16B(78)-32 - 9.5in
BHAs #11 through #17

SANVEAN®
TECHNOLOGIES
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BHA #11 (4) Motor Driven HALO RSS

Interval	BHA #	Run in That Hole Size	Bit Size	Bit Type	Bit Serial Number	Bit Mfg	Depth In (ft MD)	Depth Out (ft MD)	Footage Drilled (ft)	On Bottom Hours	On Bottom ROP (ft/hr)
Vertical	BHA #4	3	9.50	TKC73-A2	A298329	REEDHYCALOG	4980	5269	289	2.264	128

4: Directional BHA #4 HALO, 9 1/2" Hole section

Bottom Hole Assembly

Job#	OP.039349	**Rig**	Frontier 16	**BHA Length (Usft)**	1354.08
Operator	Utah Forge	**BHA #**	4	**BHA Weight dry (klbs)**	70.21
Well	16B(78)-32 - 16B(78)-32	**Bit #**	4	**BHA Weight Bouyed (klbs)**	60.67
Field	Beaver (University of Utah) - Utah Forge	**Depth In (Usft)**	0.00	**Wt. Below Jars dry (klbs)**	70.21
Date In		**Depth Out(Usft)**	0.00	**Wt. Below Jars Bouyed (klbs)**	60.67
Date Out		**Drilled(Usft)**	0.00	**Drilling / Circ Hours**	0.00 / 0.00

Sensor Offsets

Survey Offset	N/A	Gamma Offset	N/A	Gyro Offset	N/A

	#	SN	Description	OD (in)	ID (in)	FN OD (in)	FN Length (Usft)	Cnx Up	Cnx Dn	Unit Weight (lb/ft)	Comp Weight (klbs)	Total Weight (klbs)	Length (Usft)	Total Length (Usft)
	1	A298329	9 1/2" 7 Blade PDC bit	6.375	2.750	0.000	0.00	4 1/2 REG P		0.000	0.00	0.00	1.13	1.13
	2	76000781	HALO RSS w/HFTO	6.750	2.000	0.000	0.00	4 1/2 IF B	4 1/2 REG B	0.000	0.00	0.00	35.38	36.51
	3	ASM 9006	Spiral wrapped IB Stabilizer	6.500	2.813	6.500	2.40	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	5.62	42.13
	4	125-373	6 3/4 NM Pony DC	6.438	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	9.22	51.35
	5	84-772	6 3/4 NMDC	6.813	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	31.11	82.46
	6	GU1405	FG 9 1/2" Roller reamer	6.375	3.000	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	5.64	88.10
	7	7019	6 3/4 Black Box	6.750	2.250	6.750	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	6.00	94.10
	8	RS675-0023	6 3/4 RIPstick	6.750	2.000	6.750	1.10	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	19.93	114.03
	9	7150018	7.15 Mud Motor	7.188	2.000	7.188	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	41.28	155.31
	10	DR 48701	6 3/4 Filter sub	6.688	3.250	6.688	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	3.93	159.24
	11	N/A	9 JTS, 6 3/4" DC's	6.813	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	100.000	27.83	27.83	278.27	437.51
	12	N/A	Crossover (DC's to HWDP)	6.937	3.000	0.000	0.00	5 1/2 FH B	4 1/2 IF P	0.000	0.00	27.83	3.15	440.66
	13	N/A	30 JTS HWDP	5.500	3.625	0.000	0.00	5 1/2 FH B	5 1/2 FH P	46.400	42.38	70.21	913.42	1354.08

Comments

Halo 7600-0781; Pulser 128-481; Eye 1485; Gamma 1279; Battery 008-29SEP22AB SDI 7" Straight Fixed Lobe 6/7, Stage 7.1 Flow Range = 500-750 Max Diff = 1,670 Max Torque = 18,680 Rev/Gal = 0.23 9 3/8 Spiral 3 blade stabilizer Eye = 22 Gamma = 17 NB Inc/Az = 7

HALO

STAB

RR

Black Box

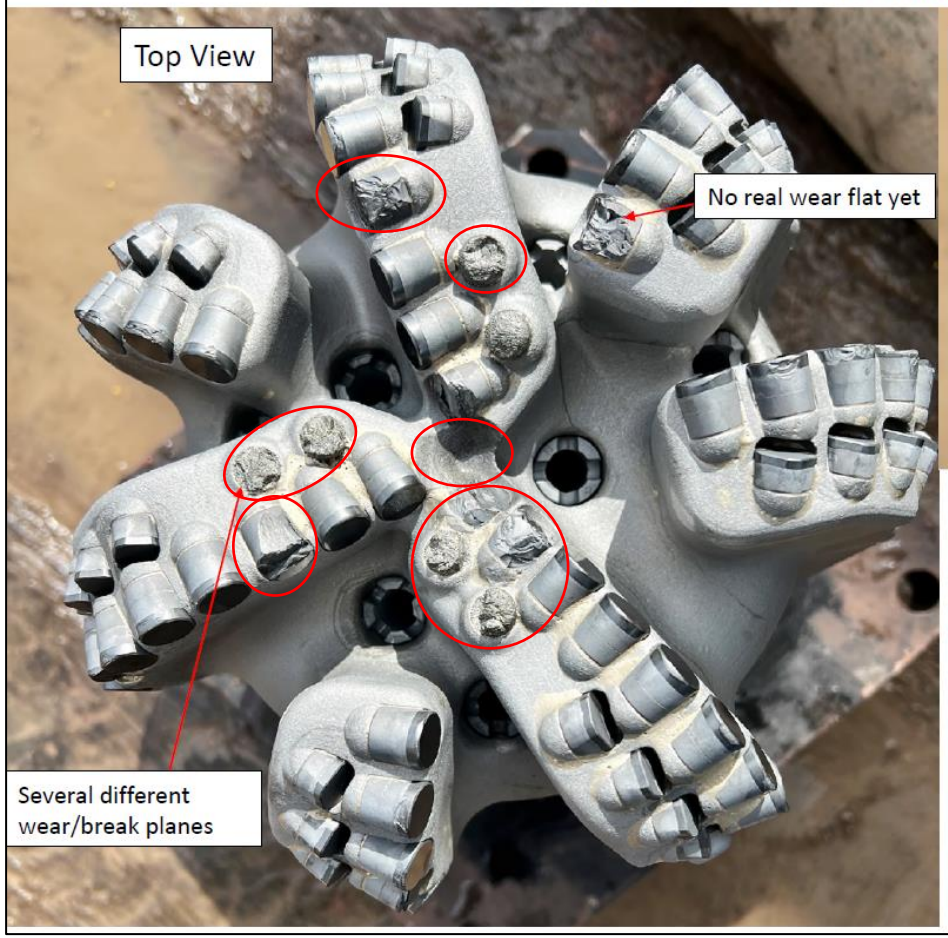
RIPstick

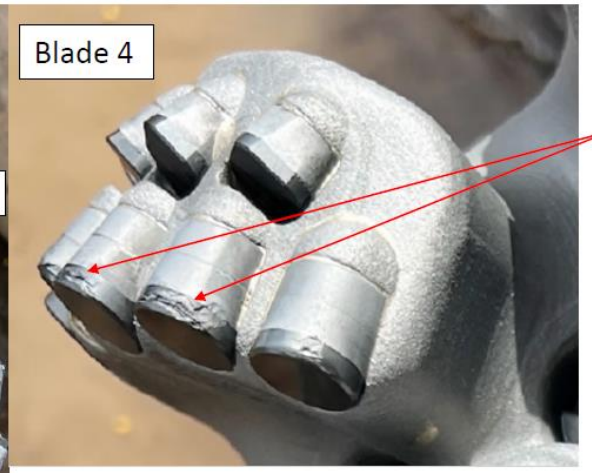
Mud Motor (6/7 7.1)

9 x 6 ¾” DC

30 x HWDP

9.5” TKC73-A2 Dull Analysis





Notes: The primary damage to the cone cutters/nose cutters was due to impact damage in the axial direction. The breakage is perpendicular and centered to the cutter face, indicating axial vibration. The TCCs in the cone appear to have broken on several different planes, suggesting several high impact events took place.

The core out likely occurred after the failure of the B1C1. B5C1 failed at 90 degrees to the cutter face from increased side load after B1C1s failure.

Breaking B1C1 may have induced extra vibration because in the time it would have taken to core out, the cutters only showing carbide should have larger wear flats. This indicates several cutters broke during/end of the core out, right before the bit was pulled.

Comments from NOV Report

Pulled for DTF. High lateral vibrations were seen from MWD tool. This limited Rotary RPM’s for majority of the run.

Bit cored out due to center column of granite not being destroyed. This means we have a very smooth borehole but could be due to the RSS keeping the bit with minimal DogLegs.

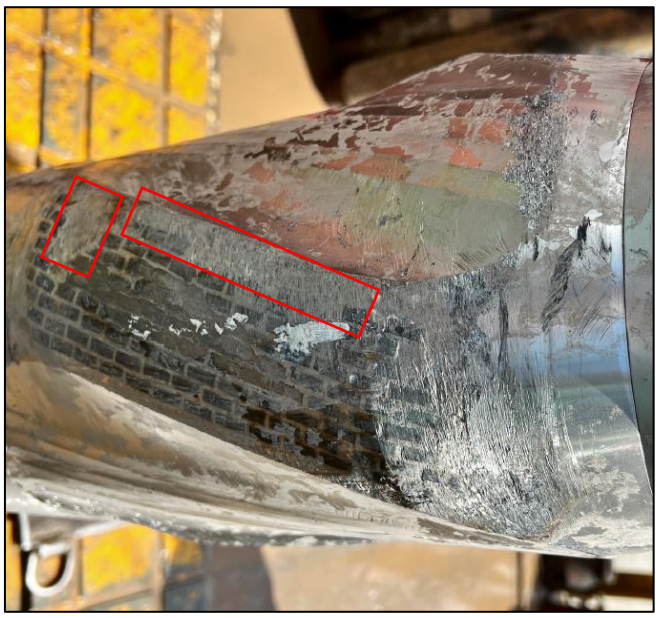
Steel shot from Particle Drilling trial was still seen in the mud at a 5% concentration.

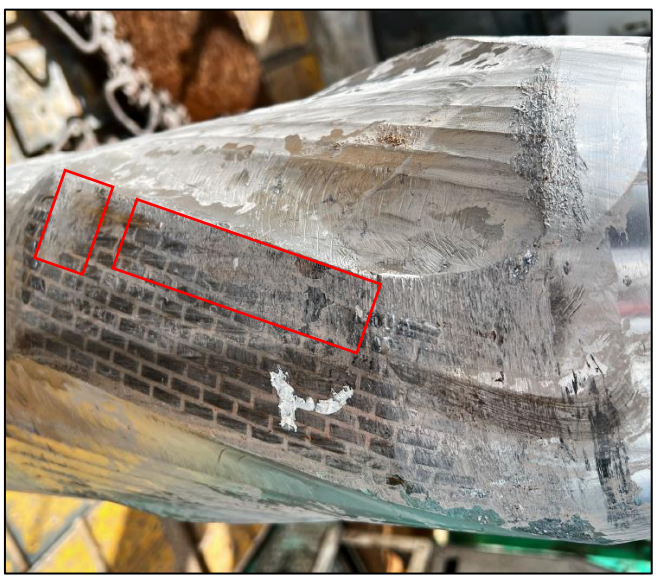
Solution: Bit modeling shows the core out occurring at a DOC higher than 7mm/rev. We can drill at the same ROP within this DOC range by increasing Bit RPM’s or by setting an ROP limiter.

Potentially separate blades on the bit to remove formation column.

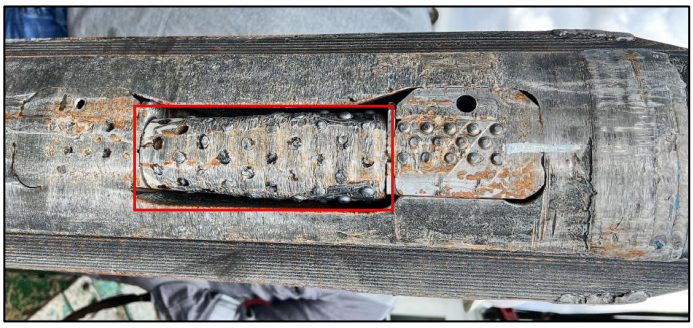
BHA #11 (4) Motor Driven HALO RSS

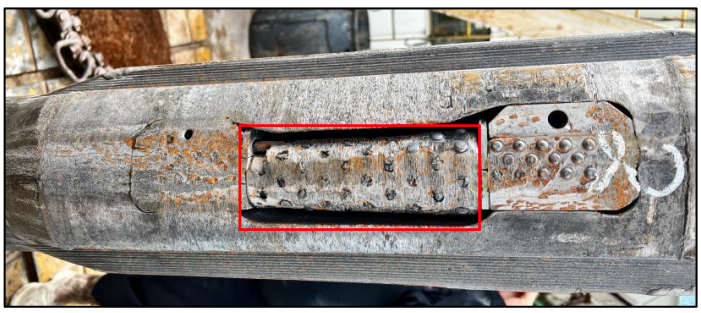
Leading Edge Wear



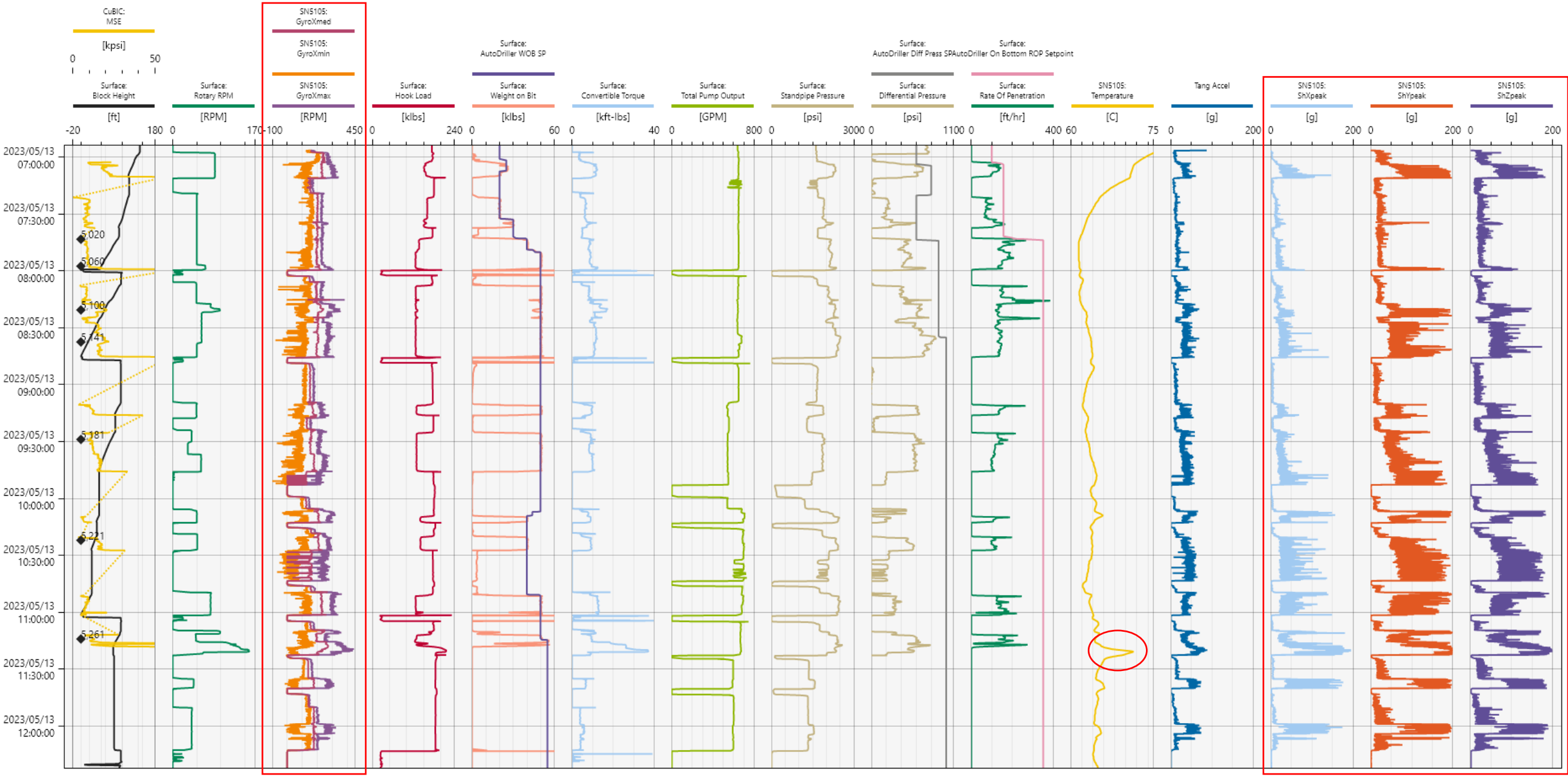


Roller Element & Button Wear





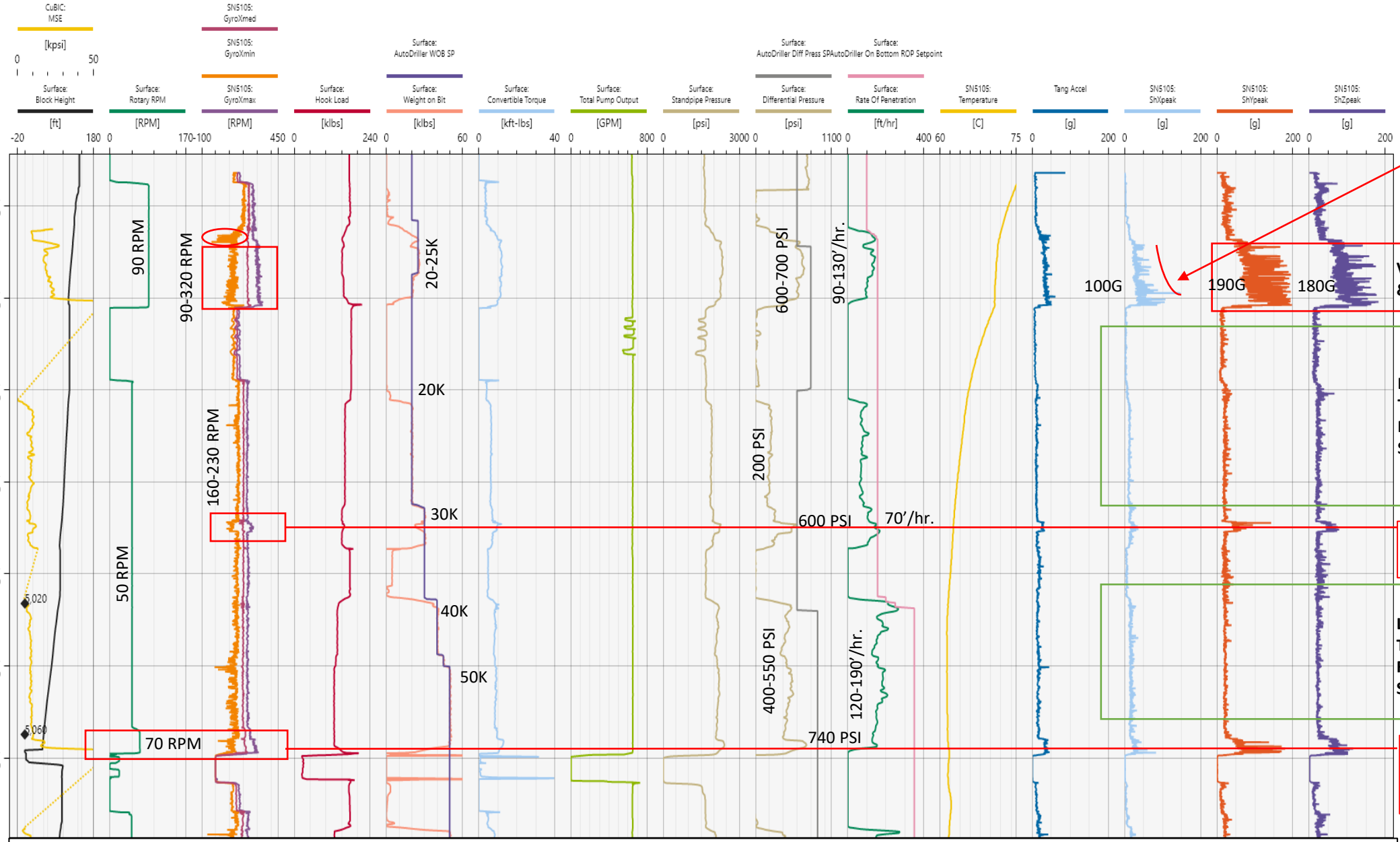
BHA #11 (4) – Entire Run (Motor Driven HALO)



Bit Negative RPM

Bit High Peak Shocks all 3-Axis

BHA #11 (4) – Stand Zoom



Axial Peak Shock Increase before and while transition off-bottom

Very High Axial, Tangential & Radial Peak Shock

Low Axial, Tangential & Radial Peak Shock

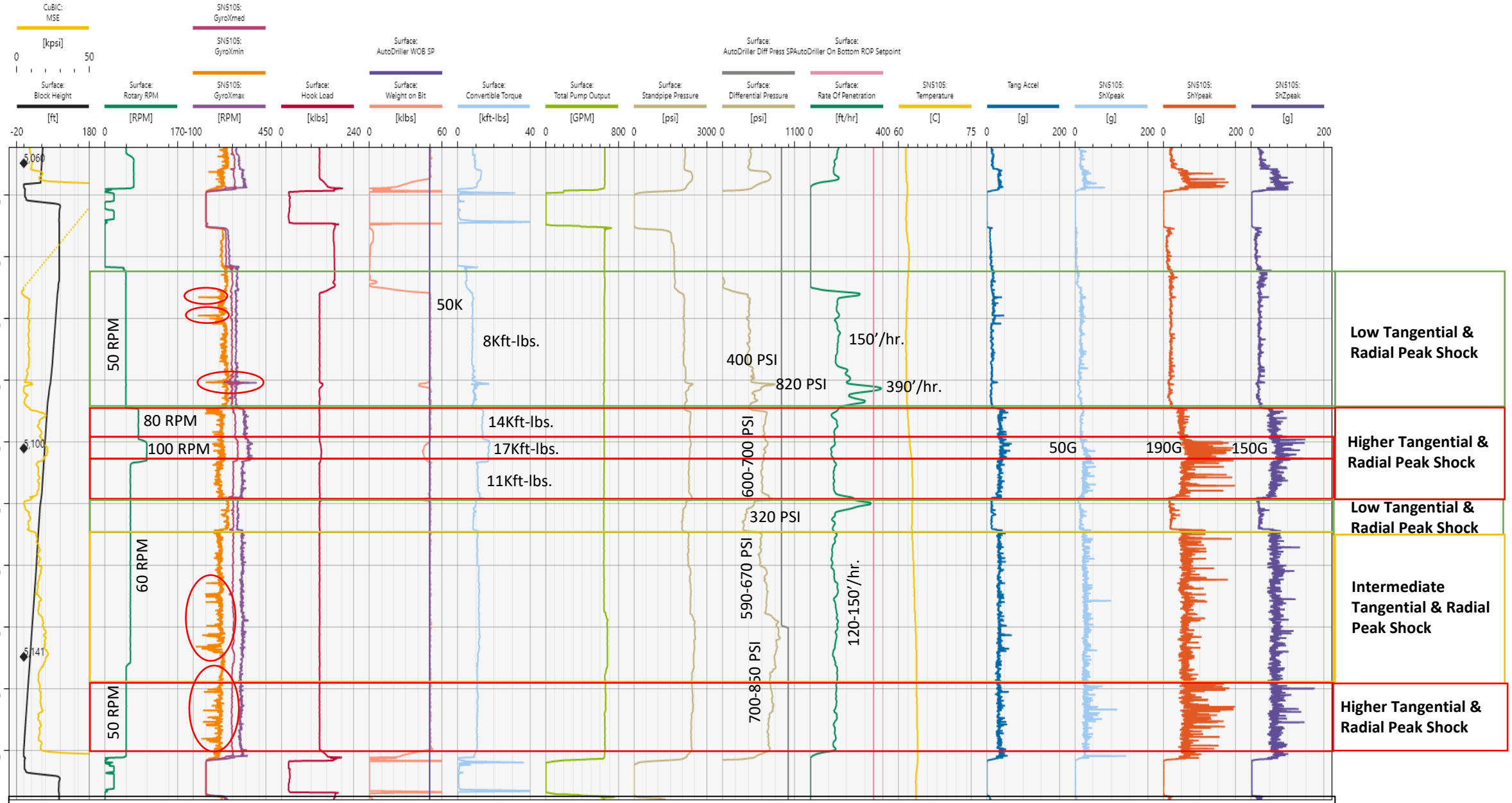
Diff Increase – Higher Tangential & Radial Peak Shock

Low Axial, Tangential & Radial Peak Shock

Increase RPM/Diff – Higher Axial, Tangential & Radial Peak Shock

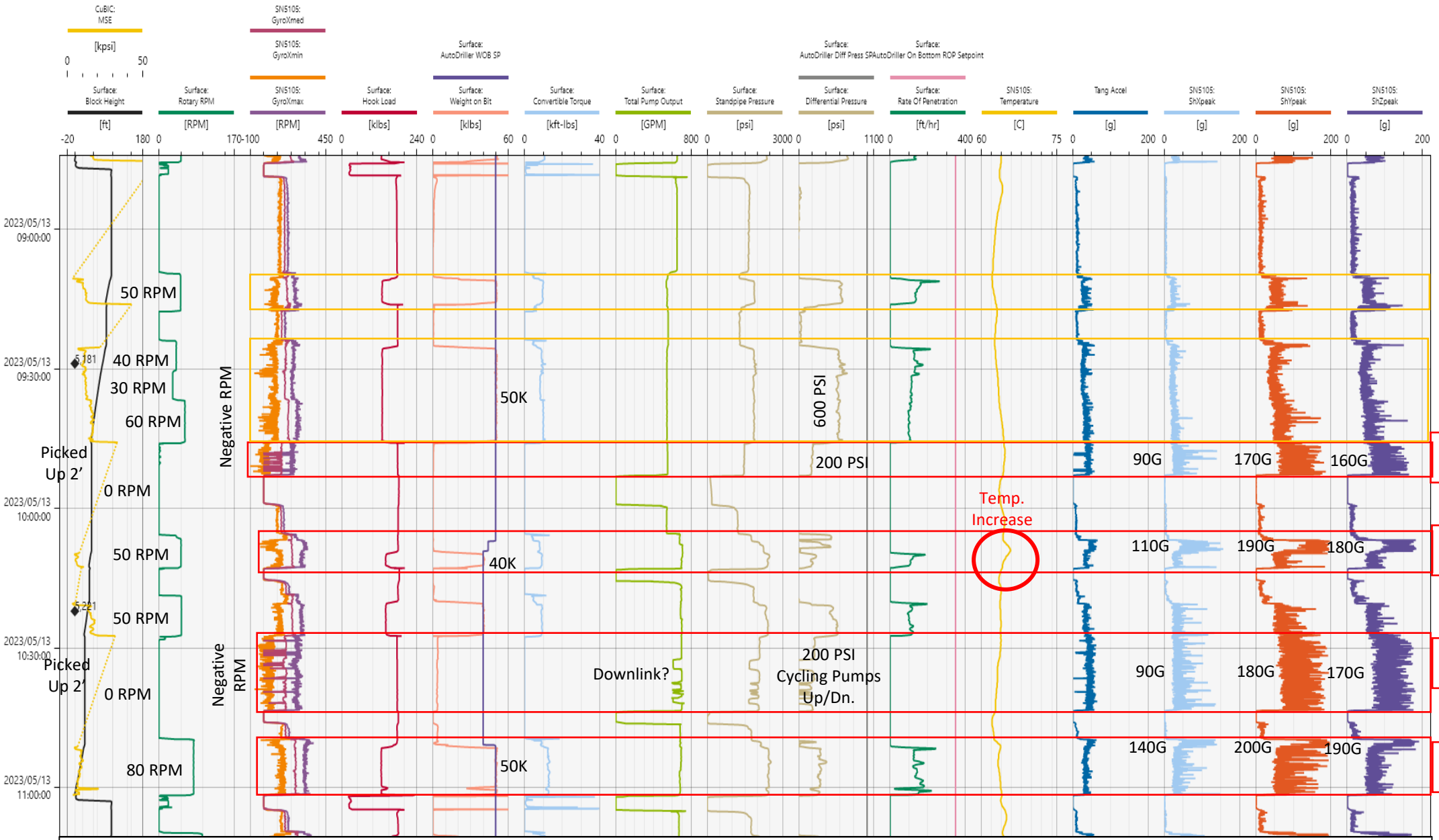
Increased differential pressure correlates to increased tangential/radial shocks and gyro spread.

BHA #11 (4) – Stand Zoom



Increased tangential/radial shocks and gyro spread when surface RPM increased from 50 to 80 to 100 RPM. 100 RPM worst condition.

