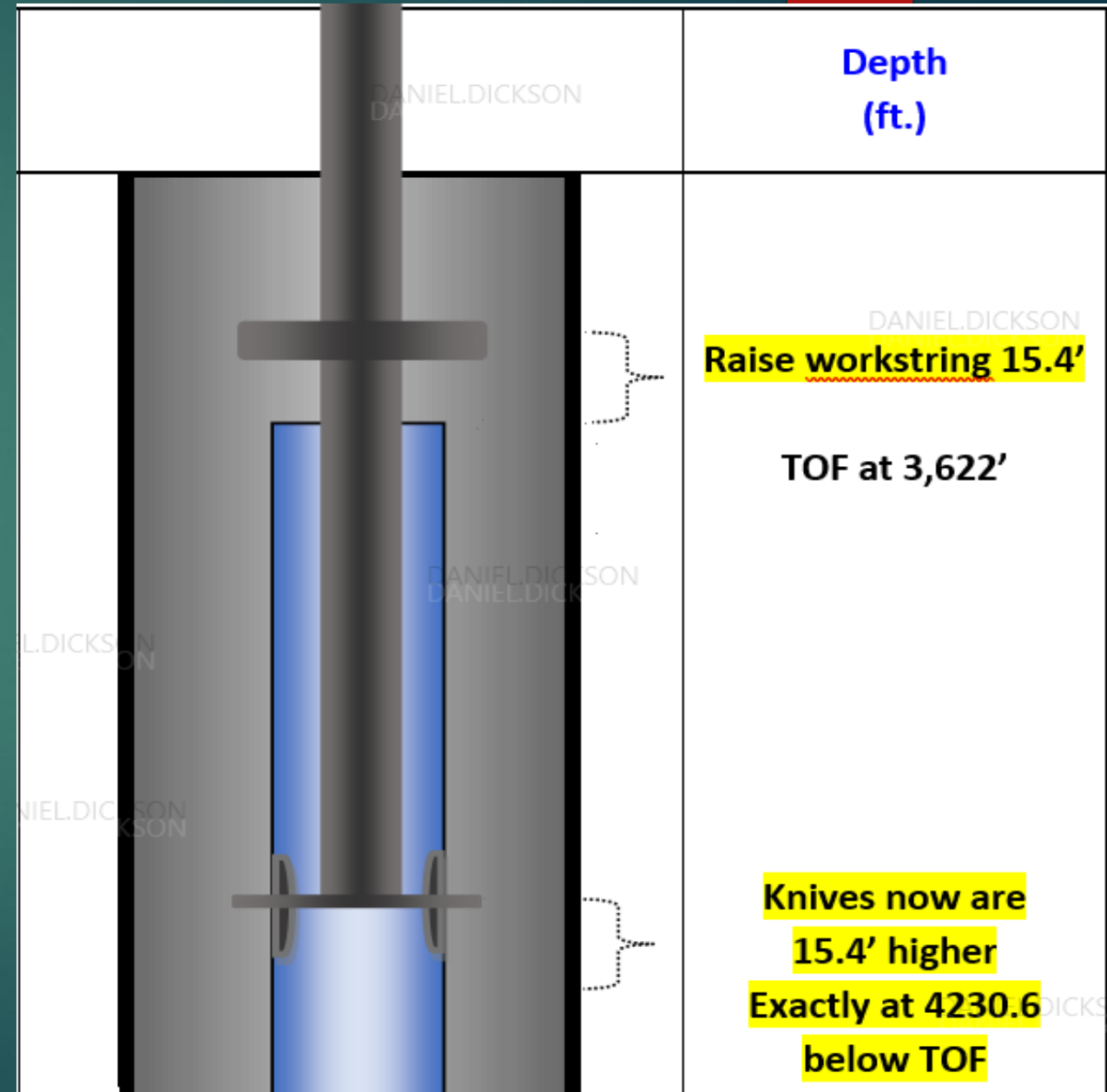
At this point we can verify the knives are 610' below TOF.



# Fishing Continued – Remove DV Slips

5) Pulled up exact amount to place cutters in precise window

The work string was pulled up a few feet (measured on pipe at rotary table) to verify exact cut depth as per the casing tally.