BHA #11 (4) – Stand Zoom



High Axial, Tangential & Radial Peak Shock Partially Off-Bottom

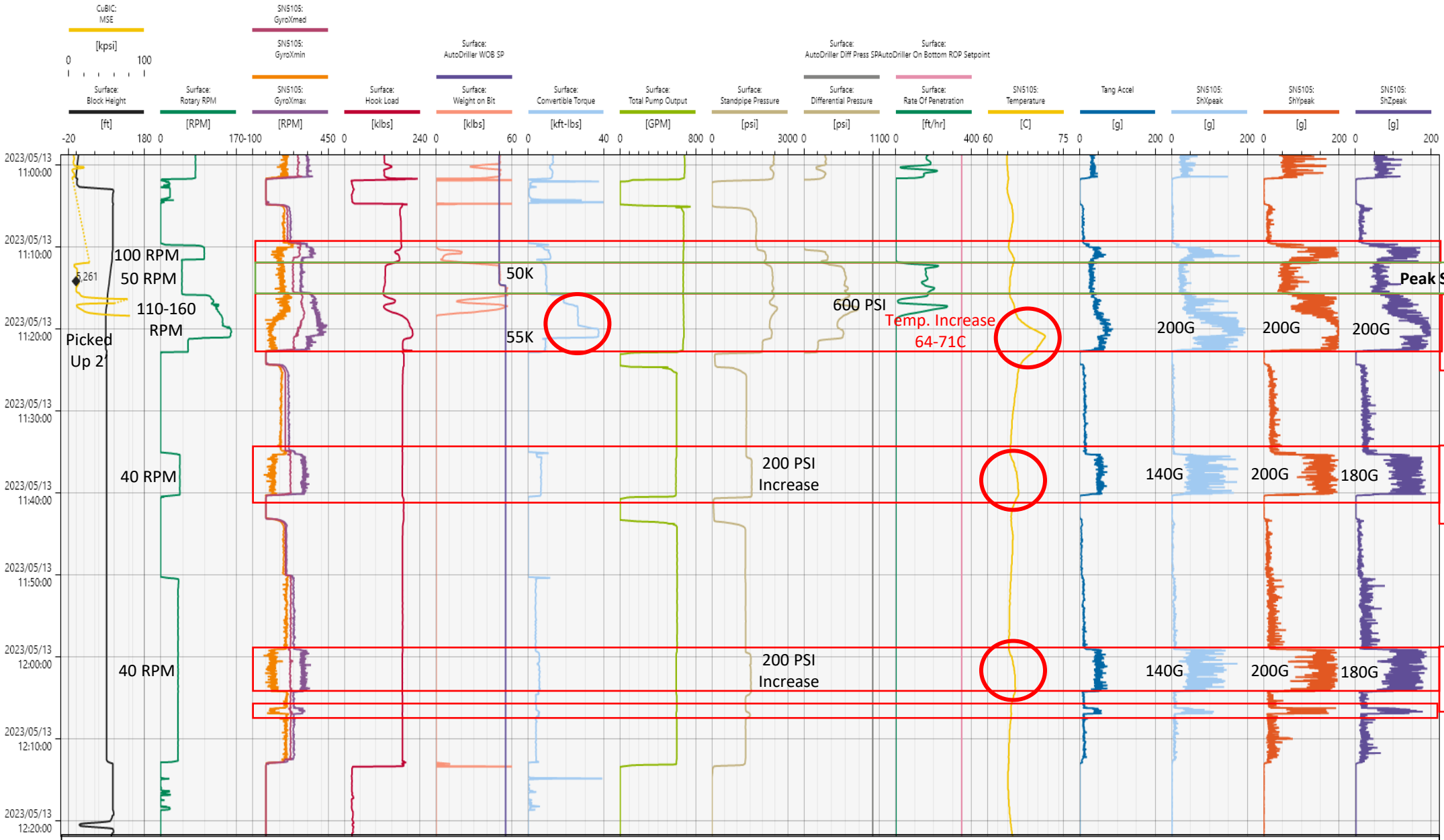
High Axial, Tangential & Radial Peak Shock Partially On-Bottom

High Axial, Tangential & Radial Peak Shock Partially Off-Bottom

High Axial, Tangential & Radial Peak Shock Partially On-Bottom

Of significant interest on this stand is increased 3-axis shocks when picked up 2' off bottom – Is this bit off bottom? Is this bit whirl?
Temperature increase is significant event for a centerline mounted sensor (if this is dynamics/rock interaction driven).

BHA #11 (4) – Stand Zoom



Peak Shock Levels Reduced On-Bottom

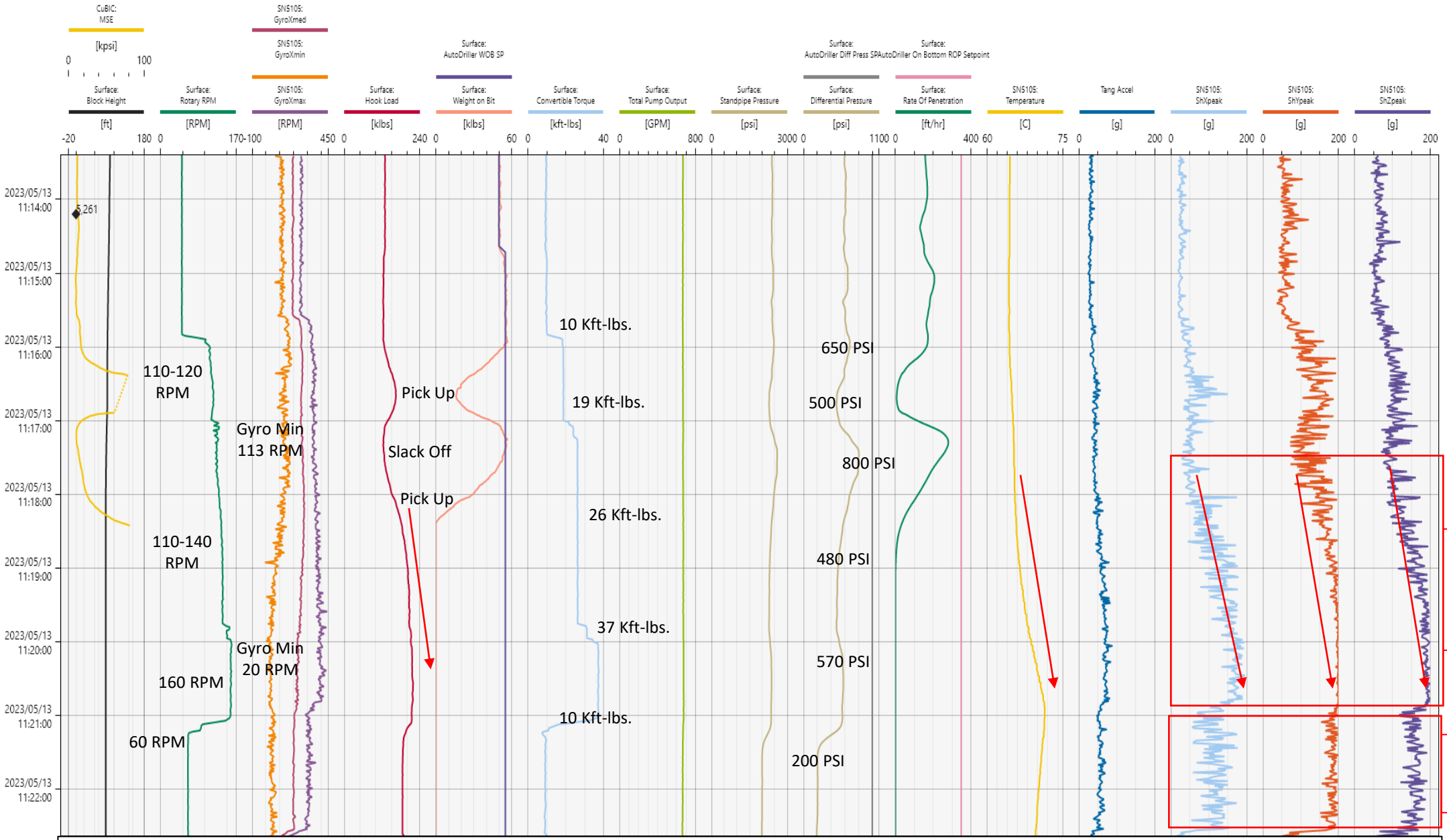
Very High Axial, Tangential & Radial Peak Shock Off-Bottom (whirl?)

Very High Axial, Tangential & Radial Peak Shock Off-Bottom (whirl?)

Very High Axial, Tangential & Radial Peak Shock Off-Bottom (whirl?)

Of significant interest on this stand is increased 3-axis shocks when 1) Ramping up RPM /picking -up and partially off bottom (see next slide zoomed);
2) Picked up 2' off-bottom – Is this bit off bottom? Is this bit whirl? Is the whirl transferring to BHA? Need to validate with NOV BB data.

BHA #11 (4) – Stand Zoom

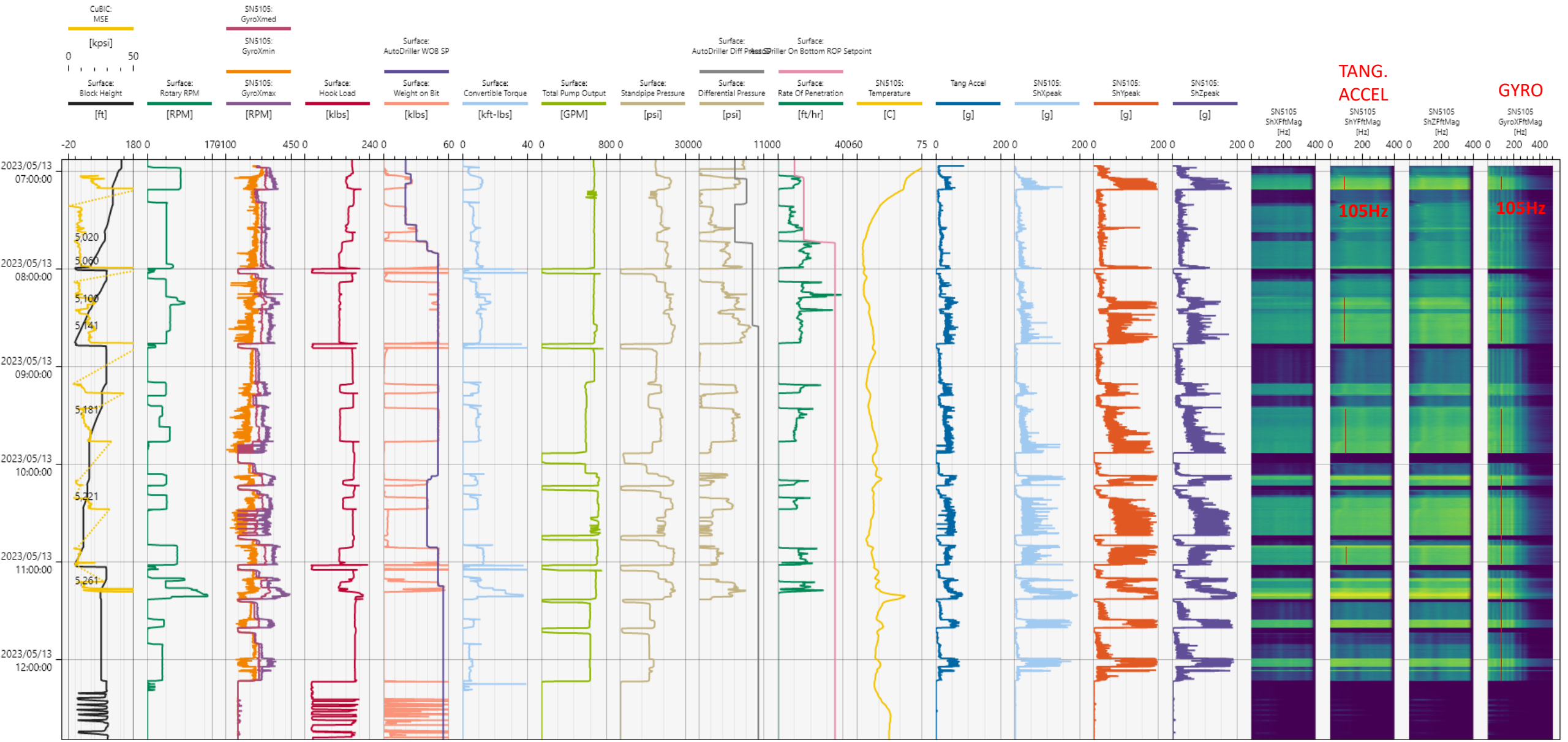


Axial, Tangential & Radial Peak Shocks progressively increasing to very high levels when picking up. Temperature increase is seen at same time.

Reduction in 3-axis peak shock correlates with reduction in surface RPM.

All 3-axis peak shocks increase when picking up and ramping up surface RPM. Temperate increase at same time. Motor continues to pull differential. Possible bit is not fully off-bottom in combination with bit whirl. Any indication of string whirl from NOV sensor sub?

BHA #11 (4) – Bit Frequency (Motor Driven HALO)



BHA #11 (4) – Discussion

- Post run comments stated high lateral vibrations at MWD.
- Temperature increase during high levels of 3-axis peak shock is significant. This is a condition that will cause thermal damage to bit/cutters.
- Very high 3-axis Peak Shocks (up to 200G) experienced during run (HFTO 105Hz).
- Negative bit RPM events experienced through run.
- Clear correlation between higher differential pressure and increased 3-axis peak shocks while on-bottom.
- Clear correlation between higher surface RPM and increased 3-axis peak shocks while on-bottom.
- Off-bottom events are significant (transitioning off-bottom) shows very high 3-axis peak shocks and still pulling torque and differential pressure. Looks very much like bit whirl.
- Should use NOV BB data to evaluate magnitude of mud motor back-drive throughout the run.
- Bit cutter damages (and wear pattern on DOC limiters) likely due to negative RPM events.
- Roller reamer roller element/button and stabilizer wear likely due to BHA whirl which was more severe while off bottom. Need to verify with NOV BB data.

BHA #12 (5) HALO RSS NO MOTOR

Interval	BHA #	Run in That Hole Size	Bit Size	Bit Type	Bit Serial Number	Bit Mfg	Depth In (ft MD)	Depth Out (ft MD)	Footage Drilled (ft)	On Bottom Hours	On Bottom ROP (ft/hr)
Curve	BHA #5	4	9.50	TKC73-A2	A298328	REEDHYCALOG	5269	5957	688	10.44	66

NO MOTOR IN BHA

Bottom Hole Assembly

Job#	OP.039349	**Rig**	Frontier 16	**BHA Length (Usft)**	1296.36
Operator	Utah Forge	**BHA #**	5	**BHA Weight dry (klbs)**	70.21
Well	16B(78)-32 - 16B(78)-32	**Bit #**	5	**BHA Weight Bouyed (klbs)**	60.67
Field	Beaver (University of Utah) - Utah Forge	**Depth In (Usft)**	0.00	**Wt. Below Jars dry (klbs)**	70.21
Date In		**Depth Out(Usft)**	0.00	**Wt. Below Jars Bouyed (klbs)**	60.67
Date Out		**Drilled(Usft)**	0.00	**Drilling / Circ Hours**	0.00 / 0.00

Sensor Offsets

Survey Offset	N/A	Gamma Offset	N/A	Gyro Offset	N/A

#	SN	Description	OD (in)	ID (in)	FN OD (in)	FN Length (Usft)	Cnx Up	Cnx Dn	Unit Weight (lb/ft)	Comp Weight (klbs)	Total Weight (klbs)	Length (Usft)	Total Length (Usft)
1	A298328	9 1/2" 7 Blade PDC bit	9.500	2.750	0.000	0.00	4 1/2 REG P		0.000	0.00	0.00	1.13	1.13
2	76001175	HALO RSS w/HFTO (Stiff)	6.750	2.000	6.688	0.00	4 1/2 IF B	4 1/2 REG B	0.000	0.00	0.00	35.31	36.44
3	ASM 9008	Spiral wrapped IB Stabilizer	6.500	2.813	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	5.66	42.10
4	125-373	6 3/4 NM Pony DC	6.438	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	9.22	51.32
5	84-772	6 3/4 NMDC	6.813	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	31.11	82.43
6	GU3275	FG 9 1/2" Roller reamer	6.625	2.938	6.625	2.10	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	6.71	89.14
7	7027	6 3/4 Black Box	6.750	2.250	6.750	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	6.00	95.14
8	AFLS603	6 3/4" Float sub	6.375	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	2.45	97.59
9	DR 48701	6 3/4 Filter sub	6.688	3.250	6.688	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	3.93	101.52
10	N/A	9 JTS, 6 3/4" DC's	6.813	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	100.000	27.83	27.83	278.27	379.79
11	N/A	Crossover (DC's to HWDP)	6.937	3.000	0.000	0.00	5 1/2 FH B	4 1/2 IF P	0.000	0.00	27.83	3.15	382.94
12	N/A	30 JTS HWDP	5.500	3.625	0.000	0.00	5 1/2 FH B	5 1/2 FH P	46.400	42.38	70.21	913.42	1296.36

Comments

Halo 7600-1125; Pulser 128-474; Eye 1733; Gamma 1182; Battery 042-29SEP22AB NO MOTOR ASSIST Flow Range = 500-750 9 3/8 Spiral 3 blade stabilizer Eye = 22 Gamma = 17 NB Inc/Az = 7 Make up torque, 4 1/2 Reg = 19,500 4 1/2 IF = 29,000

HALO STIFF

STAB

RR

Black Box

9 x 6 ¾” DC

30 x HWDP

BHA #12 (5) HALO RSS NO MOTOR

Comments from NOV Report

ROP Limiter: Drilled curve from 0 degrees to 20 degrees. BHA had a Halo RSS but no mud motor.

Curve started at 5,480'

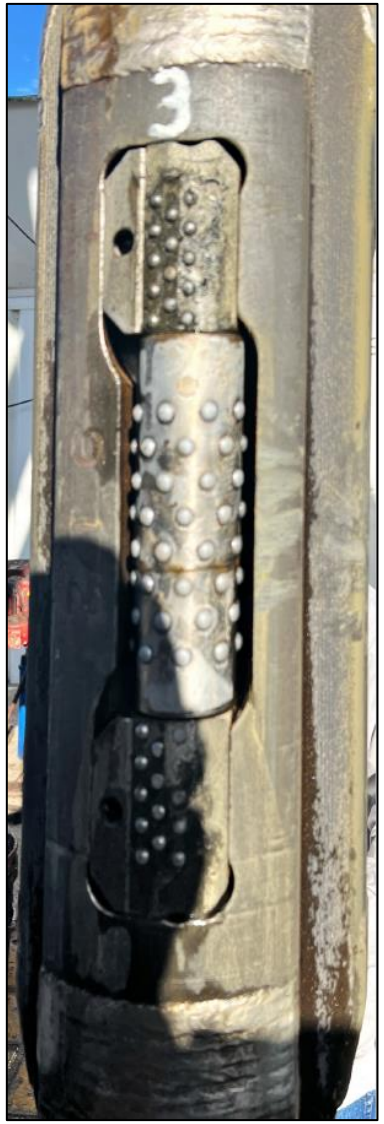
Had a short trip at 5,537' due to the Riser on the BOP stack breaking.

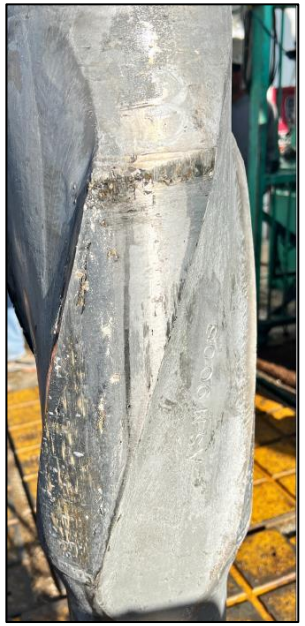
Maintained drilling at 65 klbs and 75 Bit RPM's

Bit tripped for Halo signal loss, increase in MSE and lower ROP on the BHA.

Solution: Figure out BHA vibration modeling to allow for mud motor to be ran.

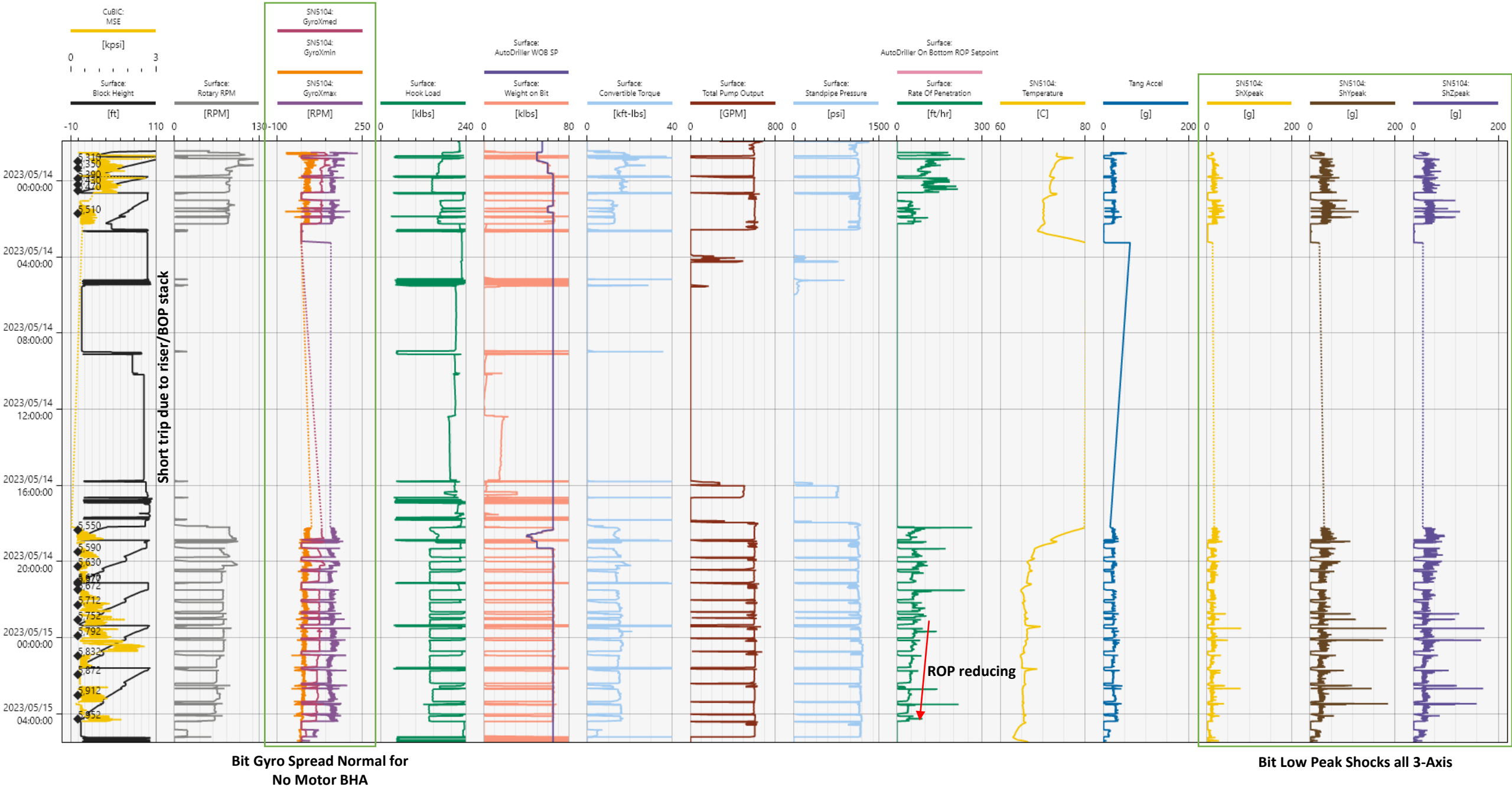
BHA #12 (5) HALO RSS NO MOTOR



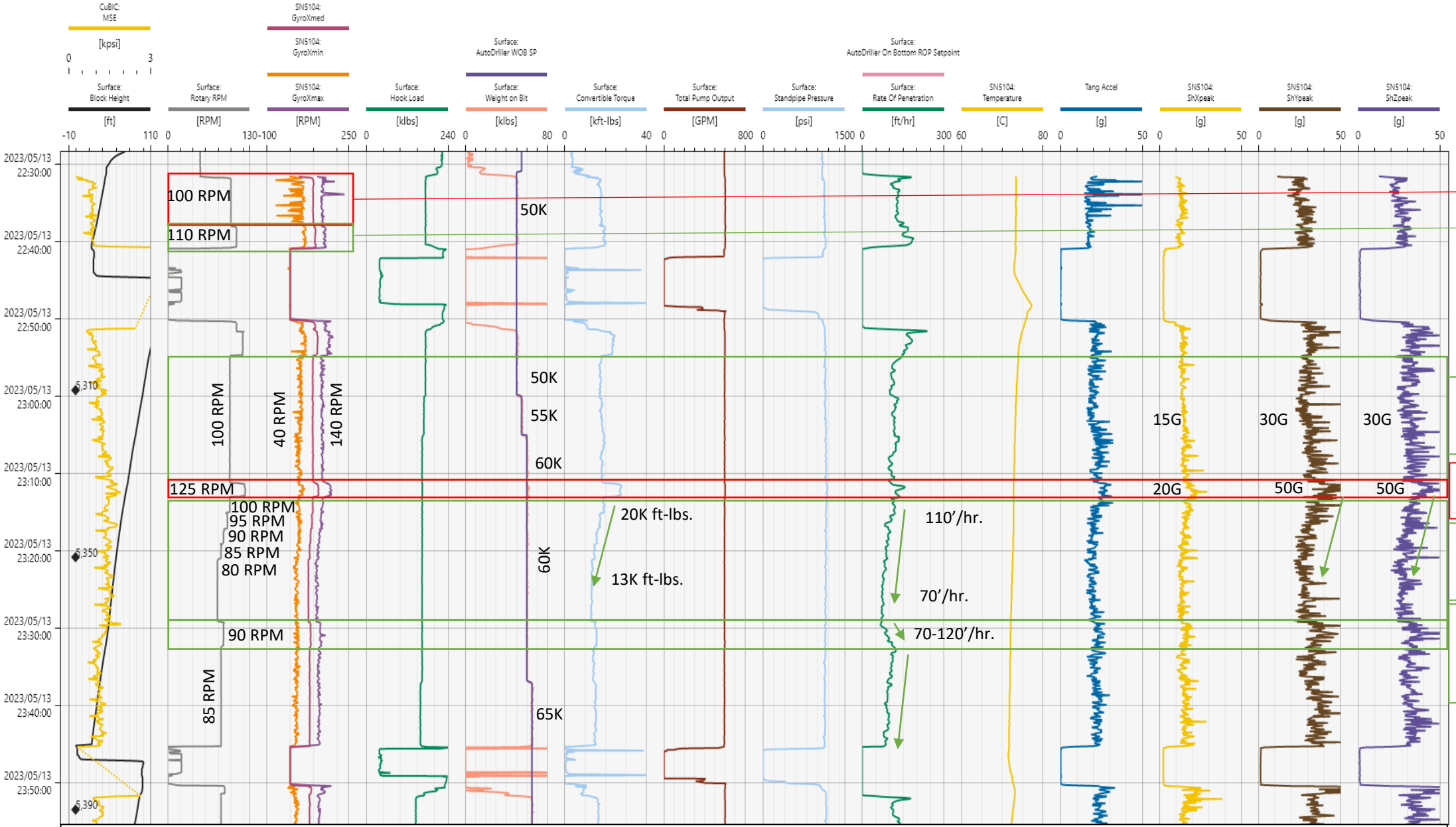


Good condition.

BHA #12 (5) – Entire Run



BHA #12 (5) – Stand Zoom



Negative Gyro RPM

Gyro RPM stable when increased to 110 RPM.

WOB Step Test - No change to Gyro Spread or 3-axis Peak Shock.

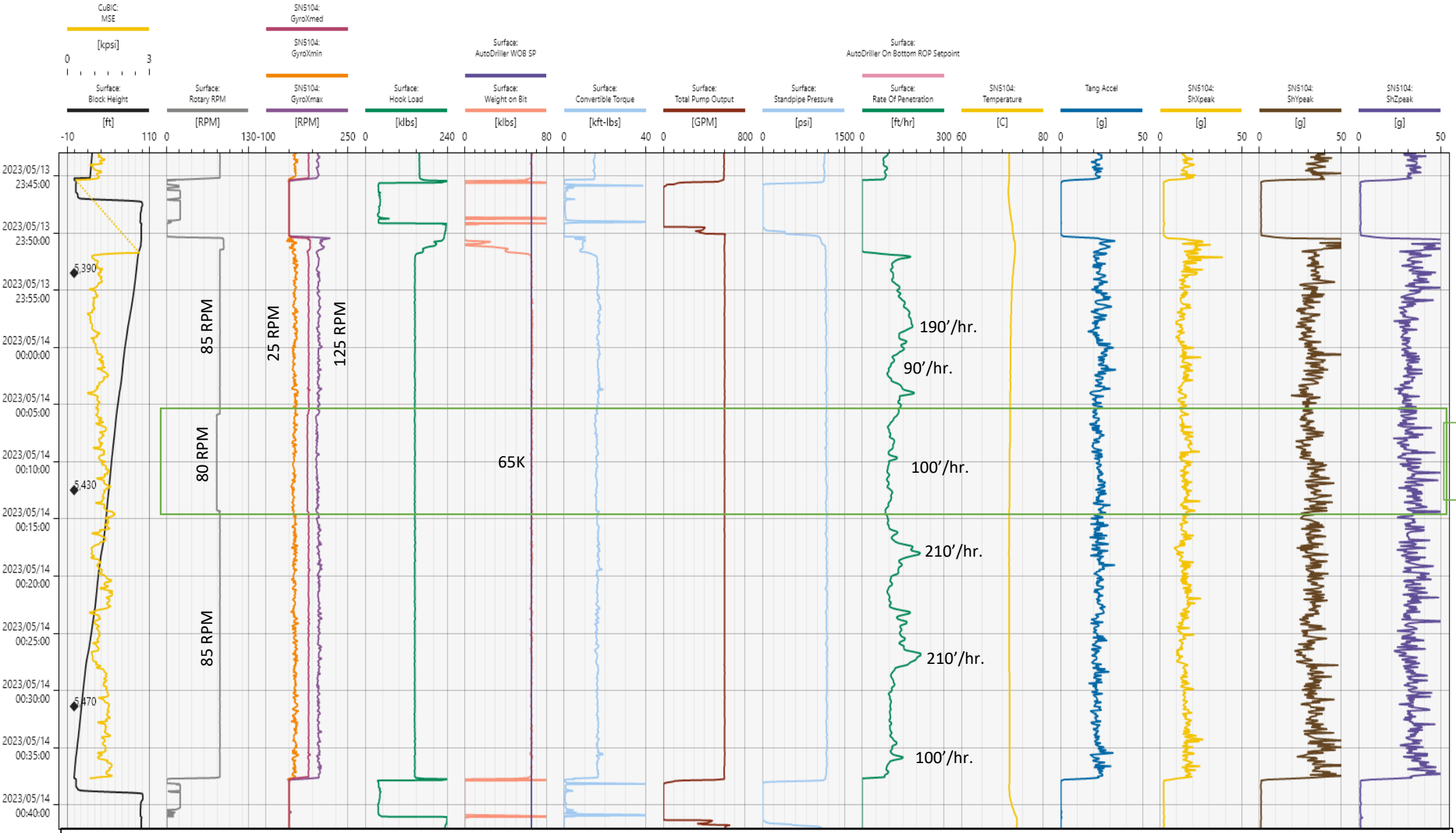
Increased 3-axis Peak Shocks at 125 RPM.

RPM Step Test – Reduction in torque and Radial/Tangential Peak Shocks.

At 90 RPM, ROP increase and slight increase in Radial/Tangential Peak Shocks.

WOB and RPM step tests at start of run. WOB step tests did not show any significant bit dynamics change. RPM step test showed reduction in radial and tangential shocks at lower RPM.

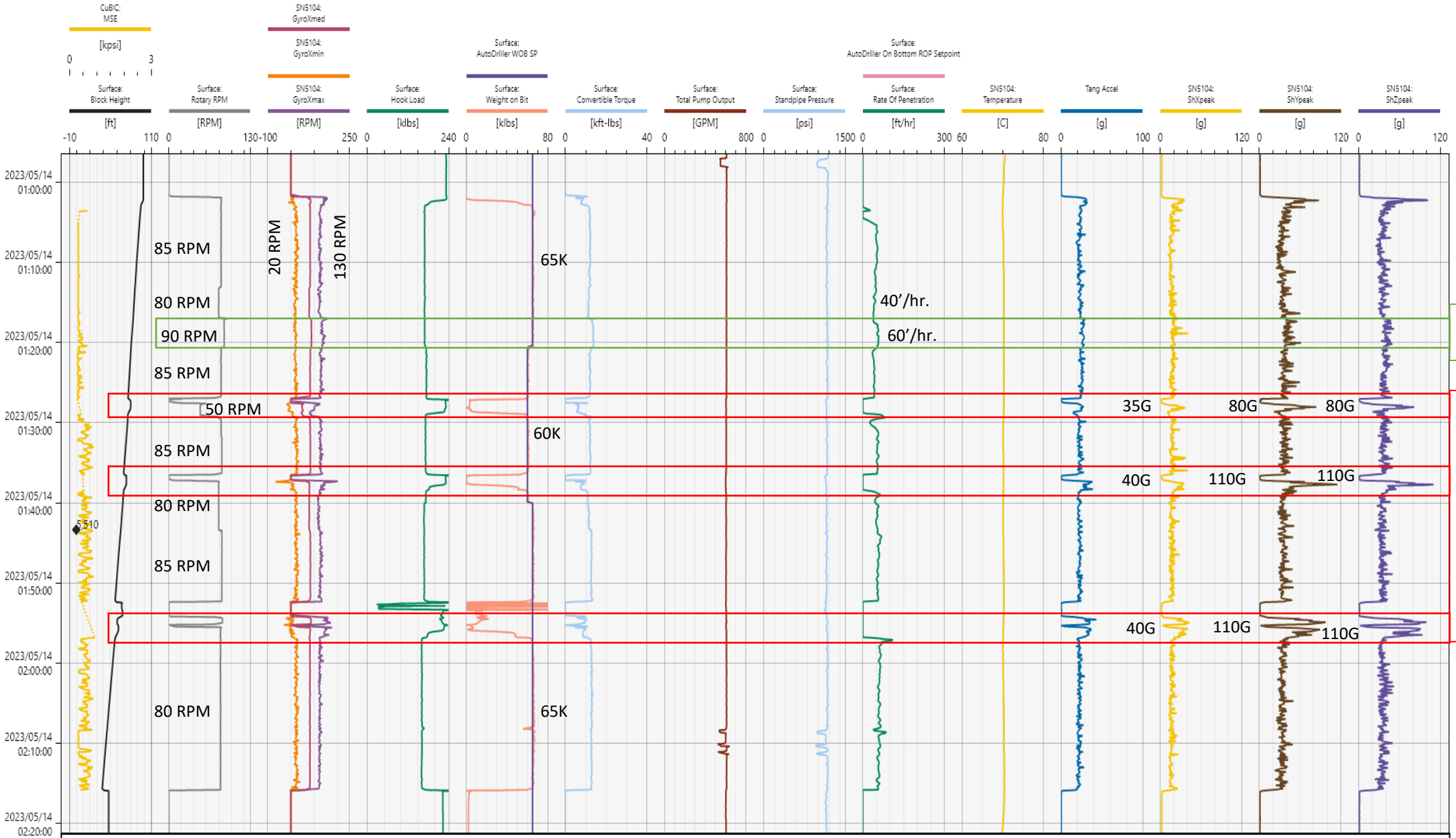
BHA #12 (5) – Stand Zoom



WOB constant through stand. Reduction to 80 RPM had no impact on Peak Shocks.

Steady drilling stand with mostly constant parameters. Variable ROP driven by rock or RSS housing roll rate (friction).

BHA #12 (5) – Stand Zoom



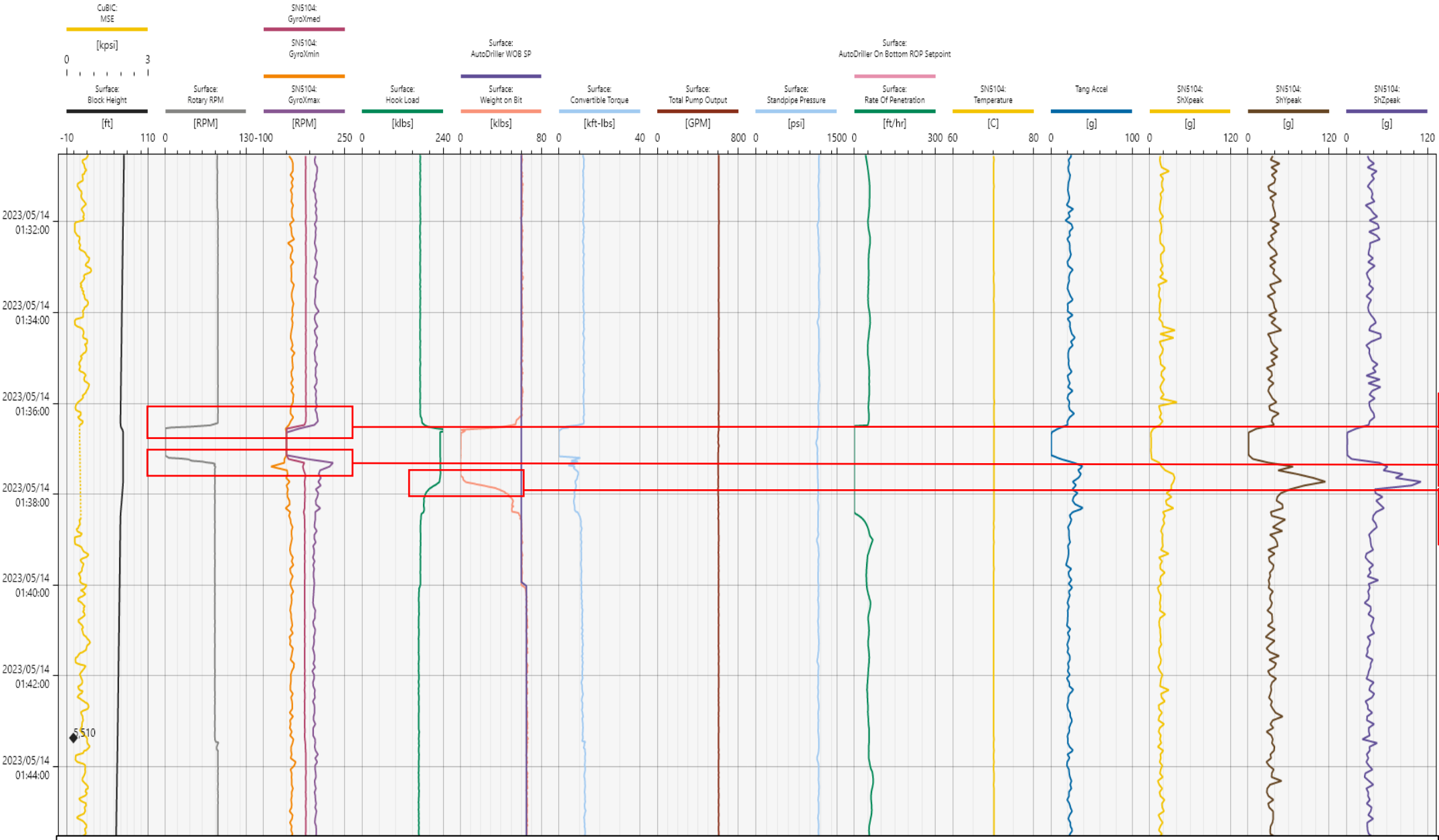
At 90 RPM, ROP picked up to 60'/hr.

High 3-axis Peak Shock events during transitional operations picking-up and going back to bottom.

See detail on next slide.

Increasing to 90 RPM increased ROP. High 3-axis Peak Shocks experienced during transitional operations.

BHA #12 (5) – Event Zoom



Pick-up and stop rotating.

Start rotary, Shocks increase off-bottom.

Start rotary and slack-off. Shocks decrease.

Stop and start RPM during pick-up and off-bottom induced high 3-axis Peak Shocks. Slack-off and application of weight reduced Shocks.

BHA #12 (5) – Discussion

- Torsional and 3-axis Peak Shock dynamics are significantly improved with removal of mud motor from BHA (200G to sub 50G).
- WOB step tests from 50-60K lbs. showed no change in gyro spread or 3-axis Peak Shocks.
- 120 RPM showed slight increase in 3-axis Peak Shocks.
- RPM step test from 100-80 RPM showed reduction in torque (20-13K ft-lbs.) and reduction in Tangential/Radial Peak Shocks.
- Higher RPM delivered higher ROP.
- Bit, stabilizers and roller reamer in good condition.

BHA #13 (6) HALO RSS NO MOTOR

Interval	BHA #	Run in That Hole Size	Bit Size	Bit Type	Bit Serial Number	Bit Mfg	Depth In (ft MD)	Depth Out (ft MD)	Footage Drilled (ft)	On Bottom Hours	On Bottom ROP (ft/hr)
Curve	BHA #6	5	9.50	TKC73-A2	A298330	REEDHYCALOG	5957	6545	588	10.04	59

NO MOTOR IN BHA

Bottom Hole Assembly

Job#	OP.039349	**Rig**	Frontier 16	**BHA Length (Usft)**	1286.80
Operator	Utah Forge	**BHA #**	6	**BHA Weight dry (klbs)**	70.21
Well	16B(78)-32 - 16B(78)-32	**Bit #**	6	**BHA Weight Bouyed (klbs)**	60.67
Field	Beaver (University of Utah) - Utah Forge	**Depth In (Usft)**	5957.00	**Wt. Below Jars dry (klbs)**	70.21
Date In	05/15/2023	**Depth Out(Usft)**	5957.00	**Wt. Below Jars Bouyed (klbs)**	60.67
Date Out	05/15/2023	**Drilled(Usft)**	0.00	**Drilling / Circ Hours**	0.00 / 0.00

Sensor Offsets

Survey Offset	N/A	Gamma Offset	N/A	Gyro Offset	N/A

	#	SN	Description	OD (in)	ID (in)	FN OD (in)	FN Length (Usft)	Cnx Up	Cnx Dn	Unit Weight (lb/ft)	Comp Weight (klbs)	Total Weight (klbs)	Length (Usft)	Total Length (Usft)
	1	A298330	9 1/2" 7 Blade PDC bit	9.500	2.750	0.000	0.00	4 1/2 REG P		0.000	0.00	0.00	1.13	1.13
	2	76000233	HALO RSS w/HFTO (Stiff)	6.750	2.000	6.688	0.00	4 1/2 IF B	4 1/2 REG B	0.000	0.00	0.00	35.31	36.44
	3	ASM 9007	Spiral wrapped IB Stabilizer	6.500	2.813	6.500	2.20	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	5.42	41.86
	4	84-772	6 3/4 NMDC	6.813	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	31.11	72.97
	5	GU3275	FG 9 1/2" Roller reamer	6.625	2.938	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	6.71	79.68
	6	7006	6 3/4 Black Box	6.750	2.250	6.750	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	5.90	85.58
	7	AFLS603	6 3/4" Float sub	6.375	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	2.45	88.03
	8	DR 48701	6 3/4 Filter sub	6.688	3.250	6.688	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	3.93	91.96
	9	N/A	9 JTS, 6 3/4" DC's	6.813	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	100.000	27.83	27.83	278.27	370.23
	10	N/A	Crossover (DC's to HWDP)	6.937	3.000	0.000	0.00	5 1/2 FH B	4 1/2 IF P	0.000	0.00	27.83	3.15	373.38
	11	N/A	30 JTS HWDP	5.500	3.625	0.000	0.00	5 1/2 FH B	5 1/2 FH P	46.400	42.38	70.21	913.42	1286.80

Comments

Halo 7600-1125; Pulser 128-474; Eye 1733; Gamma 1182; Battery 042-29SEP22AB NO MOTOR ASSIST Flow Range = 500-750 9 3/8 Spiral 3 blade stabilizer Eye = 22 Gamma = 17 NB Inc/Az = 7 Make up torque, 4 1/2 Reg = 19,500 4 1/2 IF = 29,000

HALO STIFF STAB

RR

Black Box

9 x 6 ¾” DC

30 x HWDP

BHA #13 (6) HALO RSS NO MOTOR

ROP Limiter: Drilled curve from 20 degrees to 40.3 degrees.

Small core out on the bit. This run was with an RSS but no motor in the hole.

Drilling at high ROP but lower RPM's yielded a big DOC which put formation rubbing on the center of the bit.

Could not run higher than 66 Rotary RPM's without inducing dysfunction. Rotary Speed is the main limitation.

Steel shot from Particle Drilling is still seen on the shakers at about 5% concentration.

Solution: Figure out BHA vibration modeling to allow for mud motor to be ran.

BHA #13 (6) HALO RSS NO MOTOR



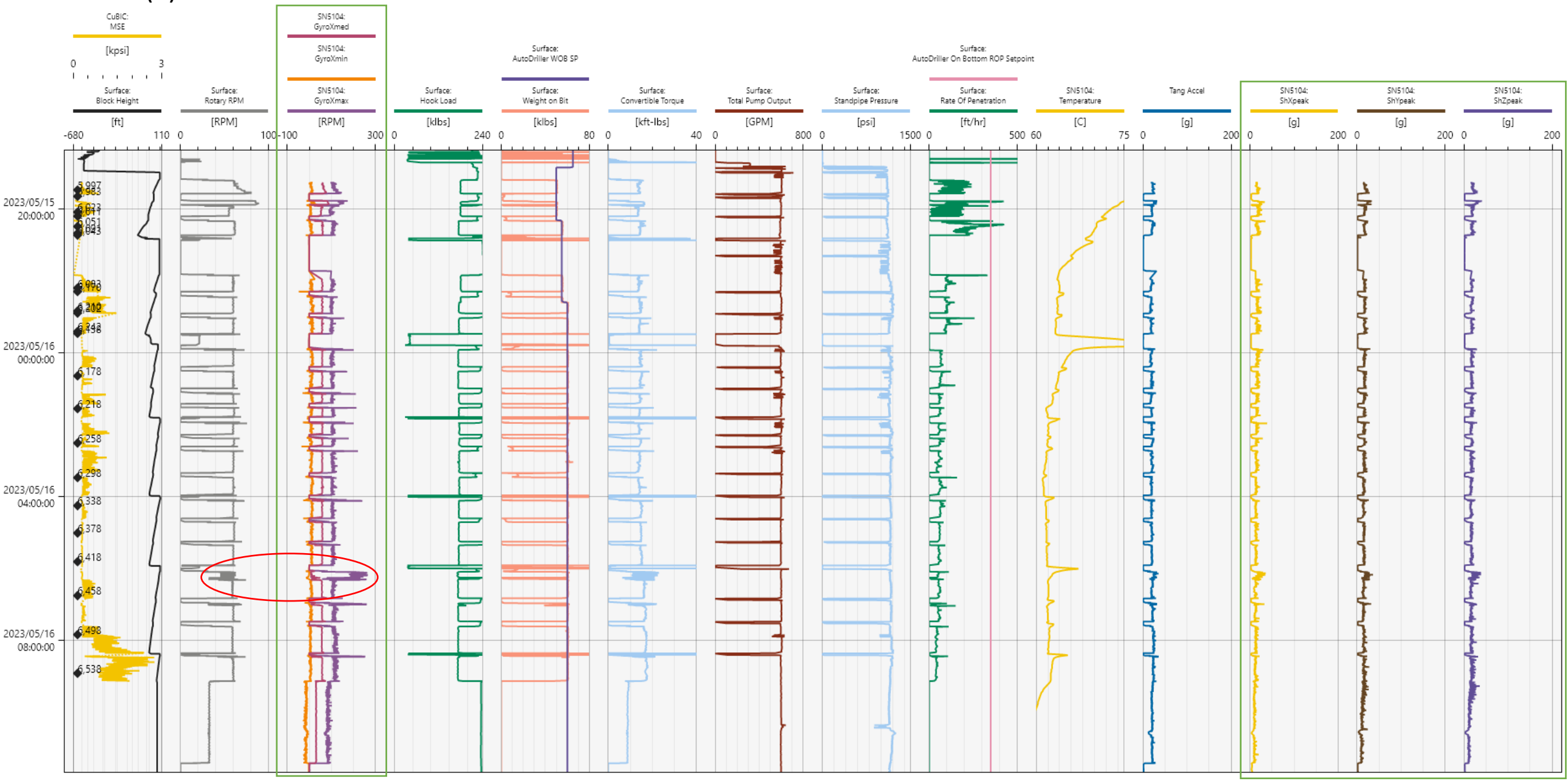






Good condition.

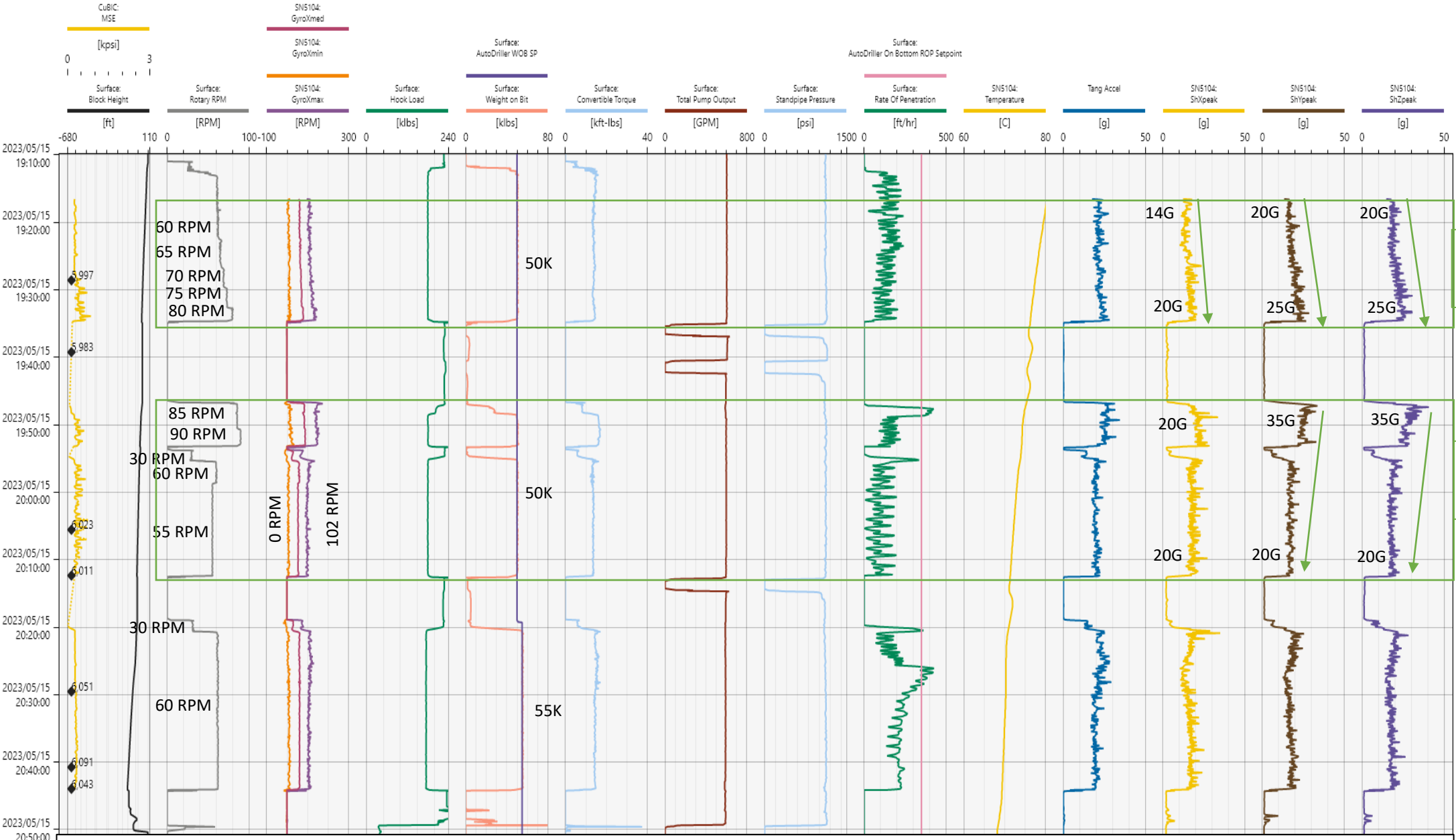
BHA #13 (6) – Entire Run



Bit Gyro Spread Normal for No Motor BHA

Bit Low Peak Shocks all 3-Axis

BHA #13 (6) – Stand Zoom

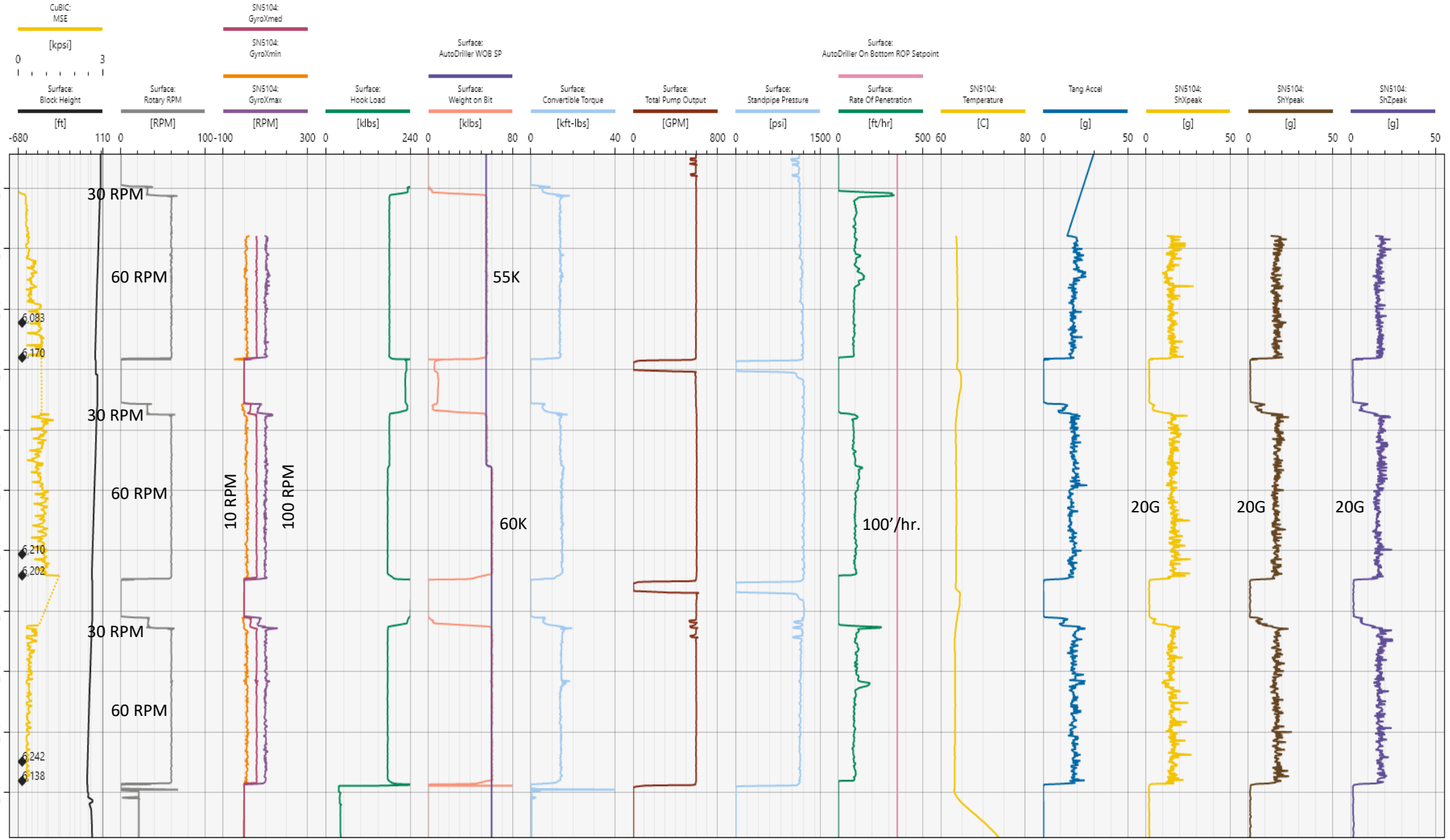


RPM step test. 3-axis Peak Shocks progressively increasing.

RPM step test. Radial and Tangential Peak Shocks are higher with higher RPM.