# Fishing Continued – Remove DV Slips

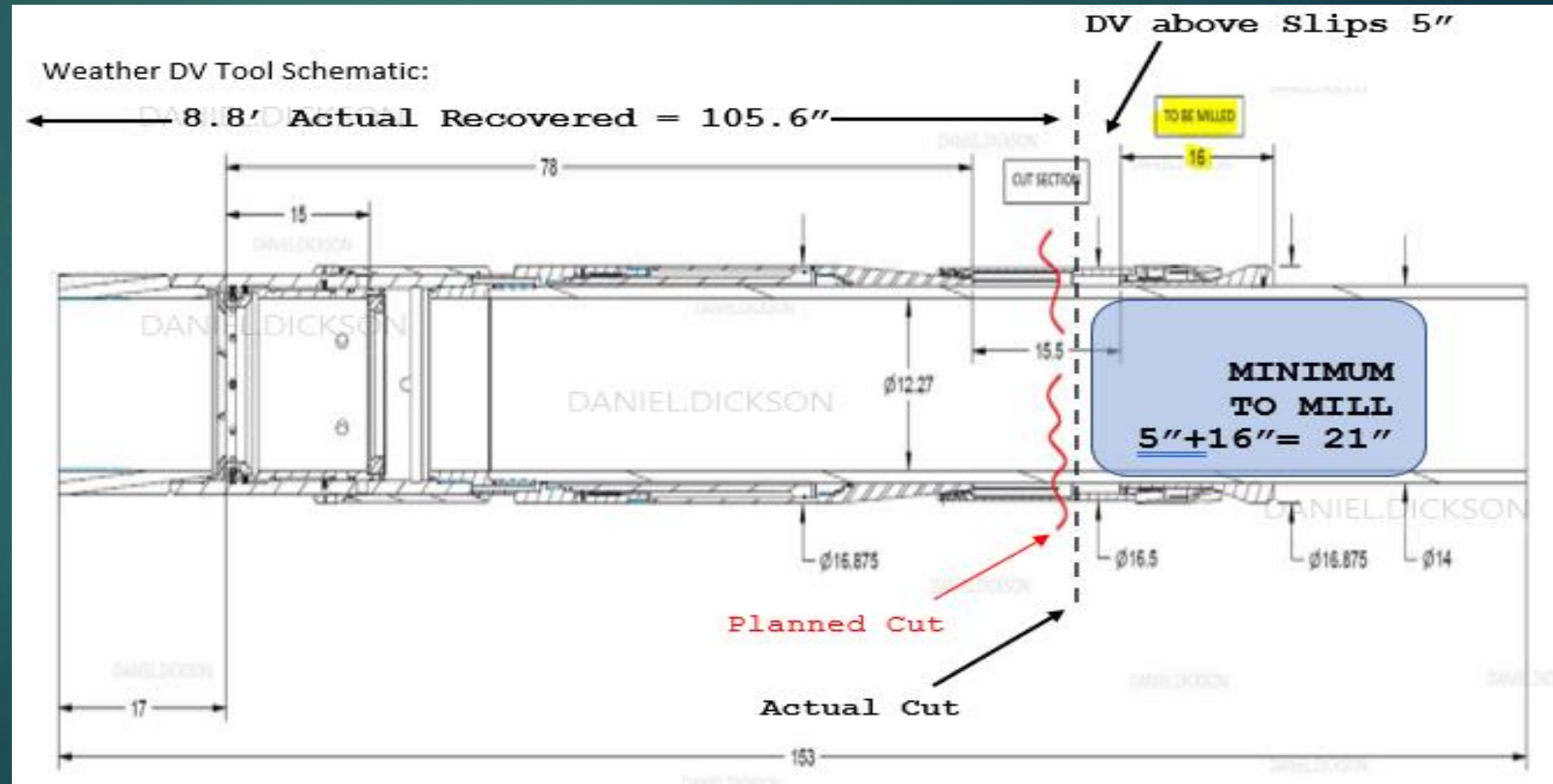
Cutters were POOH and a spear RIH to recover casing & top of DV.

Fish recovered successfully:



# Fishing Continued – Remove DV Slips

Measurements from recovered fish showed us the exact amount of milling required to remove DV slips:



# Fishing Continued – Remove DV Slips

17 1/2" bladed junk mill was RIH to remove the DV slips.

Total of three feet was milled.

ANDR-1003 Wellbore Schematic for Fishing Operations RIH with Mill Assembly to Mill DV Slips, Run #4 – Nov 30			
Well Info (IDs)	Schematic	Depth (ft.)	Notes
18 5/8" ID = 17.437"		TOF at 4230'  DV cut between slip assembly at 4230'	TOF at 4230'
13 3/8" 72# ID = 12.347"		18 3/8" Shoe 4,533' / 4,533'	Length of current fish from DV to cut at 7,361': 3,165' with 2,838' in Open Hole  Expected FISH string weight: 228 Klbs dry (stuck) 191 Klbs wet (free to pull)
DV ID = 10.25" DV ID milled to 12.25"		2838' of 13 3/8" Centralized casing with 47 bowspring centralizers in open hole  7361' casing cut #1	First casing cut in Joint 90 at 7361' (blade depth / cut)
13 3/8" 72# 12.347"			