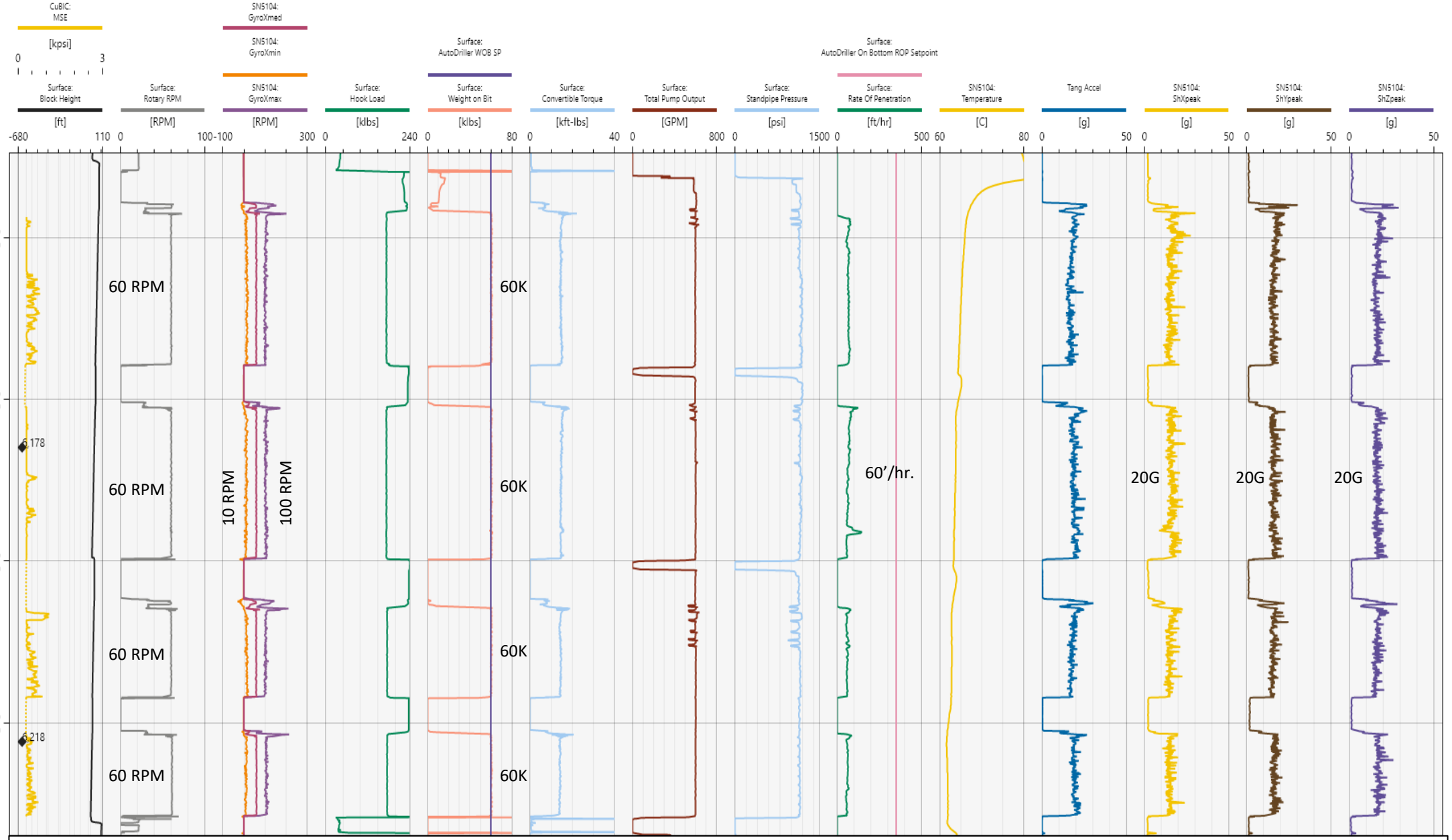
Full stall stick-slip is present (normal for rotary assembly at low RPM). Increasing RPM progressively increased Peak Shocks. 3-axis Peak Shock levels are low. ROP spread is choppy?

BHA #13 (6) – Stand Zoom



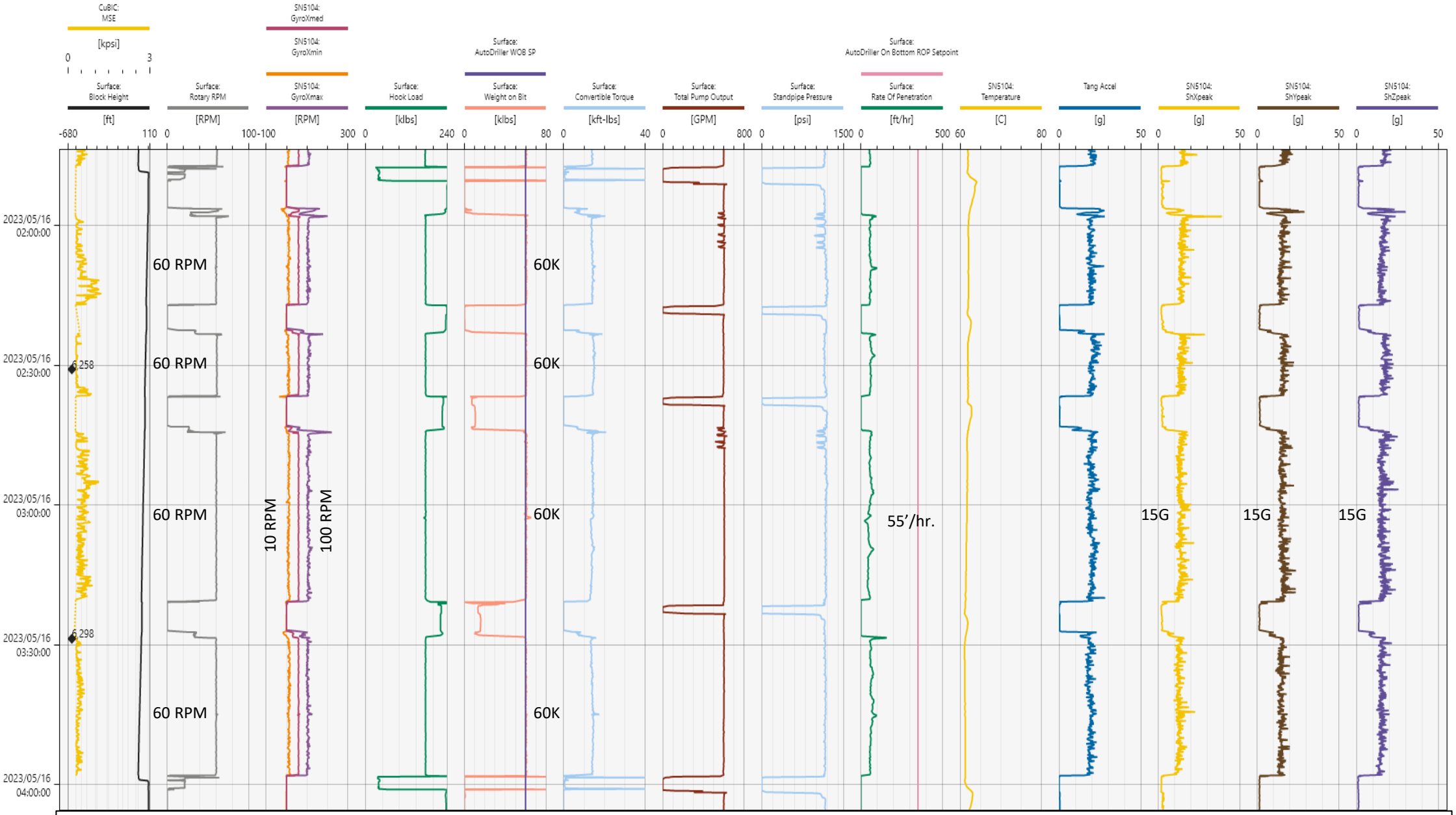
3-axis Peak Shock levels are low. ROP is steady at 100’/hr.

BHA #13 (6) – Stand Zoom



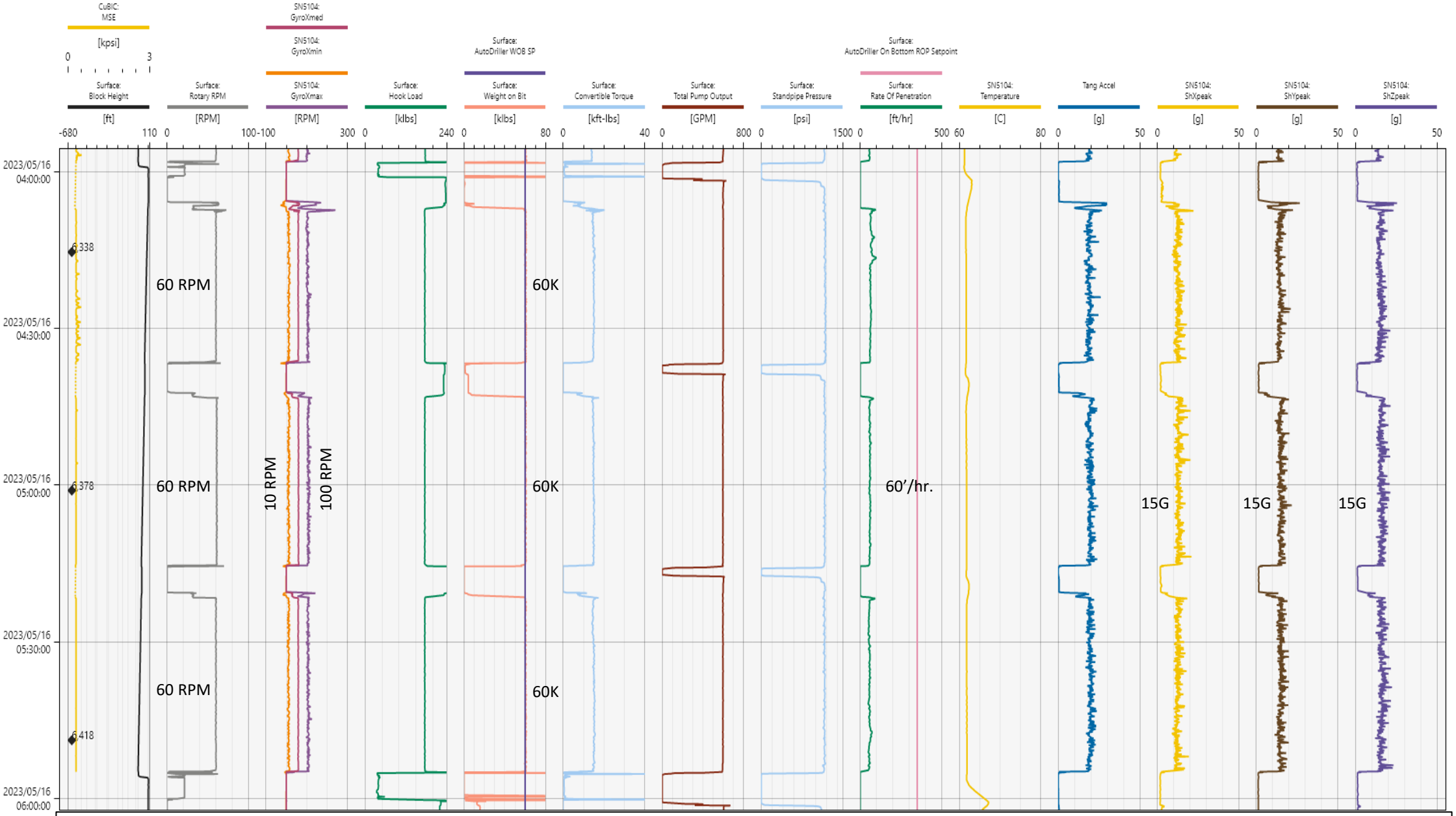
3-axis Peak Shock levels are low. ROP is steady at 60’/hr.

BHA #13 (6) – Stand Zoom



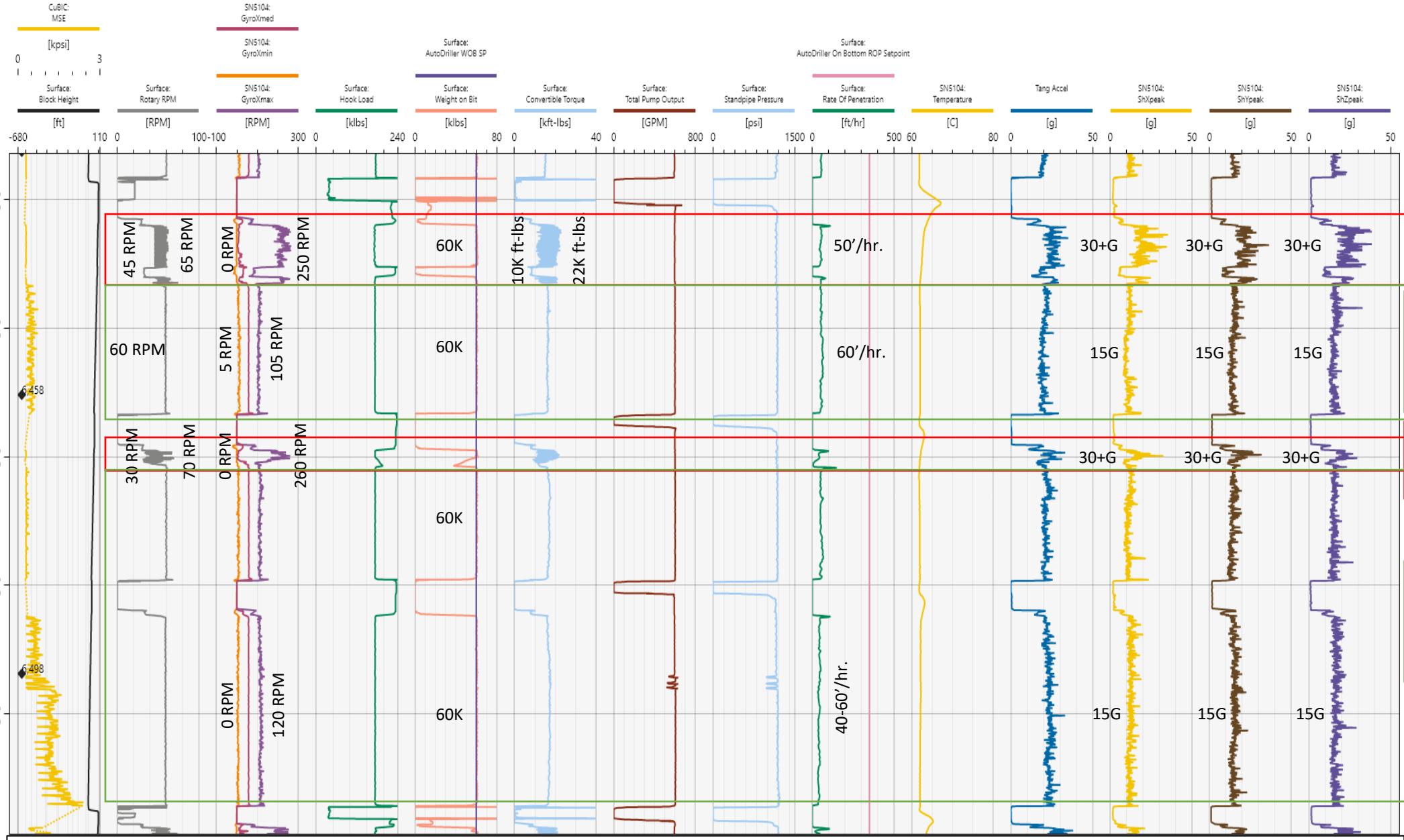
3-axis Peak Shock levels are low. ROP is steady at 55’/hr.

BHA #13 (6) – Stand Zoom



3-axis Peak Shock levels are low. ROP is steady at 55'/hr.

BHA #13 (6) – Stand Zoom



REVIT (OFF) causing significant increase in Stick-Slip and 3-axis Peak Shocks increased.

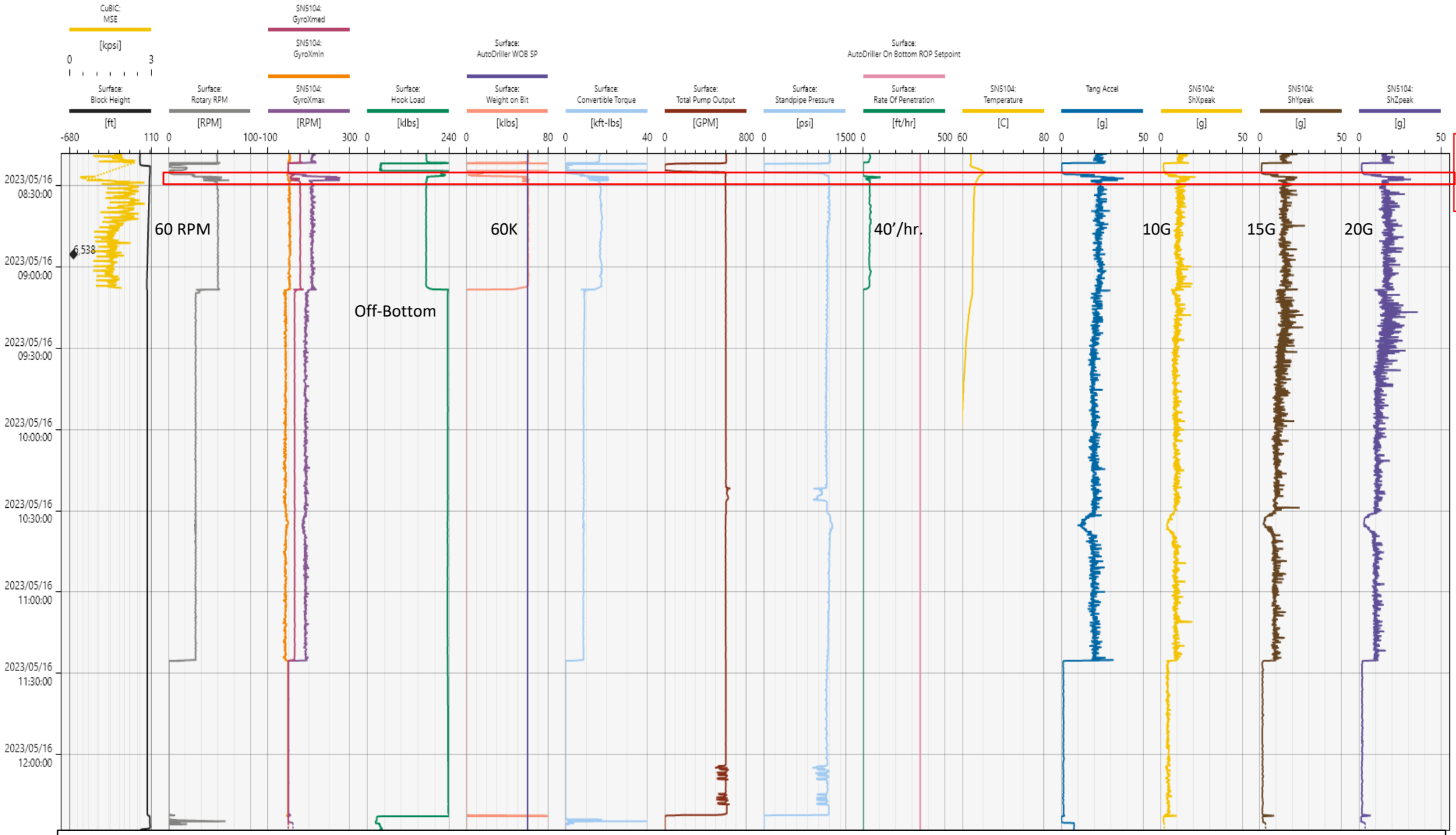
REVIT (ON) normal Stick-Slip and 3-axis Peak Shocks reduced.

REVIT (OFF) causing significant increase in Stick-Slip and 3-axis Peak Shocks increased.

REVIT (ON) normal Stick-Slip and 3-axis Peak Shocks reduced.

REVIT (OFF) is inducing severe Stick-Slip and increased 3-axis Peak Shocks at bit.

BHA #13 (6) – Stand Zoom



REVIT (OFF) causing significant increase in Stick-Slip and 3-axis Peak Shocks increased.

REVIT (OFF) is inducing severe Stick-Slip and increased 3-axis Peak Shocks at bit.

BHA #13 (6) – Discussion

- Post run comments stated could not run higher than 66 RPM without inducing dysfunction. Type of dysfunction is not stated?
- 3-axis Peak Shocks are low throughout run (typically 15-20G).
- Increasing RPM correlates with increasing tangential and radial Peak Shocks.
- Stick-slip and torsional oscillation response is normal for rotary assembly.
- 5/16 @ 06:06-06:20, 06:58-07.01, 08:26-08:27 appears REVIT disabled and induces severe stick-slip (0 to 260 RPM).
- Bit was in good condition but starting to core (high WOB).
- Stabilizers and roller reamer in good condition.

BHA #14 (7) HALO RSS NO MOTOR

Interval	BHA #	Run in That Hole Size	Bit Size	Bit Type	Bit Serial Number	Bit Mfg	Depth In (ft MD)	Depth Out (ft MD)	Footage Drilled (ft)	On Bottom Hours	On Bottom ROP (ft/hr)
Curve	BHA #7	6	9.50	TKC83-A2	A298355	REEDHYCALOG	6545	6610	65	0.7	93

NO MOTOR IN BHA

Bottom Hole Assembly

Job#	OP.039349	Rig	Frontier 16	BHA Length (Usft)	1306.42
Operator	Utah Forge	BHA #	7	BHA Weight dry (klbs)	70.21
Well	16B(78)-32 - 16B(78)-32	Bit #	7	BHA Weight Bouyed (klbs)	60.67
Field	Beaver (University of Utah) - Utah Forge	Depth In (Usft)	0.00	Wt. Below Jars dry (klbs)	70.21
Date In		Depth Out(Usft)	0.00	Wt. Below Jars Bouyed (klbs)	60.67
Date Out		Drilled(Usft)	0.00	Drilling / Circ Hours	0.00 / 0.00

Sensor Offsets

Survey Offset	25.00	Gamma Offset	N/A	Gyro Offset	N/A

#	SN	Description	OD (in)	ID (in)	FN OD (in)	FN Length (Usft)	Cnx Up	Cnx Dn	Unit Weight (lb/ft)	Comp Weight (klbs)	Total Weight (klbs)	Length (Usft)	Total Length (Usft)
1	A298355	9 1/2 8 Blade PDC bit	9.500	2.750	0.000	0.00	4 1/2 REG P		0.000	0.00	0.00	1.18	1.18
2	76000233	HALO RSS w/HFTO (Stiff)	6.750	2.000	6.688	0.00	4 1/2 IF B	4 1/2 REG B	0.000	0.00	0.00	35.31	36.49
3	650779	9 3/8 Spiral Stabilizer	6.500	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	4.14	40.63
4	DR 34302	6 3/4 NM Pony DC	6.438	3.500	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	12.24	52.87
5	153-022	6 3/4 NM Pony DC	6.813	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	9.83	62.70
6	GU1744	FG 9 1/2 Roller reamer	6.625	3.000	6.750	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	5.39	68.09
7	84-772	6 3/4 NMDC	6.813	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	31.11	99.20
8	7015	6 3/4 Black Box	6.750	2.250	6.750	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	6.00	105.20
9	DR 48701	6 3/4 Filter sub	6.688	3.250	6.688	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	3.93	109.13
10	AFLS603	6 3/4 Float sub	6.375	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	2.45	111.58
11	N/A	9 JTS, 6 3/4 DCs	6.813	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	100.000	27.83	27.83	278.27	389.85
12	N/A	Crossover (DCs to HWDP)	6.937	3.000	0.000	0.00	5 1/2 FH B	4 1/2 IF P	0.000	0.00	27.83	3.15	393.00
13	N/A	30 JTS HWDP	5.500	3.625	0.000	0.00	5 1/2 FH B	5 1/2 FH P	46.400	42.38	70.21	913.42	1306.42

Comments

Halo 7600-0233; Pulser 213-006; Eye 1697; Gamma 1490; Battery 048-29SEP22AB NO MOTOR ASSIST Flow Range = 500-750 9 3/8 Spiral 3 blade stabilizer Eye = 22 Gamma = 17 NB Inc/Az = 7 Make up torque, 4 1/2 Reg = 19,500 4 1/2 IF = 29,000

HALO STIFF STAB

REDUCED LENGTH 10’

RR

Black Box

9 x 6 ¾” DC

30 x HWDP

BHA #14 (7) HALO RSS NO MOTOR

ROP Limiter: Short run. Drilled the curve from 42 to 45 degrees.

DD commented that the bit was steerable and able to get the builds needed.

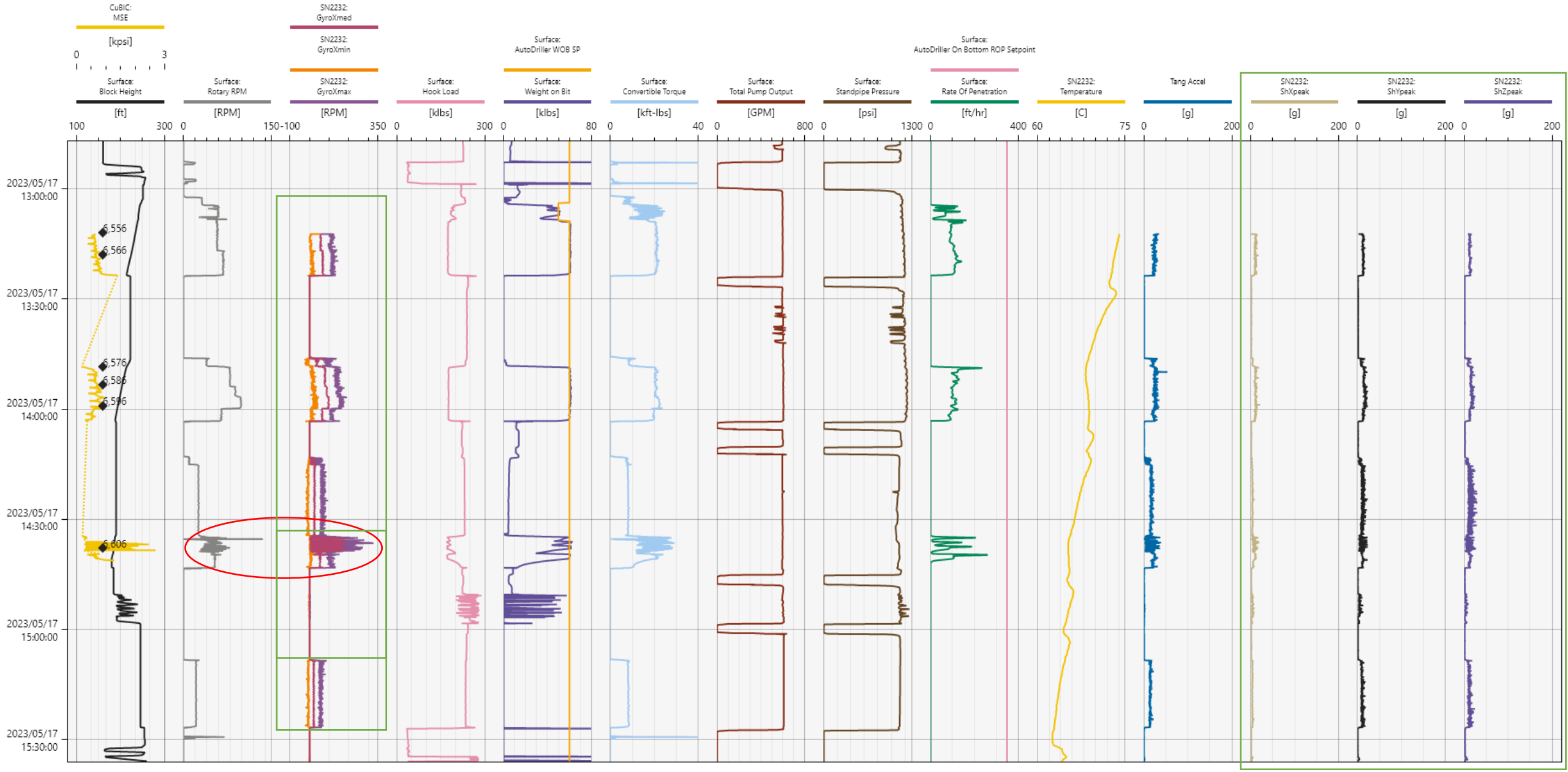
Pulled for MWD failure.

Solution: Figure out BHA vibration modeling to allow for mud motor to be ran.

BHA #14 (7) HALO RSS NO MOTOR

Good condition.

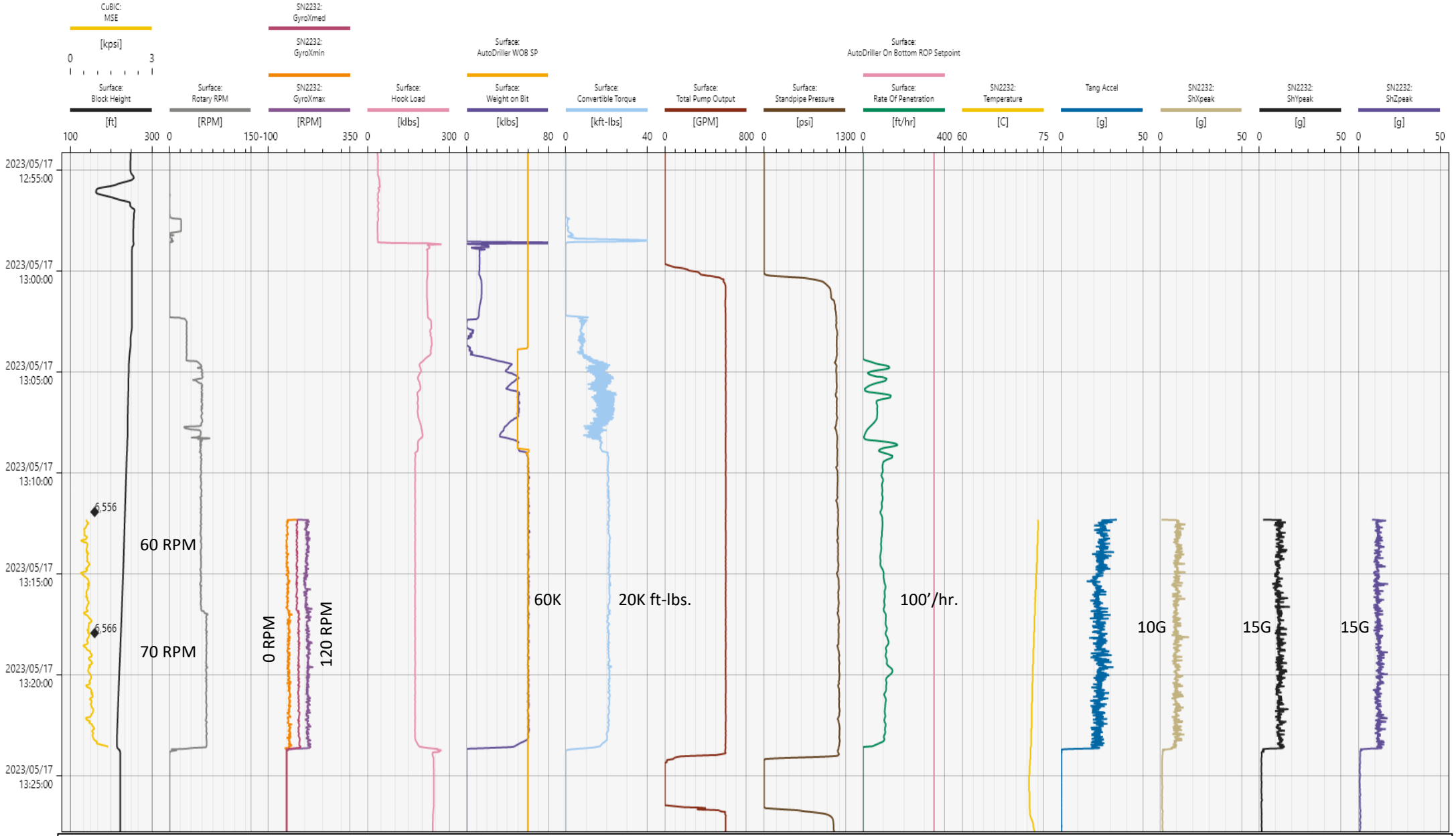
BHA #14 (7) – Entire Run



Bit Gyro Spread Normal for No Motor BHA, except for event highlighted in red.

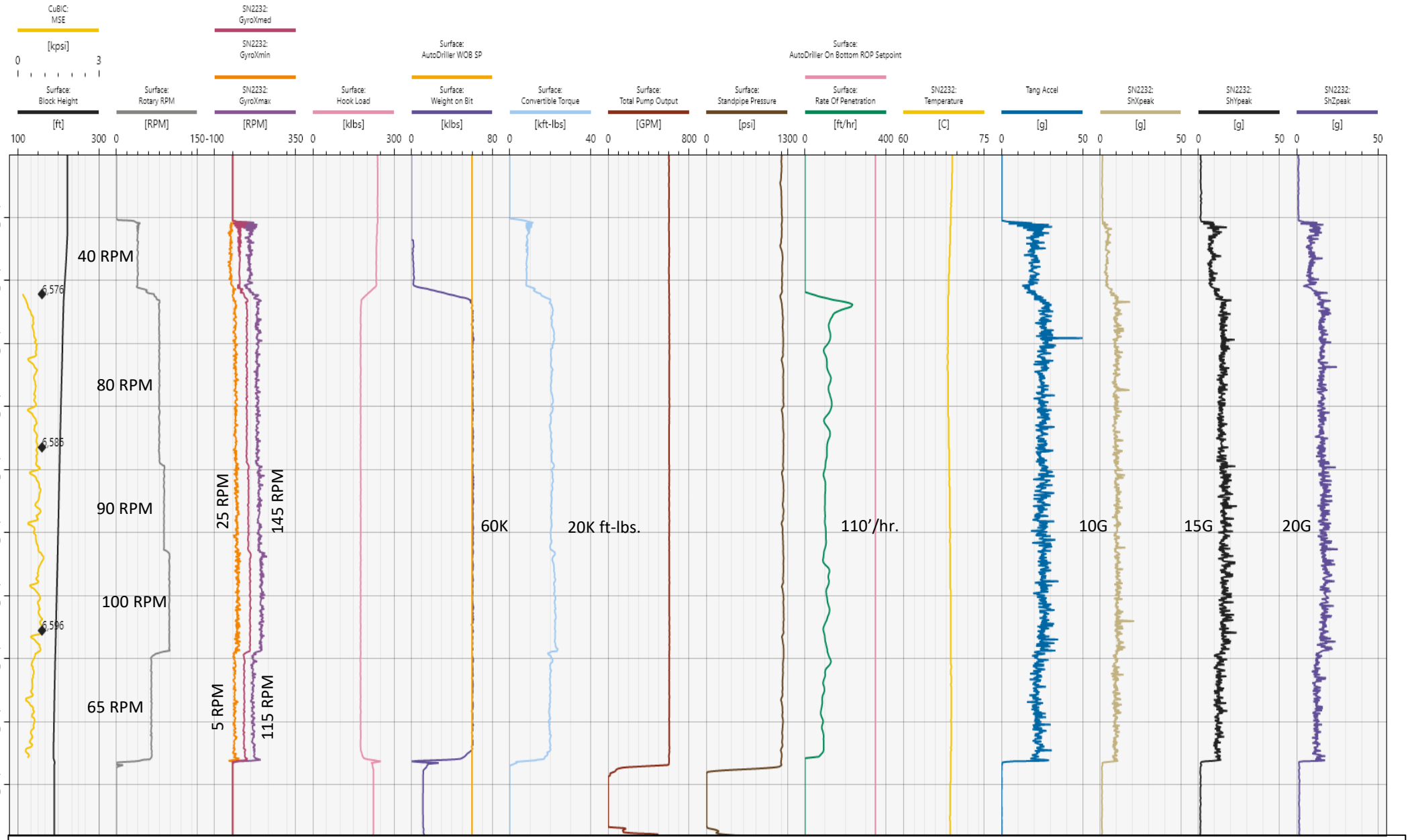
Bit Low Peak Shocks all 3-Axis

BHA #14 (7) – Stand Zoom



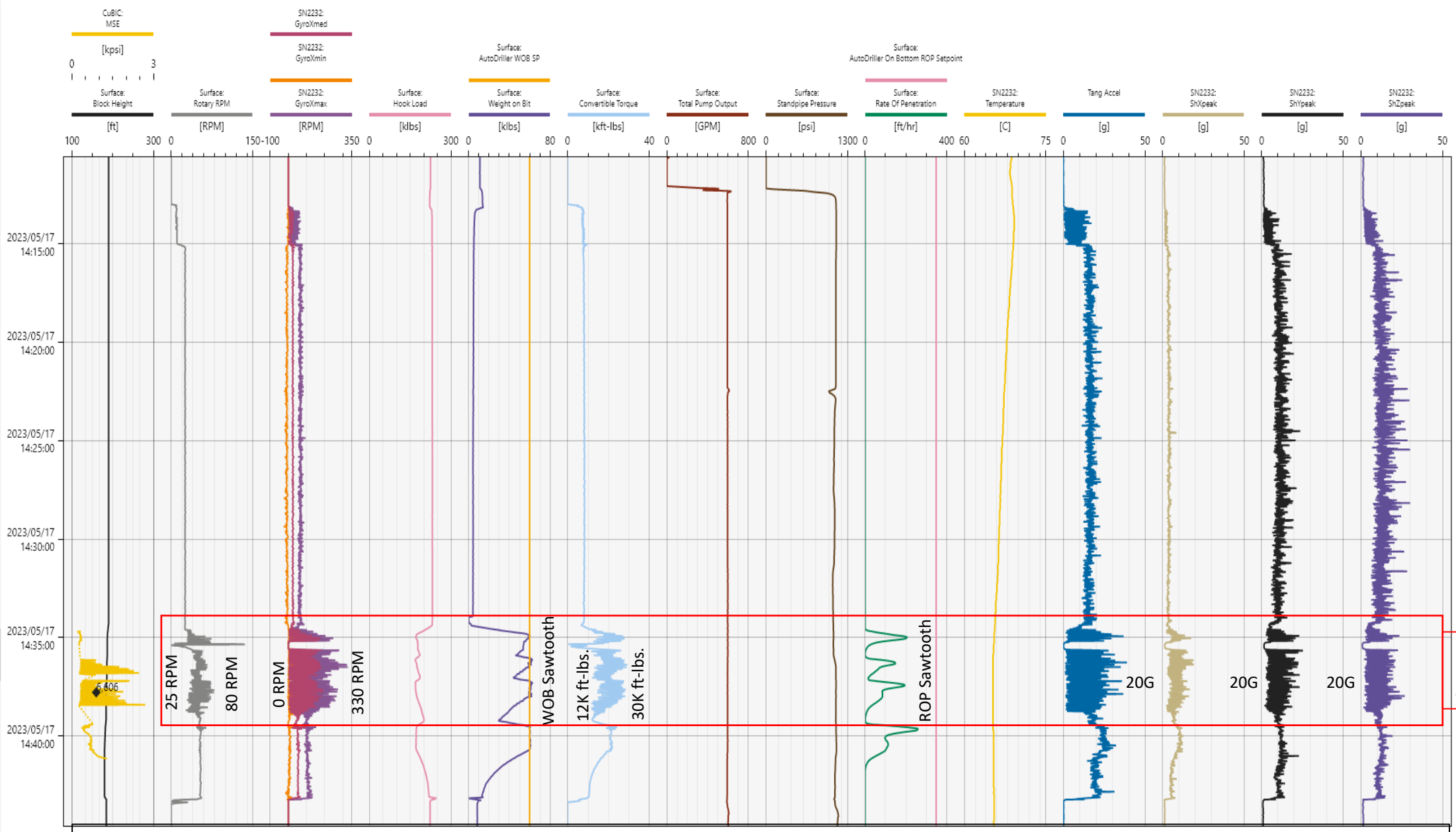
Gyro spread normal for rotary assembly. 3-axis Peak Shock low.

BHA #14 (7) – Stand Zoom



Gyro spread normal for rotary assembly. 3-axis Peak Shock low. RPM step test made no change to bit dynamics.

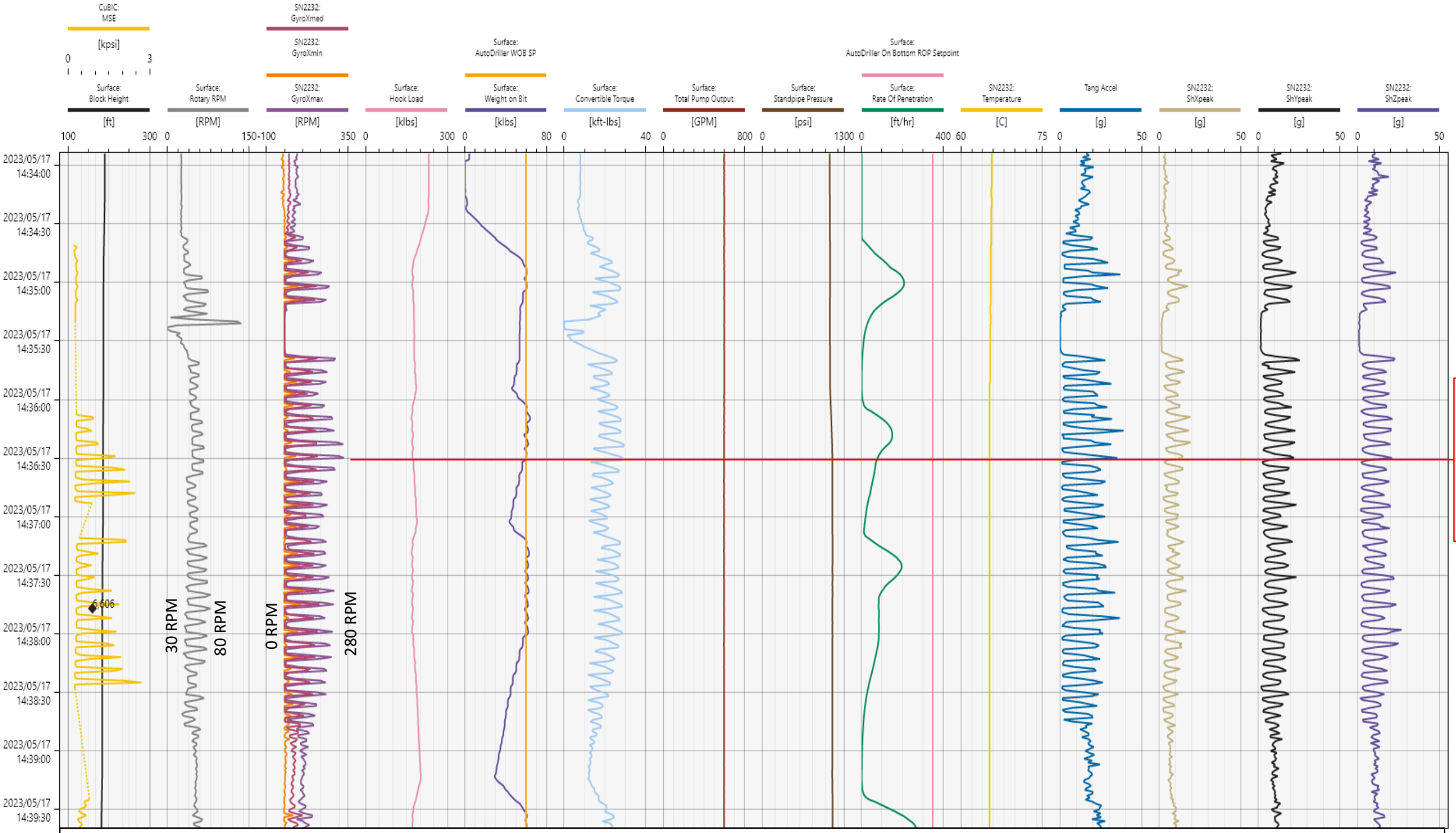
BHA #14 (7) – Stand Zoom



REVIT (OFF) causing significant increase in Stick-Slip and 3-axis Peak Shocks increased.

REVIT/DAS? Disabled and driving torsional dysfunction.

BHA #14 (7) – Event Zoom REVIT/DAS?



Rig surface system is driving downhole torsional dysfunction. Slip events (torsional release) correlate with 3-axis Peak Shock. Repeating cycle being pushed into drill string.

Rig surface system is driving the dynamics dysfunction.

BHA #14 (7) – Discussion

- Bit dynamics were normal for rotary assembly until rig surface control system enabled.
- Rig surface control system inducing torsional dynamics into drill string.
- Bit, stabs and roller reamer in good condition.
- POOH for MWD failure.

BHA #15 (8) HALO RSS NO MOTOR

Interval	BHA #	Run in That Hole Size	Bit Size	Bit Type	Bit Serial Number	Bit Mfg	Depth In (ft MD)	Depth Out (ft MD)	Footage Drilled (ft)	On Bottom Hours	On Bottom ROP (ft/hr)
Curve	BHA #8	7	9.50	TKC83-A2	A298353	REEDHYCALOG	6610	6951	341	6.5	52

NO MOTOR IN BHA

Bottom Hole Assembly

Job#	OP.039349	Rig	Frontier 16	BHA Length (Usft)	1306.63
Operator	Utah Forge	BHA #	8	BHA Weight dry (klbs)	70.21
Well	16B(78)-32 - 16B(78)-32	Bit #	8	BHA Weight Bouyed (klbs)	60.67
Field	Beaver (University of Utah) - Utah Forge	Depth In (Usft)	0.00	Wt. Below Jars dry (klbs)	70.21
Date In		Depth Out(Usft)	0.00	Wt. Below Jars Bouyed (klbs)	60.67
Date Out		Drilled(Usft)	0.00	Drilling / Circ Hours	0.00 / 0.00

Sensor Offsets

Survey Offset	25.00	Gamma Offset	N/A	Gyro Offset	N/A

#	SN	Description	OD (in)	ID (in)	FN OD (in)	FN Length (Usft)	Cnx Up	Cnx Dn	Unit Weight (lb/ft)	Comp Weight (klbs)	Total Weight (klbs)	Length (Usft)	Total Length (Usft)
1	A298353	9 1/2 8 Blade PDC bit	9.500	2.750	0.000	0.00	4 1/2 REG P		0.000	0.00	0.00	1.22	1.22
2	76001711	HALO RSS w/HFTO (Flex)	6.750	2.000	6.500	5.00	4 1/2 IF B	4 1/2 REG B	0.000	0.00	0.00	35.48	36.70
3	650779	9 3/8 Spiral Stabilizer	6.500	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	4.14	40.84
4	DR 34302	6 3/4 NM Pony DC	6.438	3.500	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	12.24	53.08
5	153-022	6 3/4 NM Pony DC	6.813	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	9.83	62.91
6	GU1744	FG 9 1/2 Roller reamer	6.625	3.000	6.750	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	5.39	68.30
7	84-772	6 3/4 NMDC	6.813	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	31.11	99.41
8	7015	6 3/4 Black Box	6.750	2.250	6.750	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	6.00	105.41
9	DR 48701	6 3/4 Filter sub	6.688	3.250	6.688	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	3.93	109.34
10	AFLS603	6 3/4 Float sub	6.375	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	2.45	111.79
11	N/A	9 JTS, 6 3/4 DCs	6.813	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	100.000	27.83	27.83	278.27	390.06
12	N/A	Crossover (DCs to HWDP)	6.937	3.000	0.000	0.00	5 1/2 FH B	4 1/2 IF P	0.000	0.00	27.83	3.15	393.21
13	N/A	30 JTS HWDP	5.500	3.625	0.000	0.00	5 1/2 FH B	5 1/2 FH P	46.400	42.38	70.21	913.42	1306.63

Comments

Halo 7600-1711; Pulser 122-1243F; Eye 1547; Gamma 1117; Battery 025-29SEP22AB NO MOTOR ASSIST Flow Range = 500-750 9 3/8 Spiral 3 blade stabilizer Eye = 22 Gamma = 17 NB Inc/Az = 7 Make up torque, 4 1/2 Reg = 19,500 4 1/2 IF = 29,000

HALO FLEX

STAB

REDUCED LENGTH 10’

RR

Black Box

9 x 6 ¾” DC

30 x HWDP

BHA #15 (8) HALO RSS NO MOTOR

ROP Limiter: Drilled the curve from 45 degrees to end of build. Tool vibrations are high due to Revit system errors.

Halo RSS ran without a motor due to high vibrations.

Rotary RPM was at 55 for majority of the run due to vibration issues.

MWD tool stopped working at 6,799.

Revit system malfunction at 6,777 feet that caused variation in drilling plots.

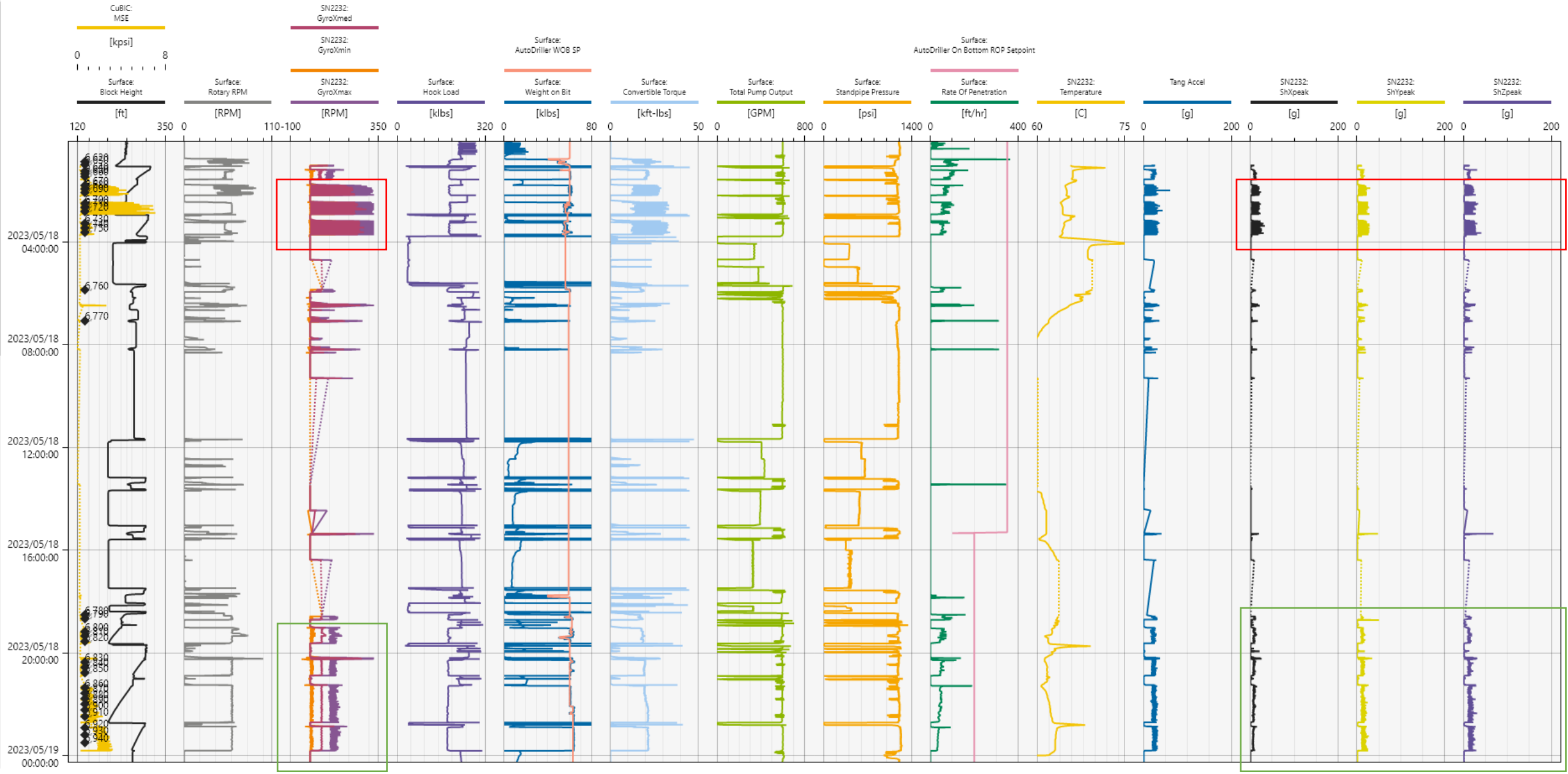
Solution: Figure out BHA vibration modeling to allow for mud motor to be ran.

Curve was still drilled efficiently with RSS system.

BHA #15 (8) HALO RSS NO MOTOR

NO POST RUN RR PHOTOS AVAILABLE

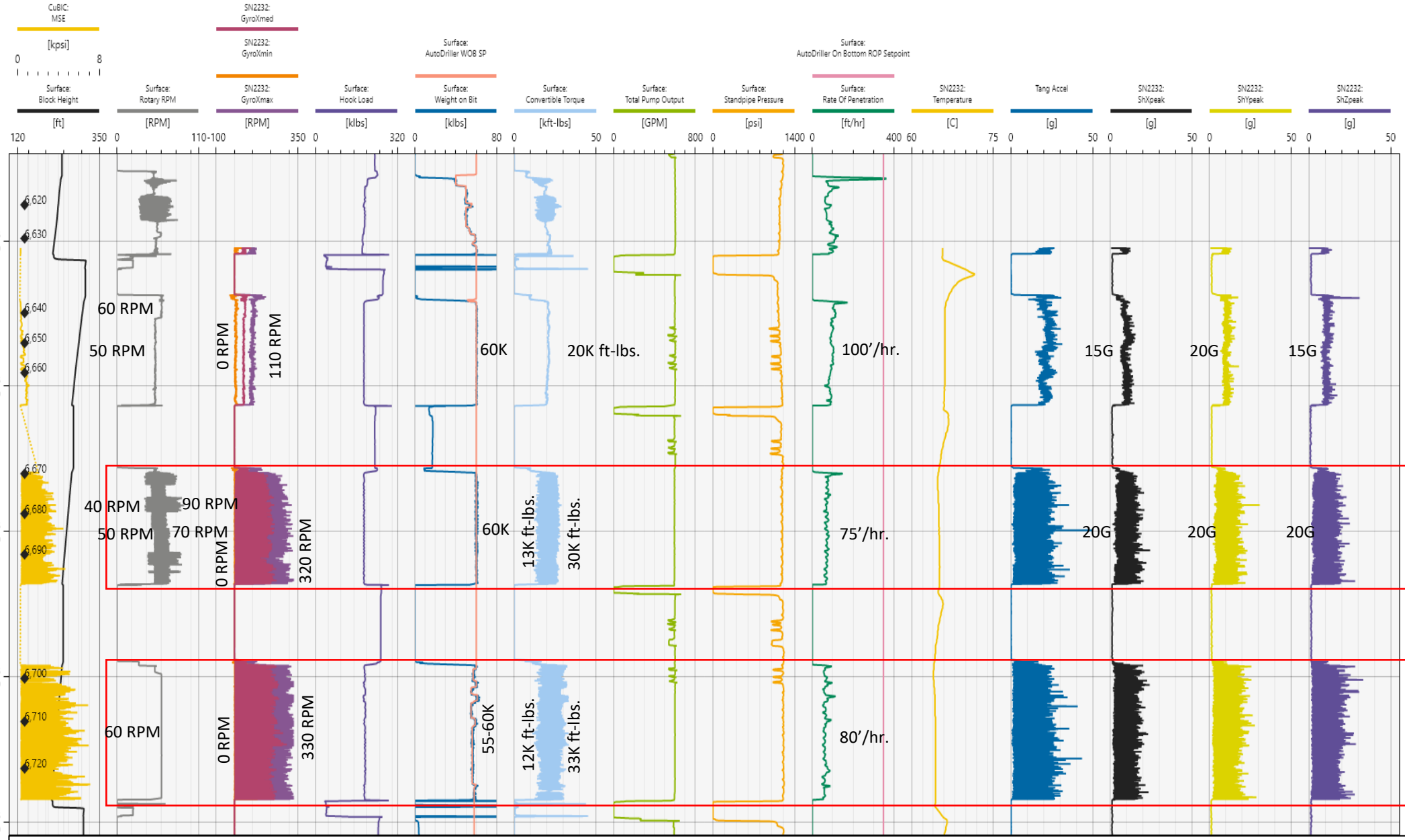
BHA #15 (8) – Entire Run



Bit Gyro Spread Normal for No Motor BHA, except for event highlighted in red.

Bit Low Peak Shocks all 3-Axis. Increased shocks highlighted in red.

BHA #15 (8) – Stand Zoom

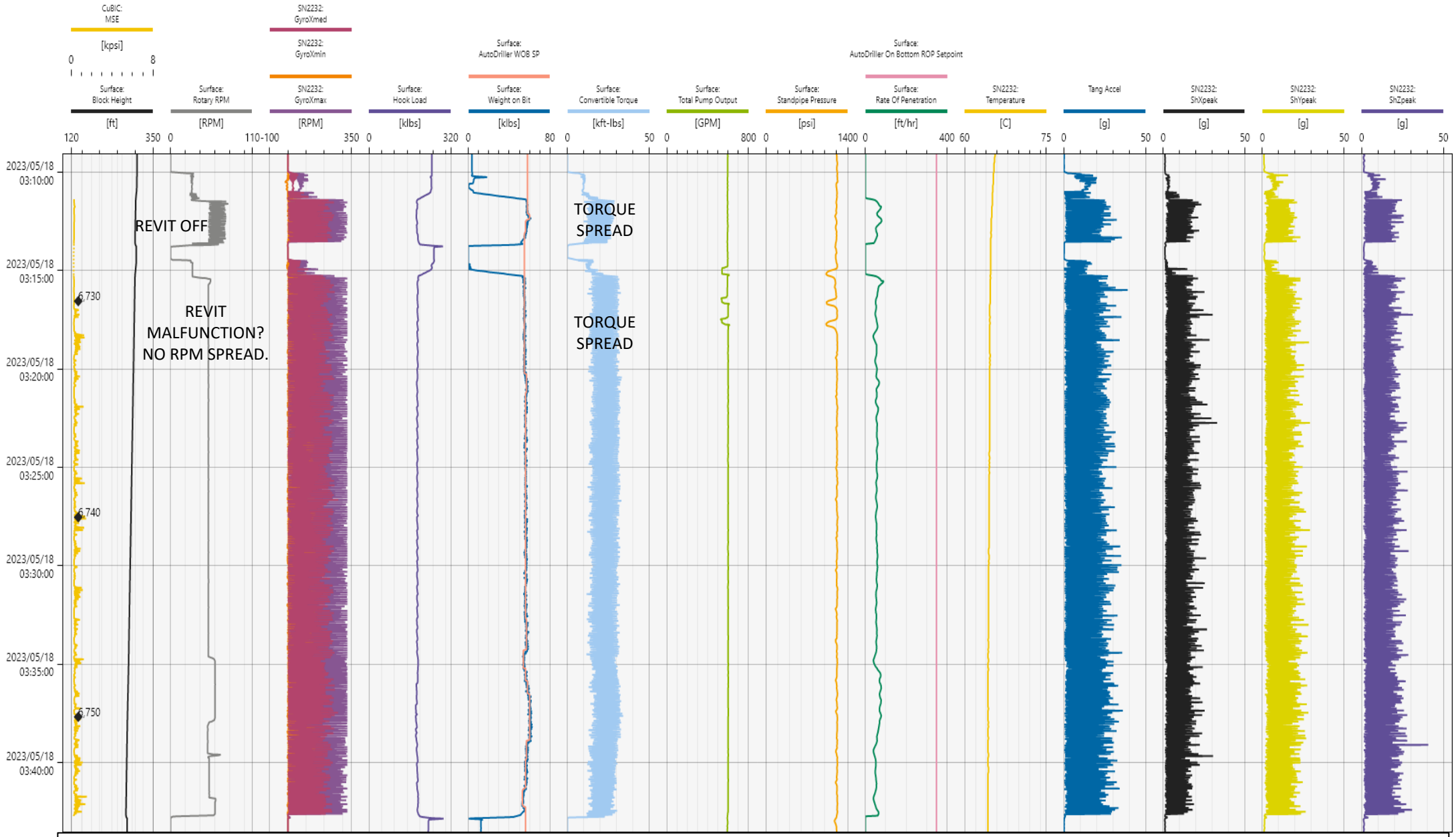


REVIT (MALFUNCTION?) causing significant increase in Stick-Slip and 3-axis Peak Shocks increased.