# Fishing Continued – Remove DV Slips

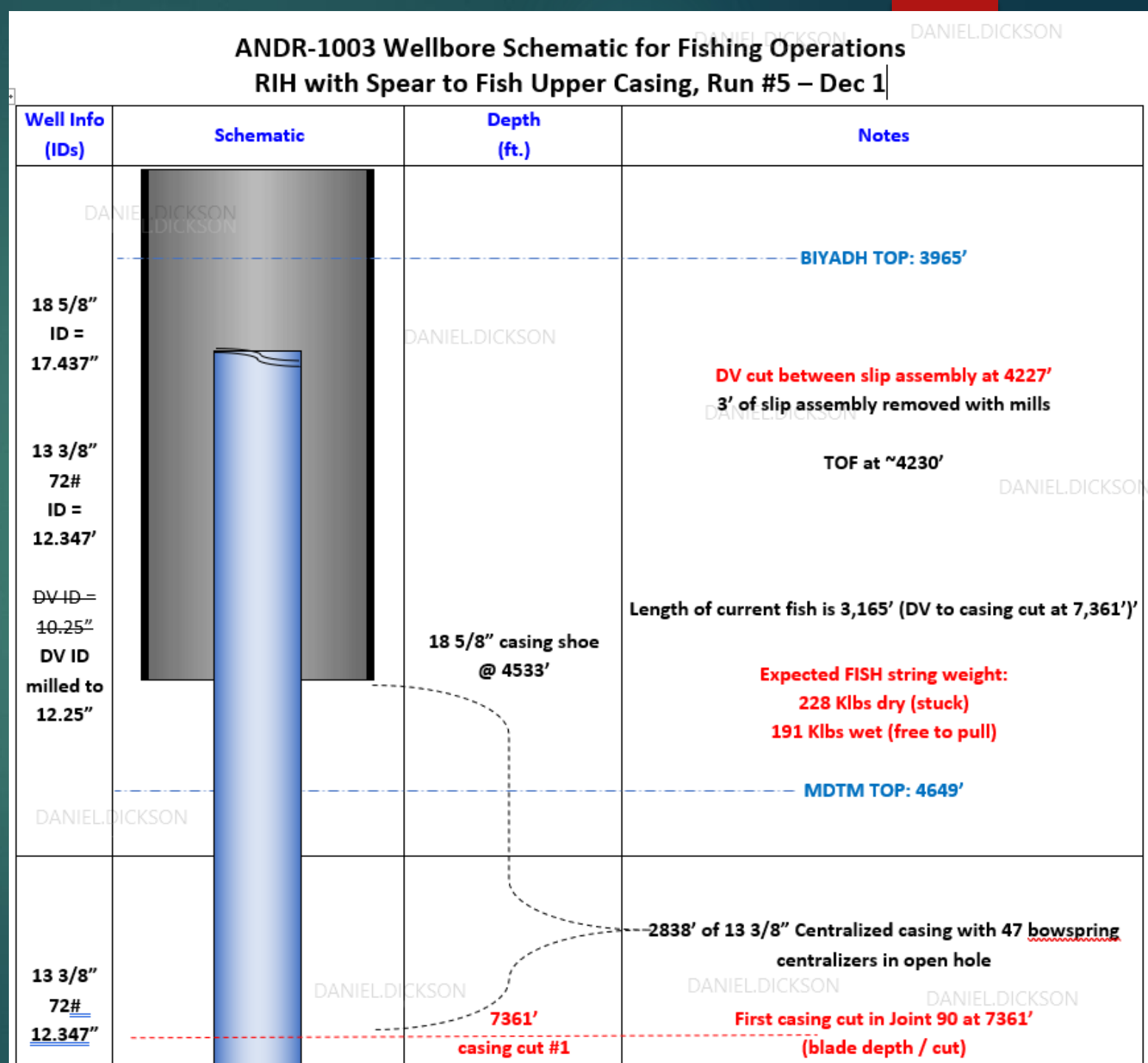
17 ½" bladed junk mill new versus after milling:



# Fishing Continued

Spear was RIH again and TOF engaged.

Casing from first cut (7,361') successfully pulled from hole.