REVIT (MALFUNCTION?) but similar dysfunction continues. Suspect this could be due to borehole patterning and not drilled enough hole to break the trend.

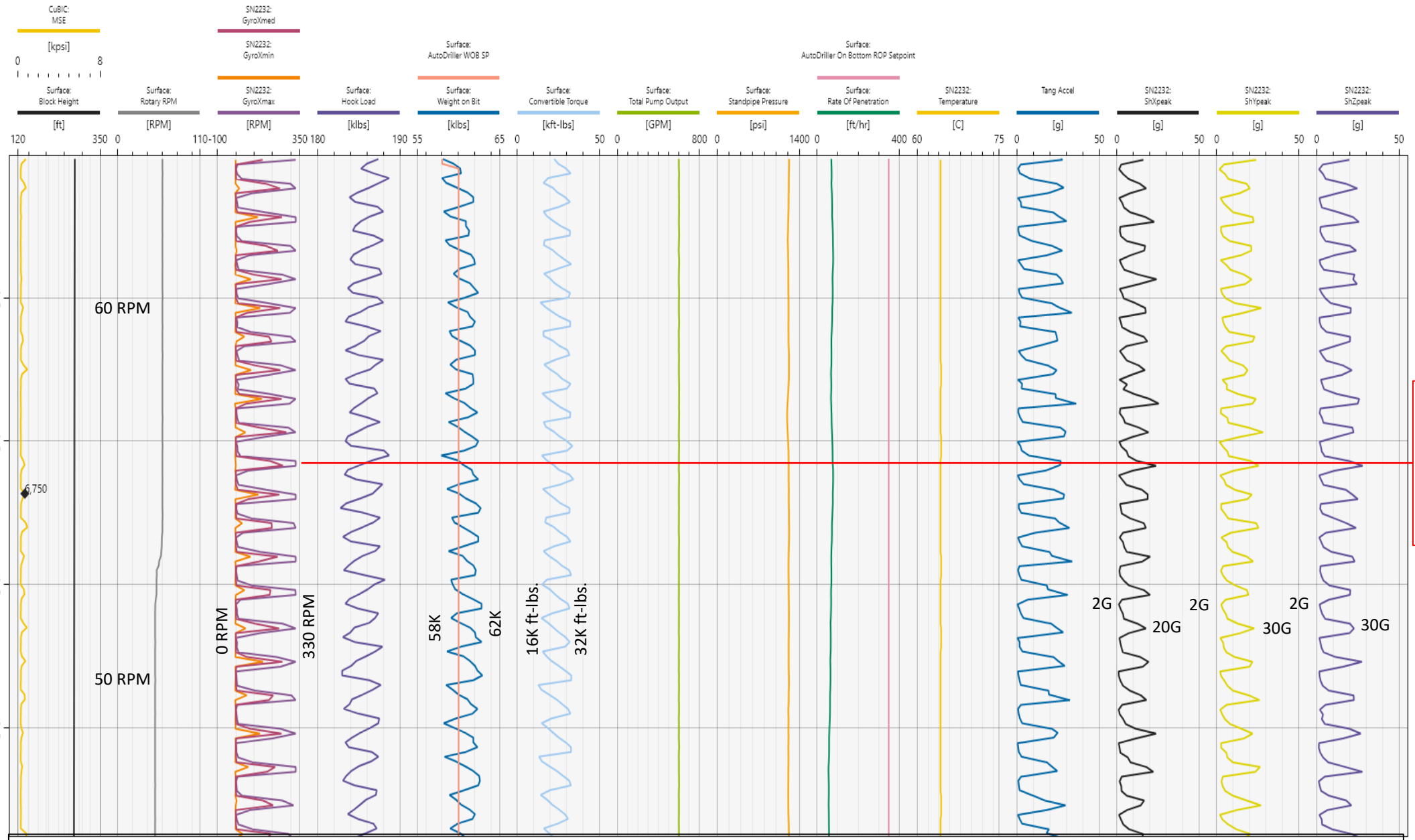
Dynamics response was normal until REVIT malfunction. Comments stated REVIT malfunction?

BHA #15 (8) – Stand Zoom



RPM spread changes, but torque spread, and bit dysfunction remain the same.

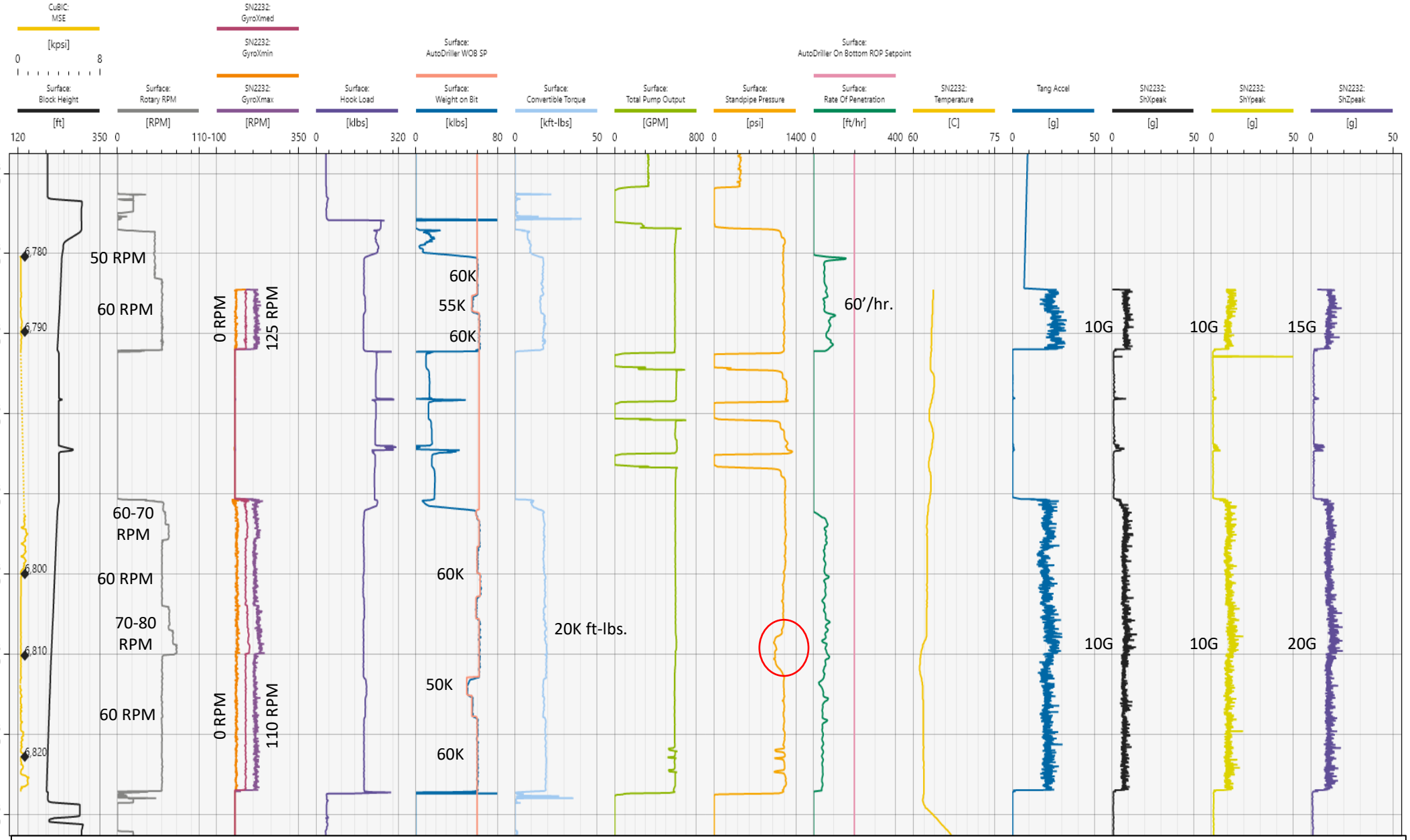
BHA #15 (8) – Event Zoom



Rig surface system is driving downhole torsional dysfunction. Slip events (torsional release) correlate with 3-axis Peak Shock. Repeating cycle being pushed into drill string.

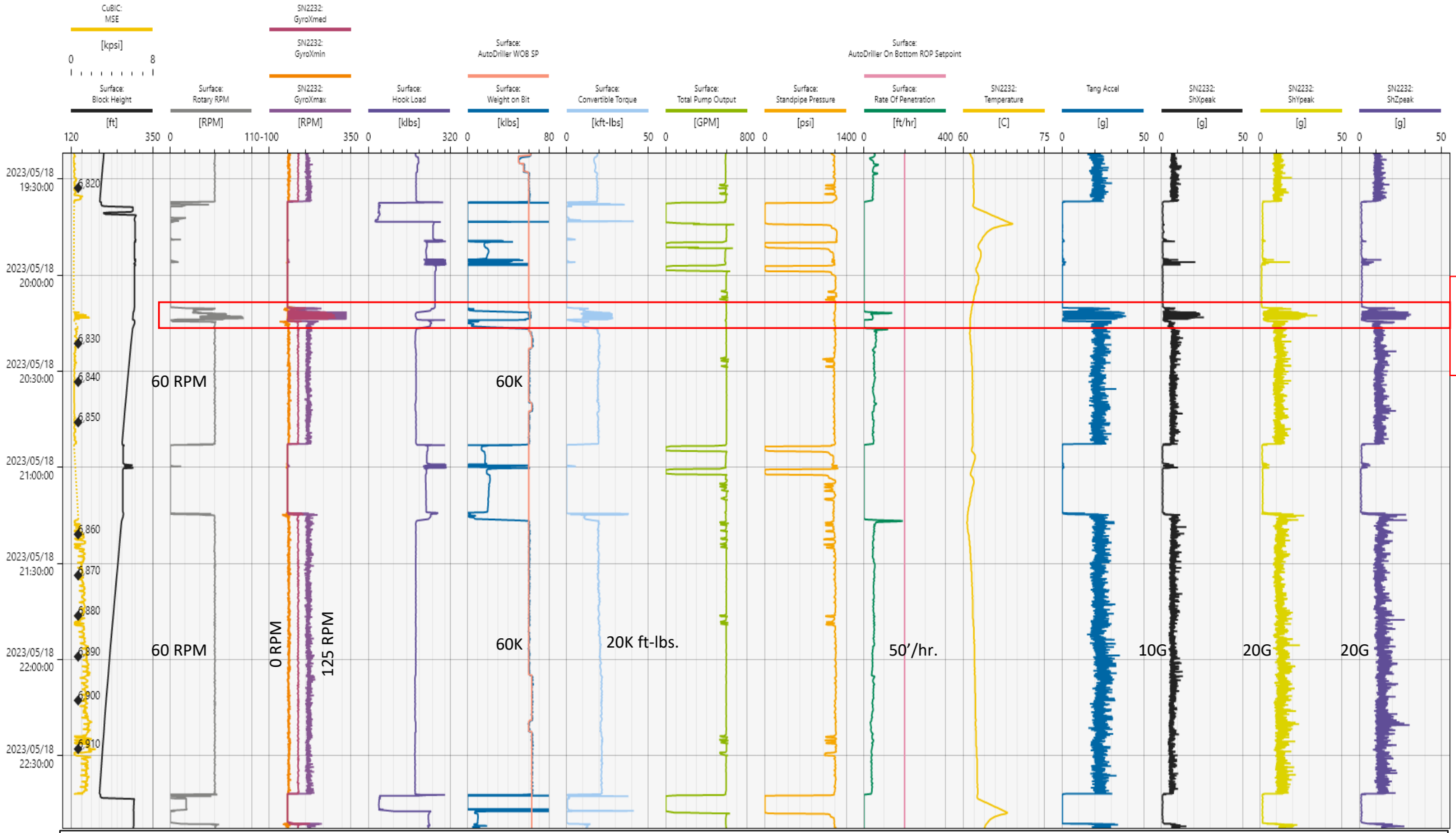
Rig surface system is driving the downhole dynamics dysfunction.

BHA #15 (8) – Stand Zoom



Gyro spread normal for rotary assembly. 3-axis Peak Shock low. RPM step test made no change to bit dynamics.

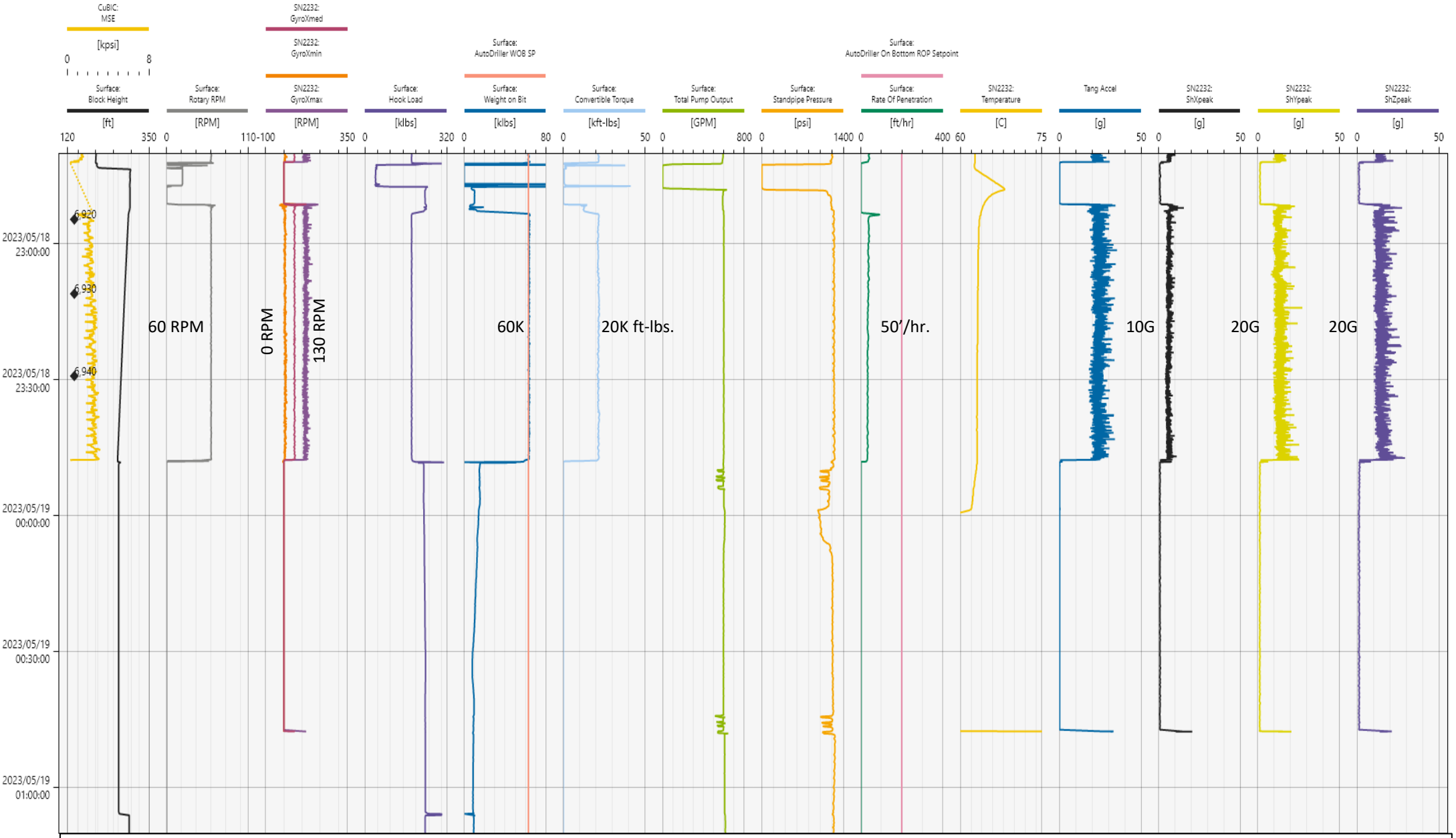
BHA #15 (8) – Stand Zoom



REVIT/DAS? (OFF) causing significant increase in Stick-Slip and 3-axis Peak Shocks increased.

Gyro spread normal for rotary assembly. 3-axis Peak Shock low. Except for red highlighted section where rig is driving downhole dynamics dysfunction.

BHA #15 (8) – Stand Zoom



Gyro spread normal for rotary assembly. 3-axis Peak Shock low.

BHA #15 (8) – Discussion

- Bit dynamics were normal for rotary assembly until rig surface control system enabled.
- Rig surface control system (malfunction) inducing torsional dynamics into drill string.
- Bit, HALO stab in good condition. No other photos available.
- POOH for MWD failure.

BHA #16 (9) HALO RSS NO MOTOR

Interval	BHA #	Run in That Hole Size	Bit Size	Bit Type	Bit Serial Number	Bit Mfg	Depth In (ft MD)	Depth Out (ft MD)	Footage Drilled (ft)	On Bottom Hours	On Bottom ROP (ft/hr)
Tangent	BHA #9	8	9.50	TKC83-A2	A298354	REEDHYCALOG	6951	7584	633	12.62	50

NO MOTOR IN BHA

Bottom Hole Assembly

Job#	OP.039349	**Rig**	Frontier 16	**BHA Length (Usft)**	1306.41
Operator	Utah Forge	**BHA #**	9	**BHA Weight dry (klbs)**	70.21
Well	16B(78)-32 - 16B(78)-32	**Bit #**	9	**BHA Weight Bouyed (klbs)**	60.67
Field	Beaver (University of Utah) - Utah Forge	**Depth In (Usft)**	0.00	**Wt. Below Jars dry (klbs)**	70.21
Date In		**Depth Out(Usft)**	0.00	**Wt. Below Jars Bouyed (klbs)**	60.67
Date Out		**Drilled(Usft)**	0.00	**Drilling / Circ Hours**	0.00 / 0.00

Sensor Offsets

Survey Offset	25.00	Gamma Offset	N/A	Gyro Offset	N/A

#	SN	Description	OD (in)	ID (in)	FN OD (in)	FN Length (Usft)	Cnx Up	Cnx Dn	Unit Weight (lb/ft)	Comp Weight (klbs)	Total Weight (klbs)	Length (Usft)	Total Length (Usft)
1	A298354	9 1/2 8 Blade PDC bit	9.500	2.750	0.000	0.00	4 1/2 REG P		0.000	0.00	0.00	1.18	1.18
2	76000406	HALO RSS w/HFTO (Stiff)	6.750	2.000	6.500	5.00	4 1/2 IF B	4 1/2 REG B	0.000	0.00	0.00	35.33	36.51
3	650779	9 3/8 Spiral wrapped stabilizer	6.500	2.875	6.500	1.42	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	4.14	40.65
4	DR 34302	6 3/4 NM Pony DC	6.438	3.500	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	12.24	52.89
5	153-022	6 3/4 NM Pony DC	6.813	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	9.83	62.72
6	GU1744	FG 9 1/2 Roller reamer	6.625	3.000	6.750	2.19	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	5.39	68.11
7	84-772	6 3/4 NMDC	6.813	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	31.11	99.22
8	7006	6 3/4 Black Box	6.750	2.250	6.750	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	5.97	105.19
9	DR 48701	6 3/4 Filter sub	6.688	3.250	6.688	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	3.93	109.12
10	AFLS603	6 3/4 Float sub	6.375	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	2.45	111.57
11	N/A	9 JTS, 6 3/4 DCs	6.813	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	100.000	27.83	27.83	278.27	389.84
12	N/A	Crossover (DCs to HWDP)	6.937	3.000	0.000	0.00	5 1/2 FH B	4 1/2 IF P	0.000	0.00	27.83	3.15	392.99
13	N/A	30 JTS HWDP	5.500	3.625	0.000	0.00	5 1/2 FH B	5 1/2 FH P	46.400	42.38	70.21	913.42	1306.41

Comments

Halo 7600-0406; Pulser 213-004F; Eye 1754; Gamma 1311; Battery 007-29SEP22AB NO MOTOR ASSIST Flow Range = 500-750 9 3/8 Spiral 3 blade stabilizer Eye = 22 Gamma = 17 NB Inc/Az = 7 Make up torque, 4 1/2 Reg = 19,500 4 1/2 IF = 29,000

HALO STIFF STAB

SHORT

RR

Black Box

9 x 6 ¾” DC

30 x HWDP

BHA #16 (9) HALO RSS NO MOTOR

ROP Limiter: WOB was not being zeroed every stand until 7,570'. You can see the ROP decline each consecutive stand until the issue was corrected. When corrected, MSE and ROP returned to baseline.

Tested 100% fresh water pill (@7,090') as well as a 50/50 fresh water/reserve pit pill (@7,420').

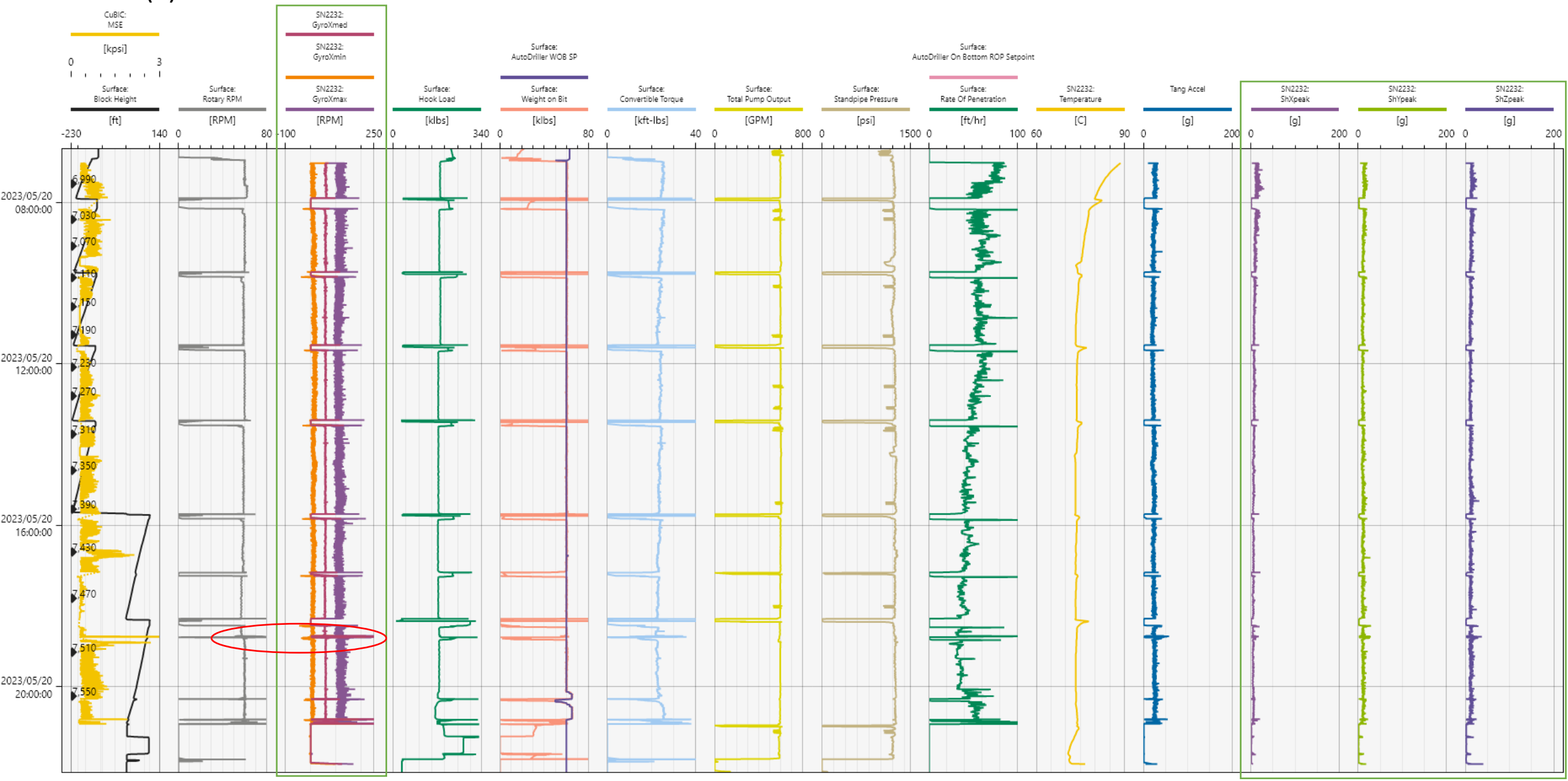
ROP showed that the fresh water pill was more effective than the 50/50 fresh and reserve pill.

Solution: Need to make sure WOB and Diff are zeroed consistently to yield a consistent Downhole and Total MSE.

BHA #16 (9) HALO RSS NO MOTOR

NO POST RUN PHOTOS AVAILABLE

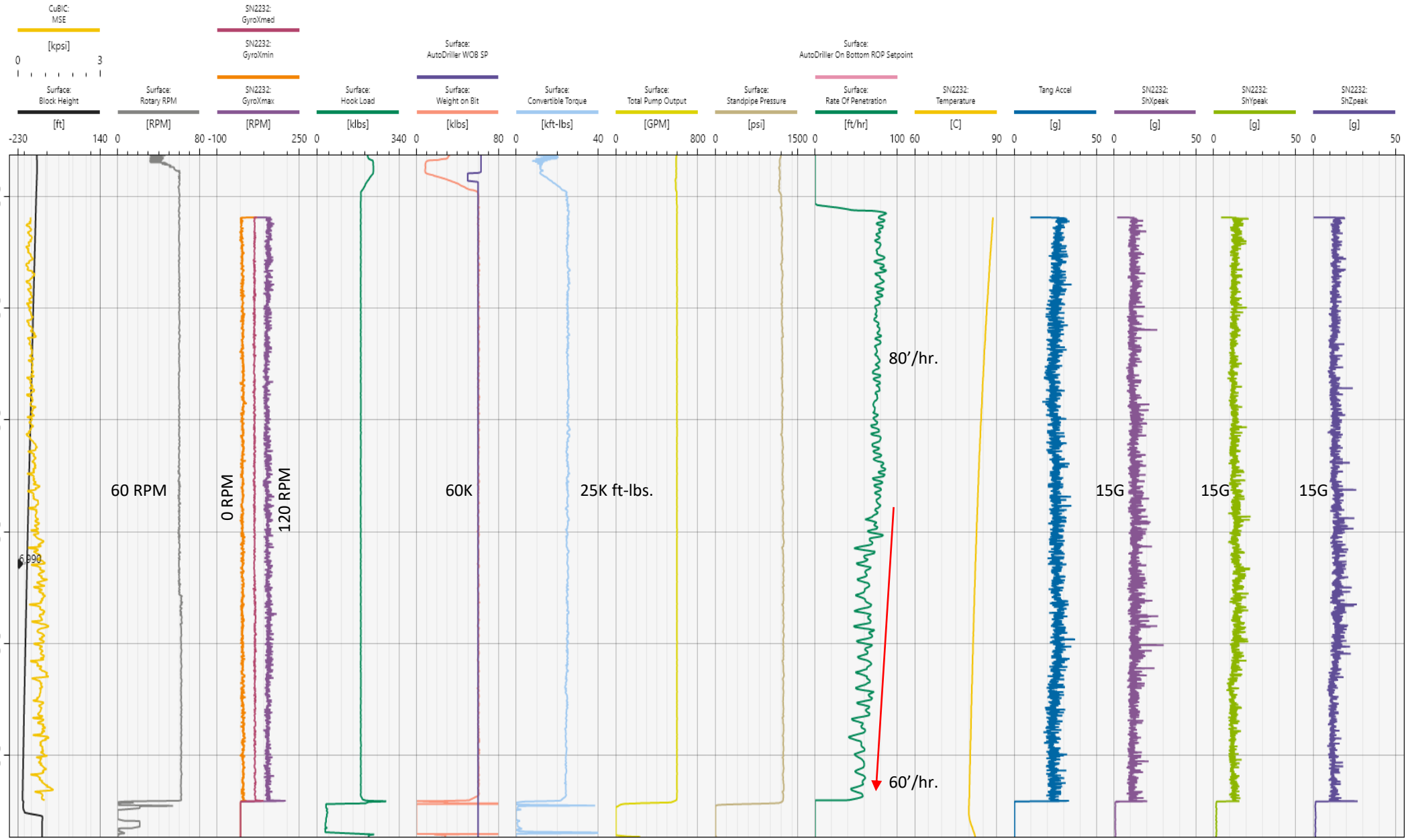
BHA #16 (9) – Entire Run



Bit Gyro Spread Normal for No Motor BHA

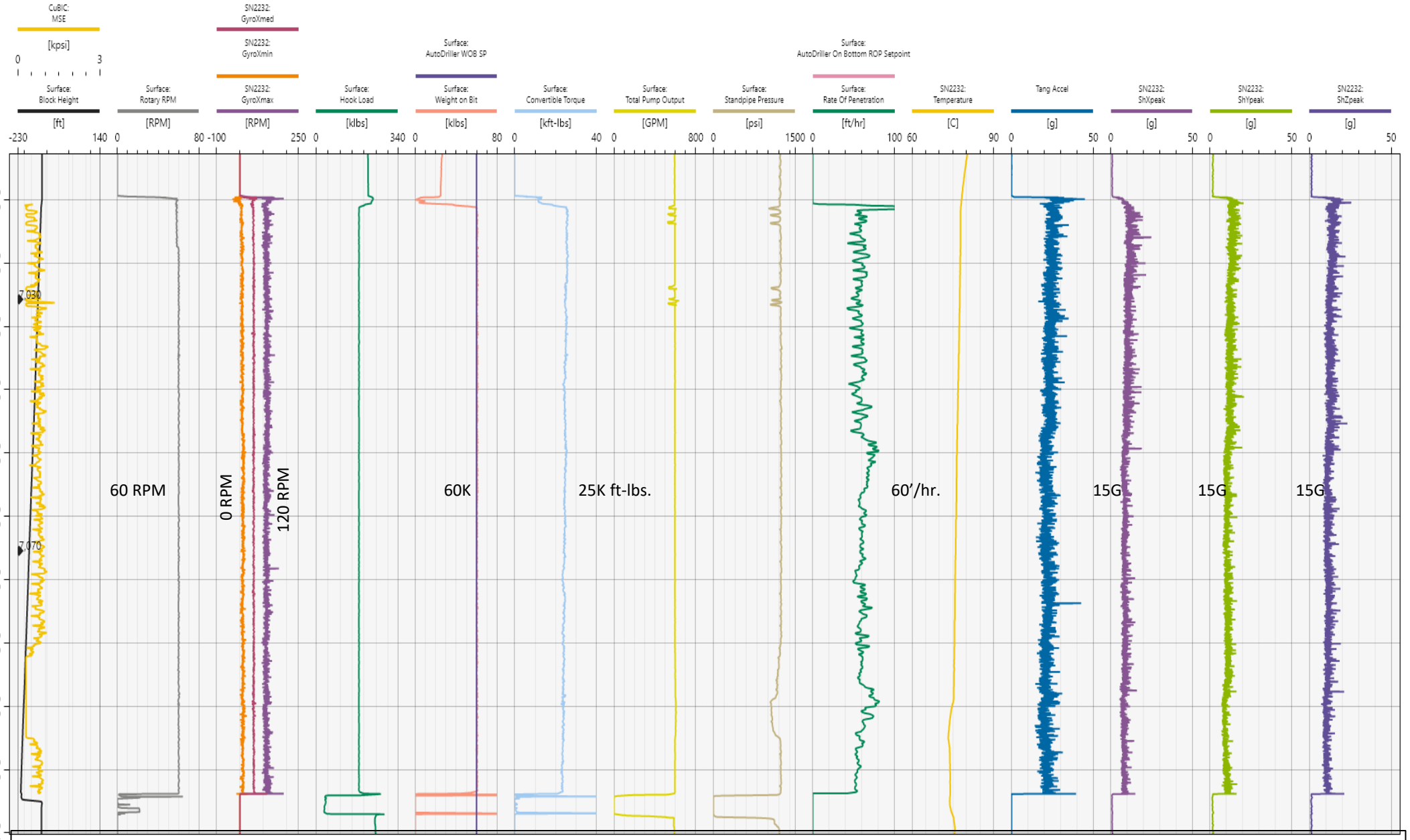
Bit Low Peak Shocks all 3-Axis

BHA #16 (9) – Stand Zoom



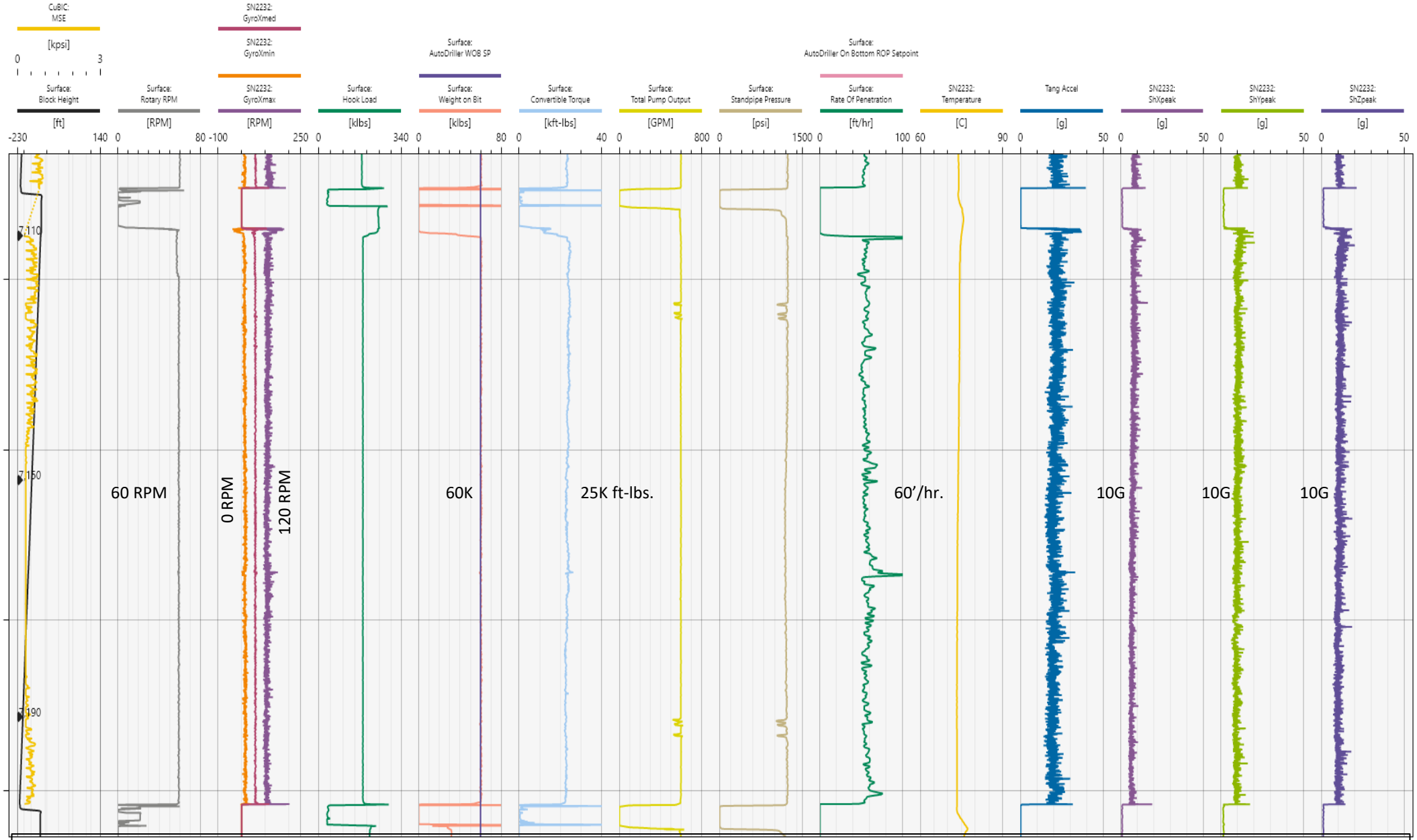
Gyro spread normal for rotary assembly. 3-axis Peak Shock low.

BHA #16 (9) – Stand Zoom



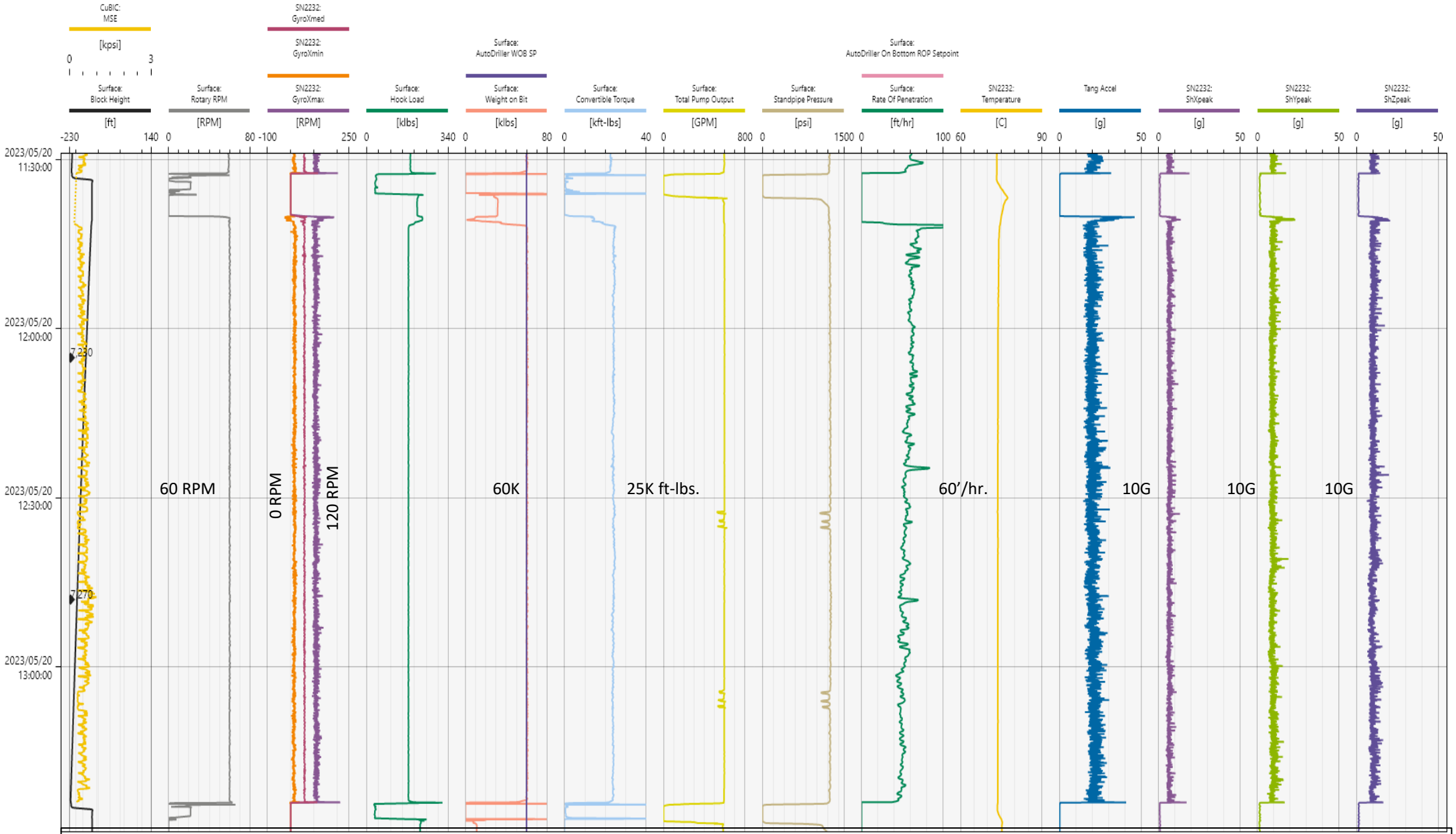
Gyro spread normal for rotary assembly. 3-axis Peak Shock low.

BHA #16 (9) – Stand Zoom



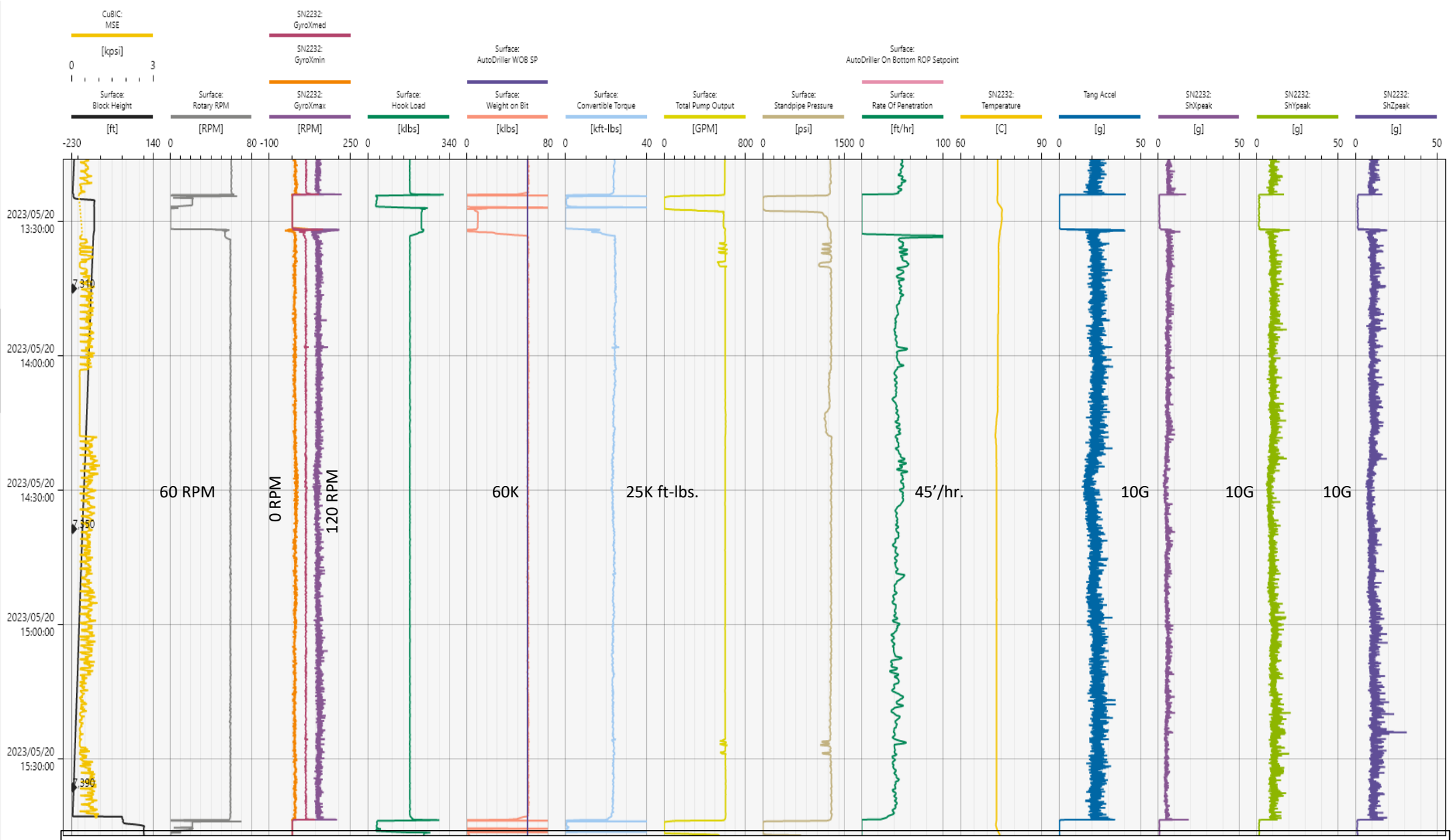
Gyro spread normal for rotary assembly. 3-axis Peak Shock low.

BHA #16 (9) – Stand Zoom



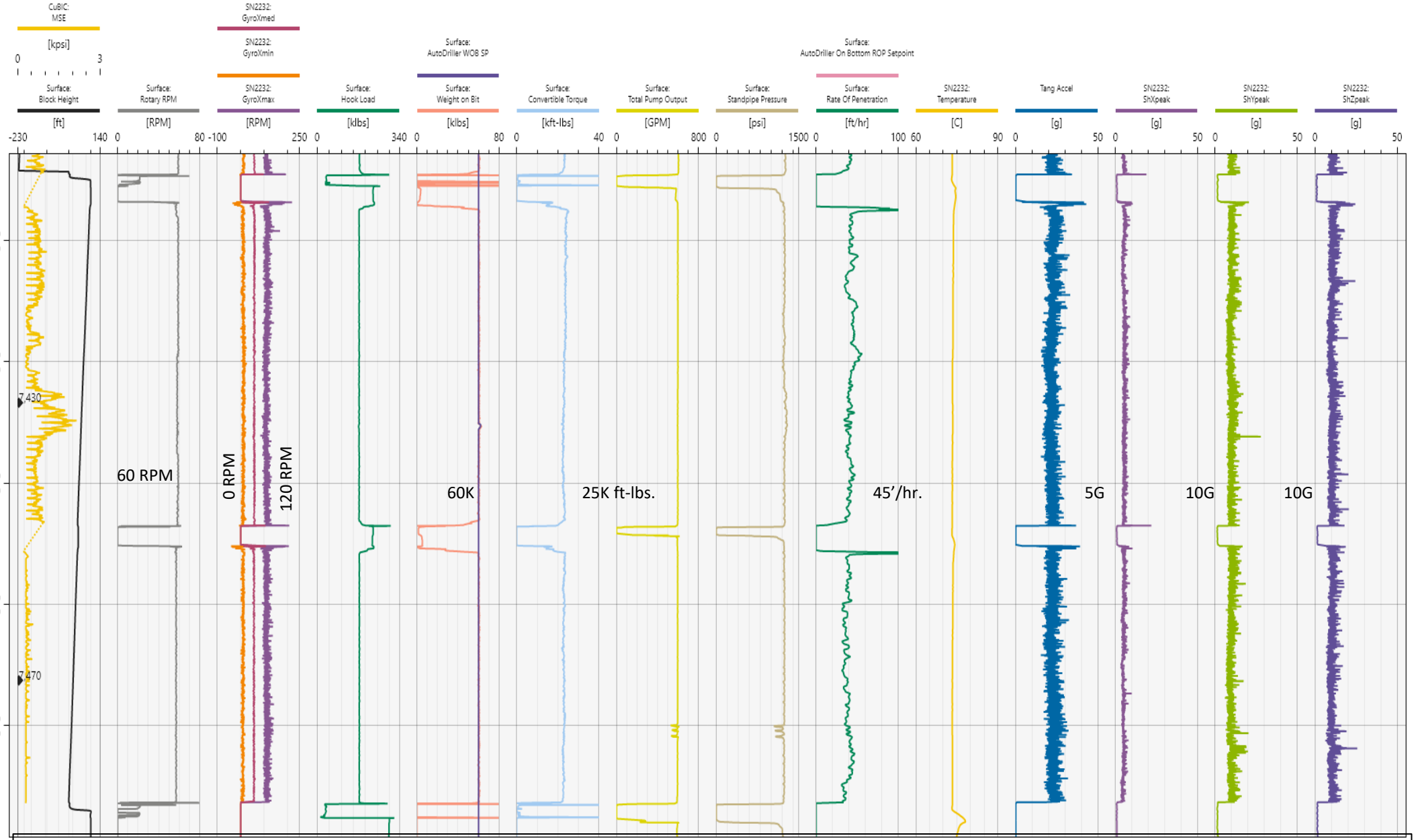
Gyro spread normal for rotary assembly. 3-axis Peak Shock low.

BHA #16 (9) – Stand Zoom



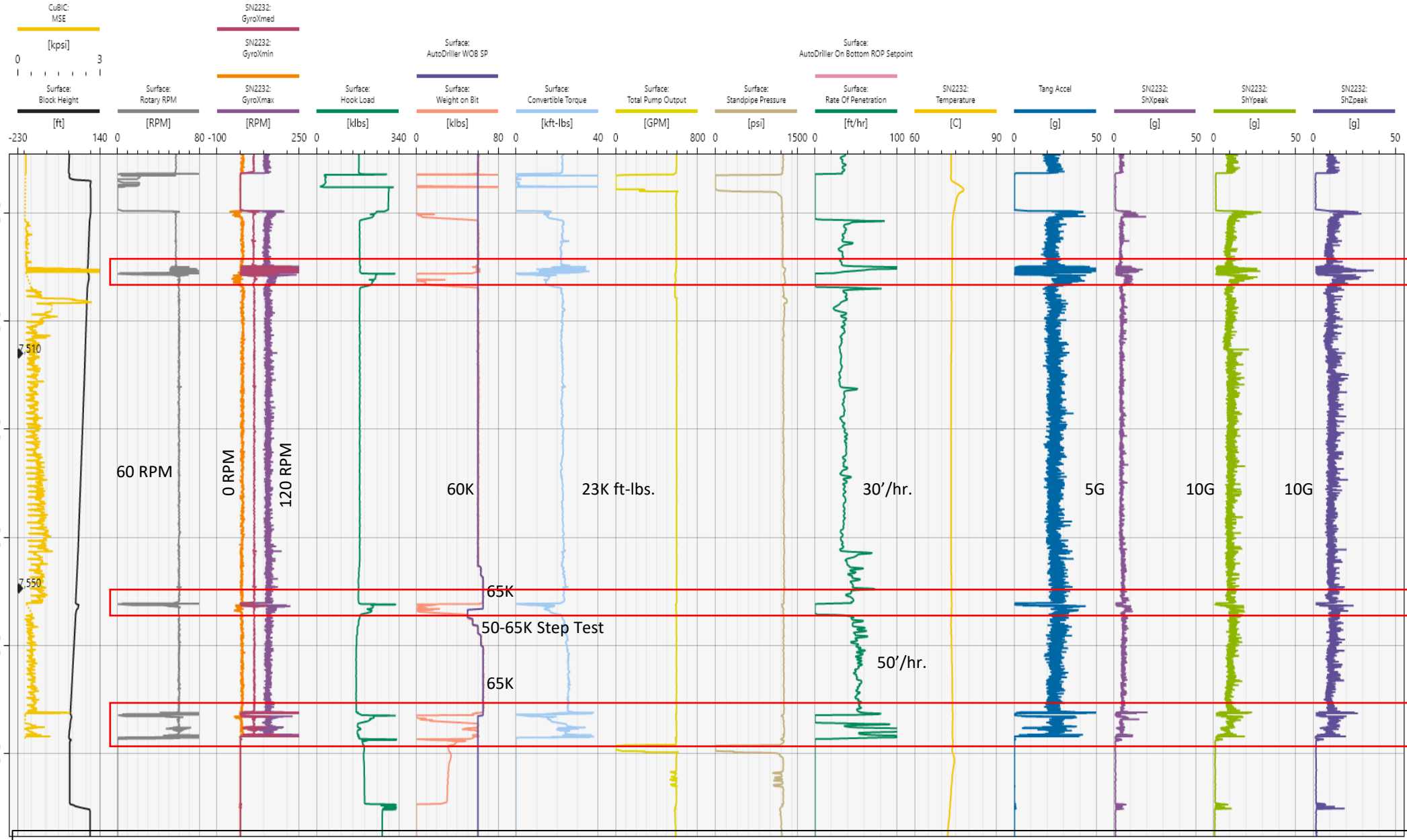
Gyro spread normal for rotary assembly. 3-axis Peak Shock low.

BHA #16 (9) – Stand Zoom



Gyro spread normal for rotary assembly. 3-axis Peak Shock low.

BHA #16 (9) – Stand Zoom



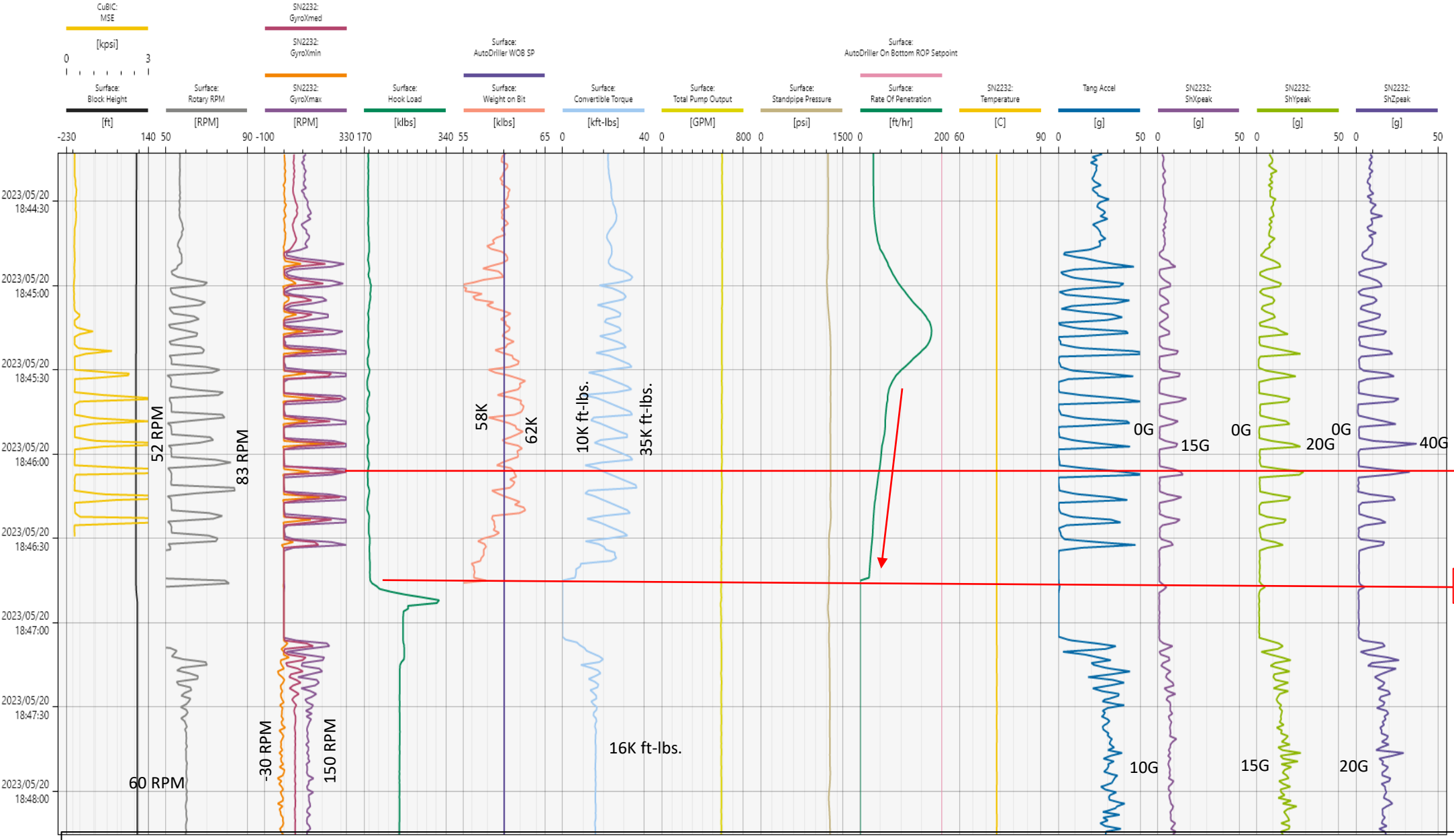
Stick-slip and higher 3-axis Peak Shocks.

Stick-slip and higher 3-axis Peak Shocks.

Stick-slip and higher 3-axis Peak Shocks.

Gyro spread normal for rotary assembly. 3-axis Peak Shock low. Torsional events highlighted in red.

BHA #16 (9) – Event Zoom



Rig surface system is driving downhole torsional dysfunction. Slip events (torsional release) correlate with 3-axis Peak Shock. Repeating cycle being pushed into drill string.

Pick-up.

DAS enabled? Rig surface control is driving downhole dysfunction.

BHA #16 (9) – Discussion

- Bit dynamics were normal for rotary assembly until rig surface control system enabled.
- Rig surface control system inducing torsional dynamics into drill string.
- Bit in good condition. No other photos available.
- POOH for ?