# Fishing Continued

Pictures of recovered casing showing the initial casing cut at 7,361'



# Fishing Continued

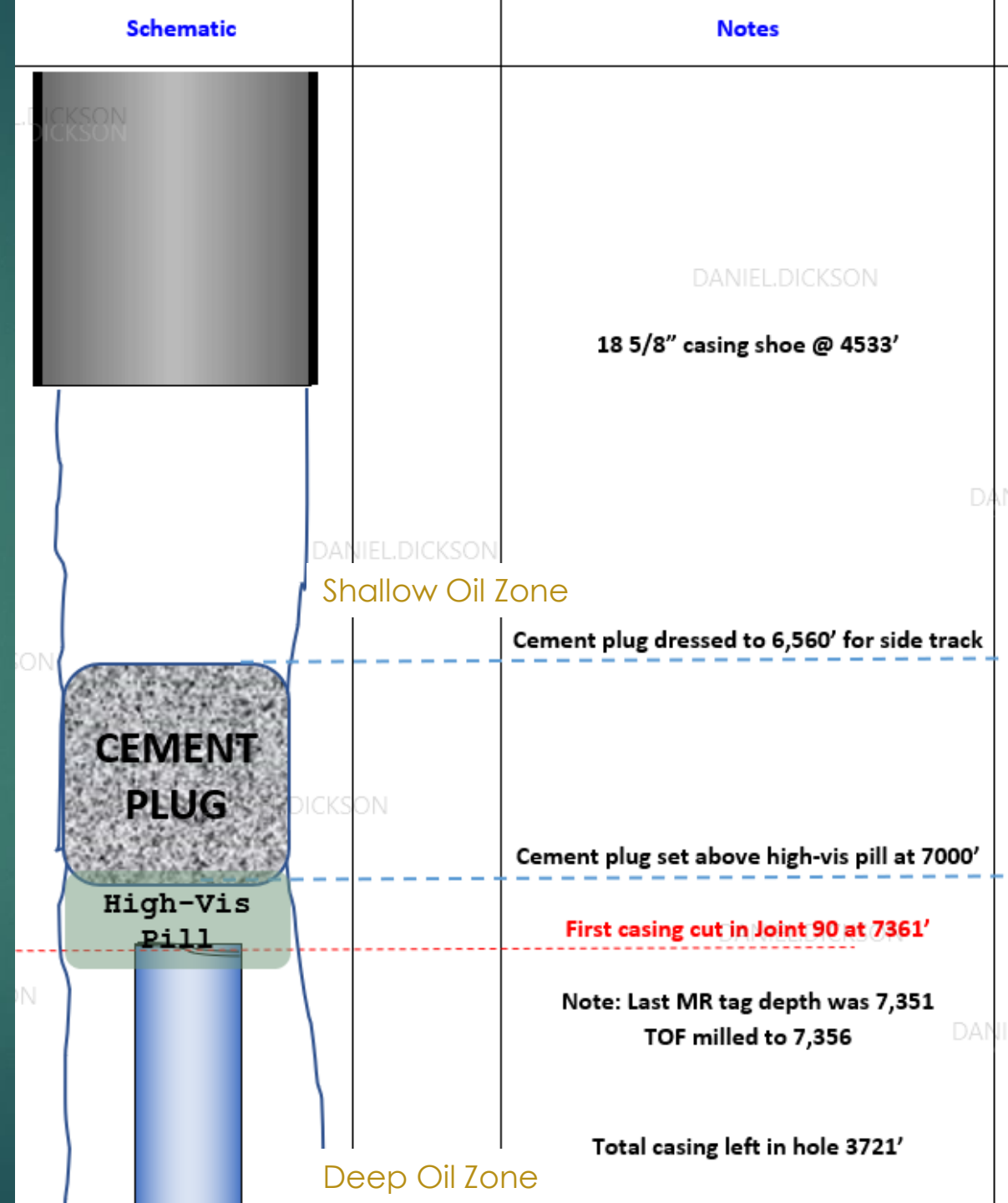
Two more spearing attempts and a run to dress the TOF with a mill were conducted.

The lower casing section was not recovered and a decision to sidetrack the well was made.

By pulling the upper casing section we were able to maintain subsurface integrity by isolating the various hydrocarbon zones.

Lower section abandoned and re-drilled with OH whipstock.

Over a month of NPT with several million dollars worth of equipment lost and time wasted



# Key Takeaways As Engineers:

**Address any abnormal condition** – reject equipment that doesn't meet spec or just doesn't look correct.

Premium threaded connections have clearly defined make-up chart profiles. **All operations personal need to be familiar with examples of accepted torque profiles.**

**When fishing a casing string with a DV tool**, first isolate the tool's slips by cutting and milling before further fishing – ***assume slips have set.***



Any question or comments, please reach out to me, at [ddickson@rhythmeng.com](mailto:ddickson@rhythmeng.com)