BHA #17 (10) STEERABLE MOTOR

Interval	BHA #	Run in That Hole Size	Bit Size	Bit Type	Bit Serial Number	Bit Mfg	Depth In (ft MD)	Depth Out (ft MD)	Footage Drilled (ft)	On Bottom Hours	On Bottom ROP (ft/hr)
Tangent	BHA #10	9	9.50	TKC83-A2	A298358	REEDHYCALOG	7584	8085	501	7.53	67

CONVENTIONAL MOTOR BHA

Bottom Hole Assembly

Job#	OP.039349	Rig	Frontier 16	BHA Length (Usft)	1312.71
Operator	Utah Forge	BHA #	10	BHA Weight dry (klbs)	70.21
Well	16B(78)-32 - 16B(78)-32	Bit #	10	BHA Weight Bouyed (klbs)	60.67
Field	Beaver (University of Utah) - Utah Forge	Depth In (Usft)	0.00	Wt. Below Jars dry (klbs)	70.21
Date In		Depth Out(Usft)	0.00	Wt. Below Jars Bouyed (klbs)	60.67
Date Out		Drilled(Usft)	0.00	Drilling / Circ Hours	0.00 / 0.00

Sensor Offsets

Survey Offset	N/A	Gamma Offset	N/A	Gyro Offset	N/A

#	SN	Description	OD (in)	ID (in)	FN OD (in)	FN Length (Usft)	Cnx Up	Cnx Dn	Unit Weight (lb/ft)	Comp Weight (klbs)	Total Weight (klbs)	Length (Usft)	Total Length (Usft)
1	A298358	9 1/2 8 Blade PDC bit	9.500	2.750	0.000	0.00	4 1/2 REG P		0.000	0.00	0.00	1.25	1.25
2		7.15 Mud Motor	6.750	2.000	0.000	0.00	4 1/2 IF B	4 1/2 REG B	0.000	0.00	0.00	35.00	36.25
3	GU1744	FG 9 1/2 Roller reamer	6.625	3.000	6.750	2.19	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	5.39	41.64
4	125-373	6 3/4 NM Pony DC	6.438	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	9.22	50.86
5	84-772	6 3/4 NMDC	6.813	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	31.11	81.97
6	129-076	6 3/4 Pulser Sub	6.500	3.500	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	3.93	85.90
7	DR34302	6 3/4 NM Pony DC	6.438	3.500	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	12.24	98.14
8	153-022	6 3/4 NM Pony DC	6.813	3.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	9.83	107.97
9	7006	6 3/4 Black Box	6.750	2.250	0.000	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	5.97	113.94
10	DR48701	6 3/4 Filter sub	6.688	3.250	6.688	0.00	4 1/2 IF B	4 1/2 IF P	0.000	0.00	0.00	3.93	117.87
11		9 JTS. 6 3/4 DCs	6.813	2.875	0.000	0.00	4 1/2 IF B	4 1/2 IF P	100.000	27.83	27.83	278.27	396.14
12		Crossover (DCs to HWDP)	6.937	3.000	0.000	0.00	5 1/2 FH B	4 1/2 IF P	0.000	0.00	27.83	3.15	399.29
13		30 JTS HWDP	5.500	3.625	0.000	0.00	5 1/2 FH B	5 1/2 FH P	46.400	42.38	70.21	913.42	1312.71

MOTOR

RR

Black Box

9 x 6 ¾” DC

30 x HWDP

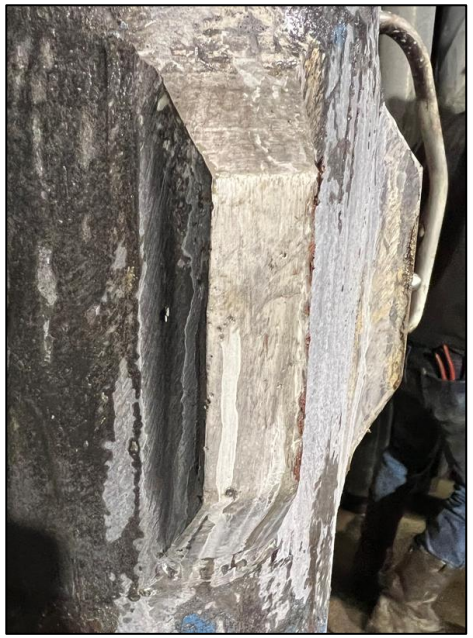
BHA #17 (10) STEERABLE MOTOR

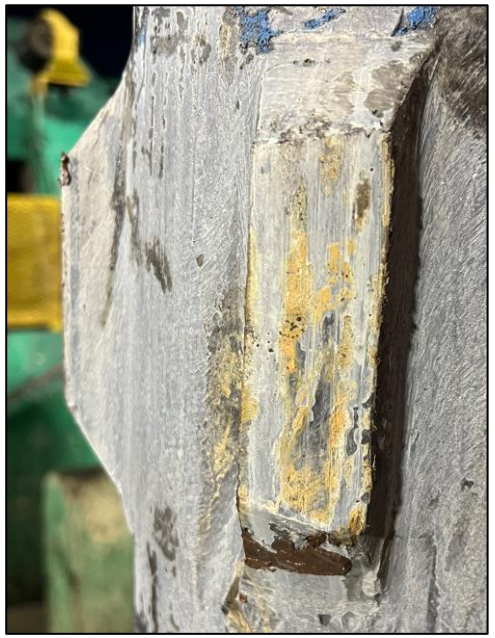
ROP Limiter: BHA was ran with a 1° motor. The BHA wanted to build. Axial vibrations were high which could be due to limiting WOB and not getting enough DOC.

Step test at 7,670 did not change Downhole MSE much.

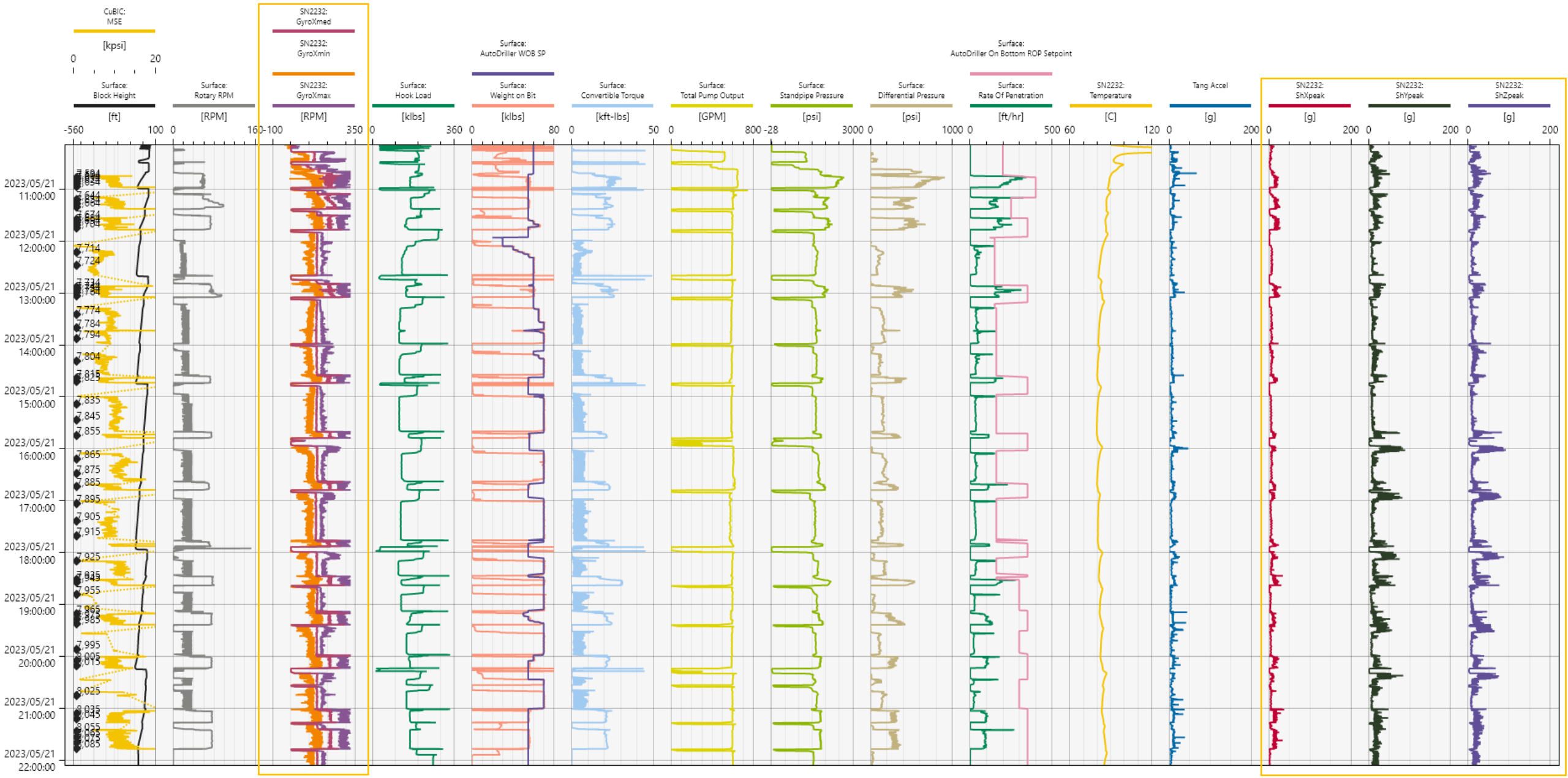
Solution: To deal with the build tendency, the next run will be ran with higher bit RPM's by increasing Flowrate and Rotary Speed.

BHA #17 (10) STEERABLE MOTOR





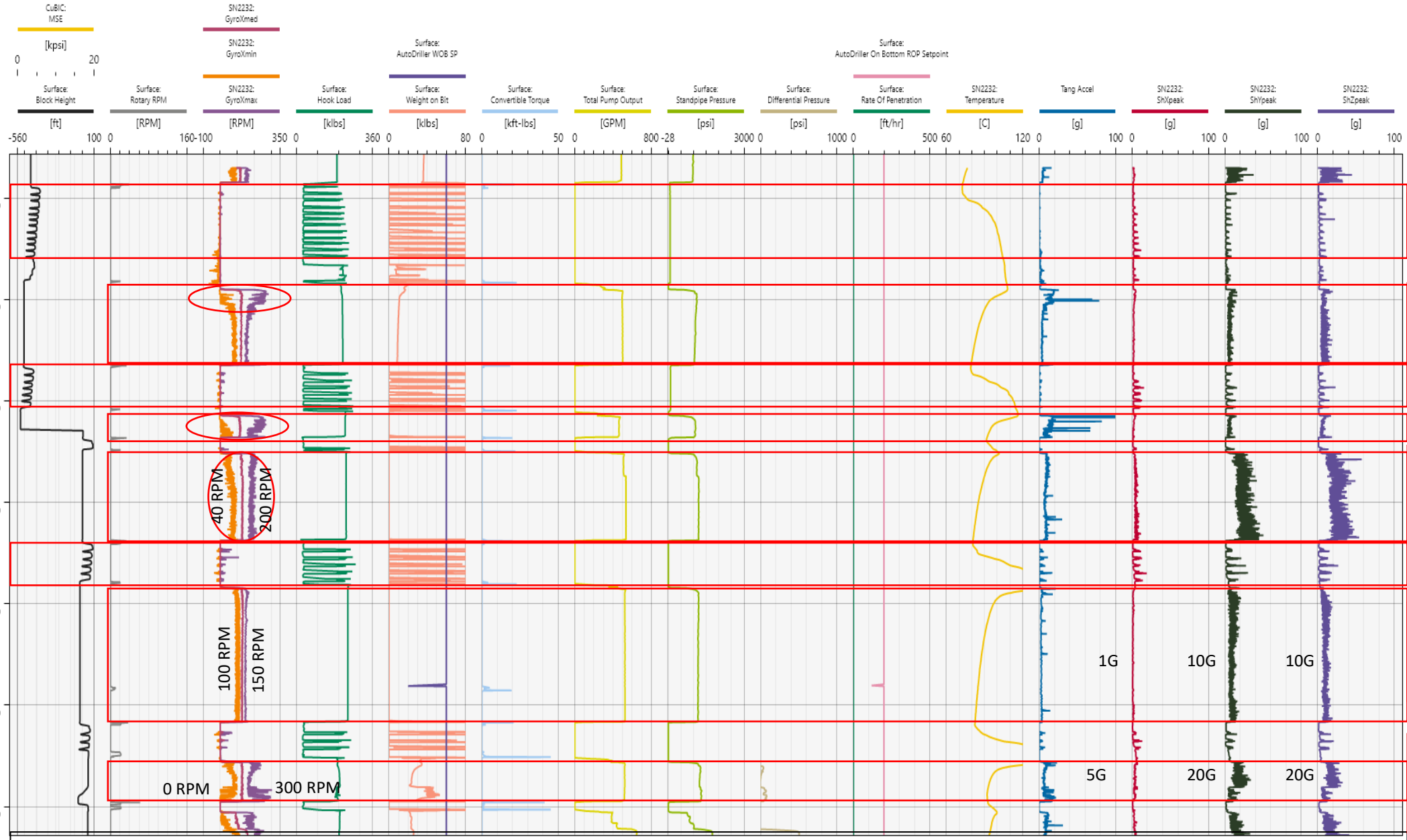
BHA #17 (10) – Entire Run



Bit Gyro Spread Variable Response Sliding & Rotating

Variable Bit Peak Shocks all 3-Axis Dependent on Operation

BHA #17 (10) – Stand Zoom



Pumps off and no rotary. Working BHA up/down

Pumps on and no rotary. Initial high gyro spread then tightens up.

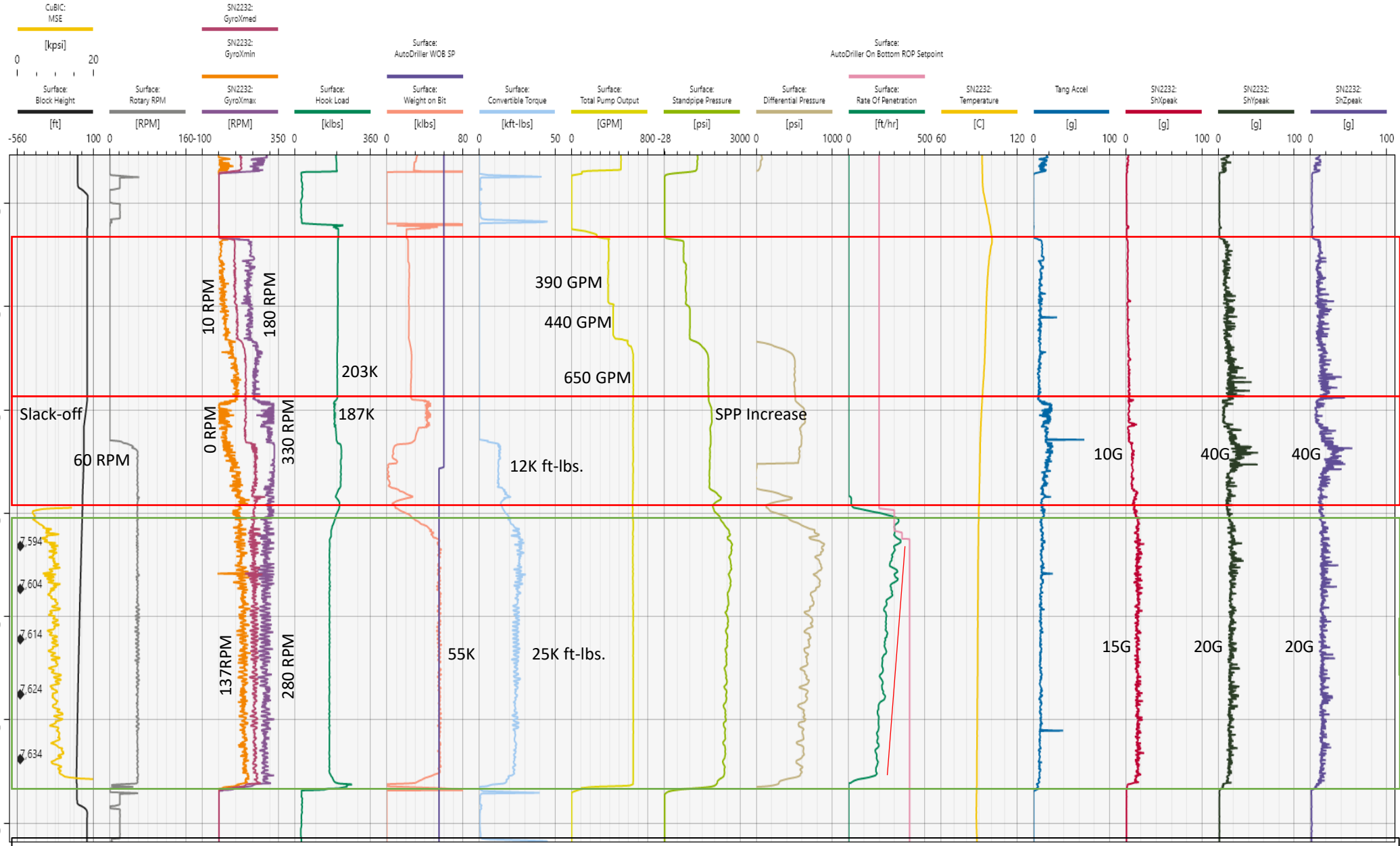
Pumps on and no rotary. High gyro spread and increased Tangential/Radial Peak Shocks.

Pumps on and no rotary. Tight gyro spread and reduced Tangential/Radial Peak Shocks.

Pumps on and no rotary. High gyro spread and increased Tangential/Radial Peak Shocks.

Working conventional BHA to bottom. Variable gyro and shock response off bottom. Bit whirl or hole conditions?

BHA #17 (10) – Stand Zoom



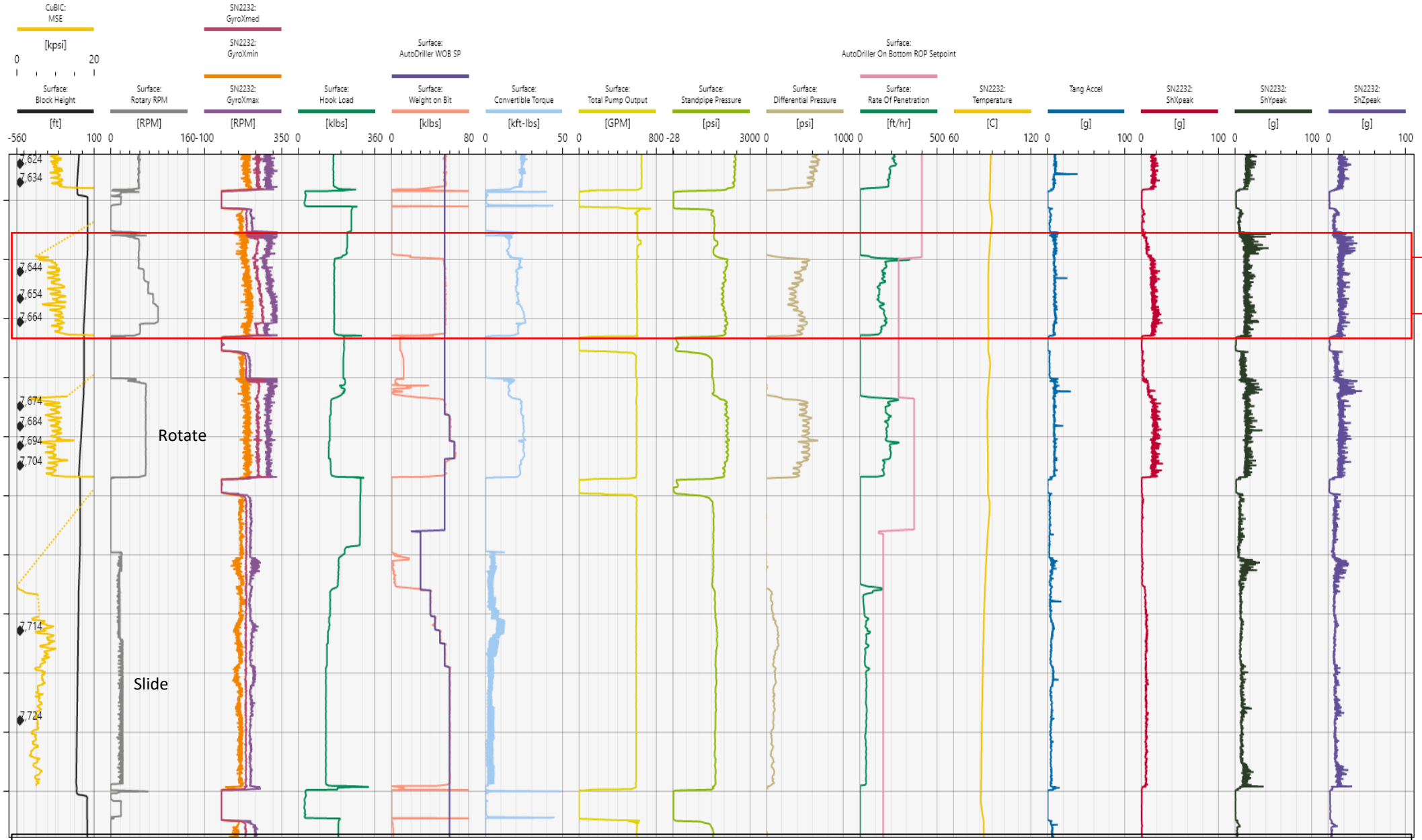
Ramp up pumps and no rotary..

Increased gyro spread and Peak Shocks.

Smooth dynamics on bottom, ROP tailing off.

Establishing parameters before tagging bottom and drilling ahead. Dynamics smooth once on bottom.

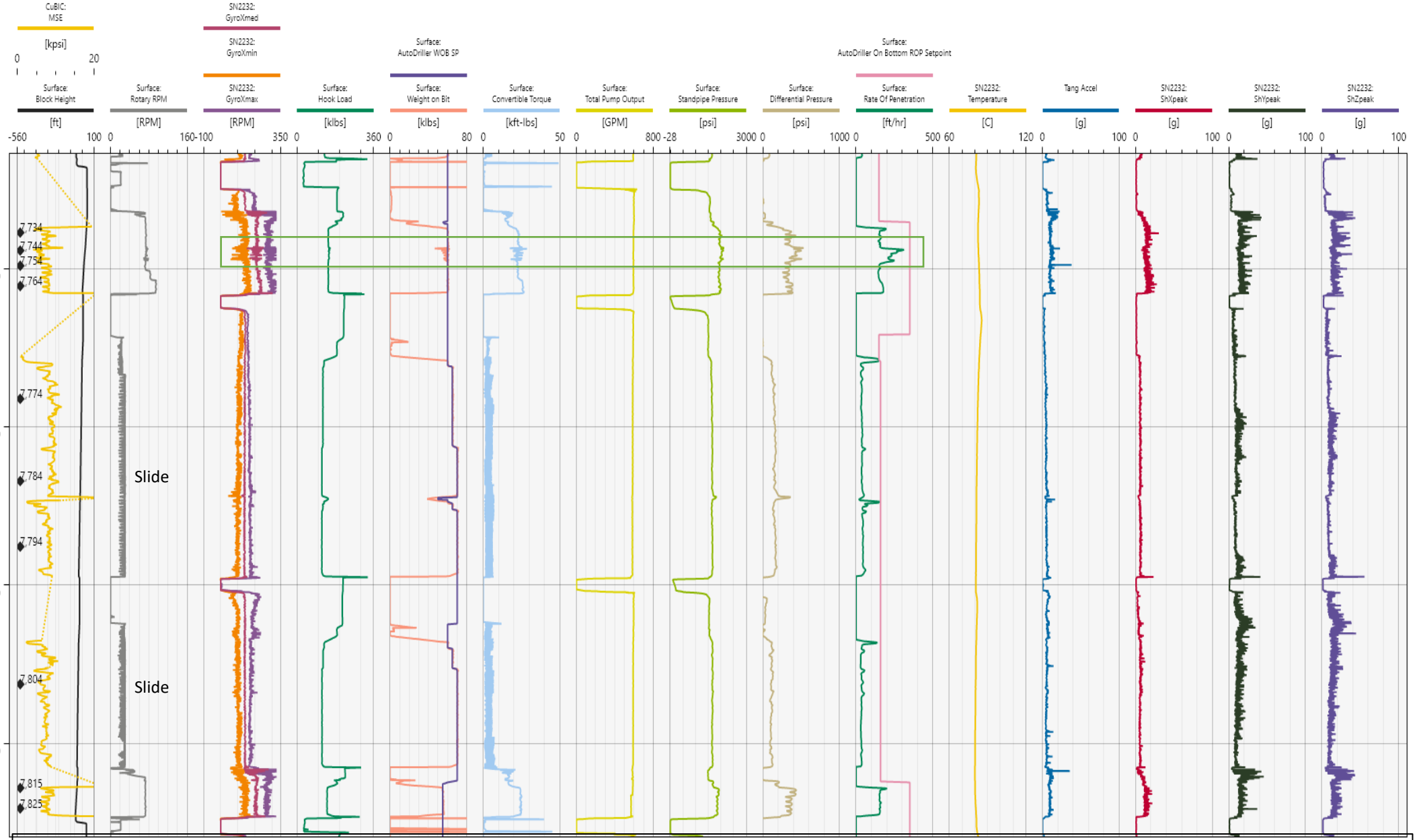
BHA #17 (10) – Stand Zoom



RPM step test with no significant dynamics change.

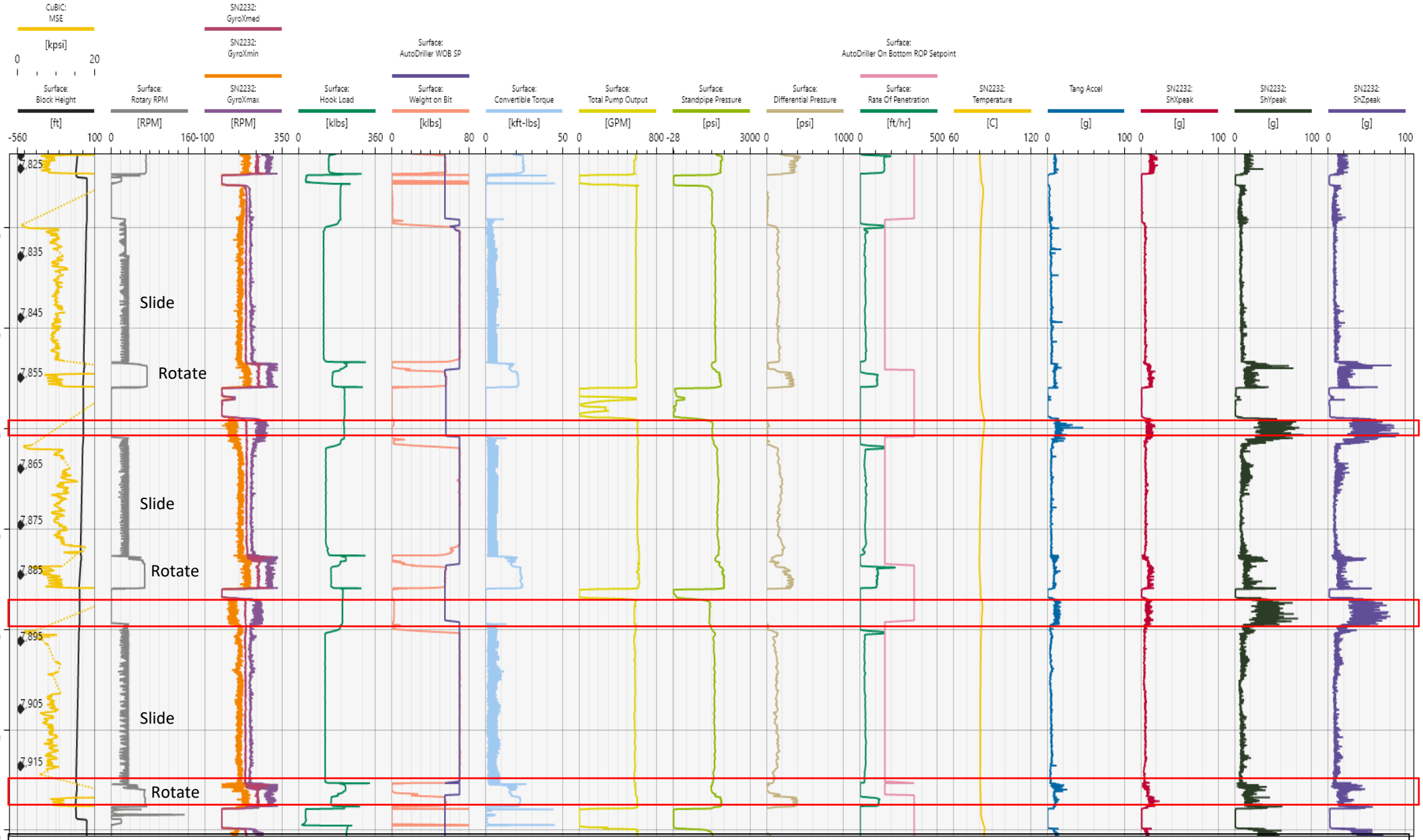
Sliding and rotating ahead. Dynamics normal. No significant change in downhole dynamics during RPM step test.

BHA #17 (10) – Stand Zoom



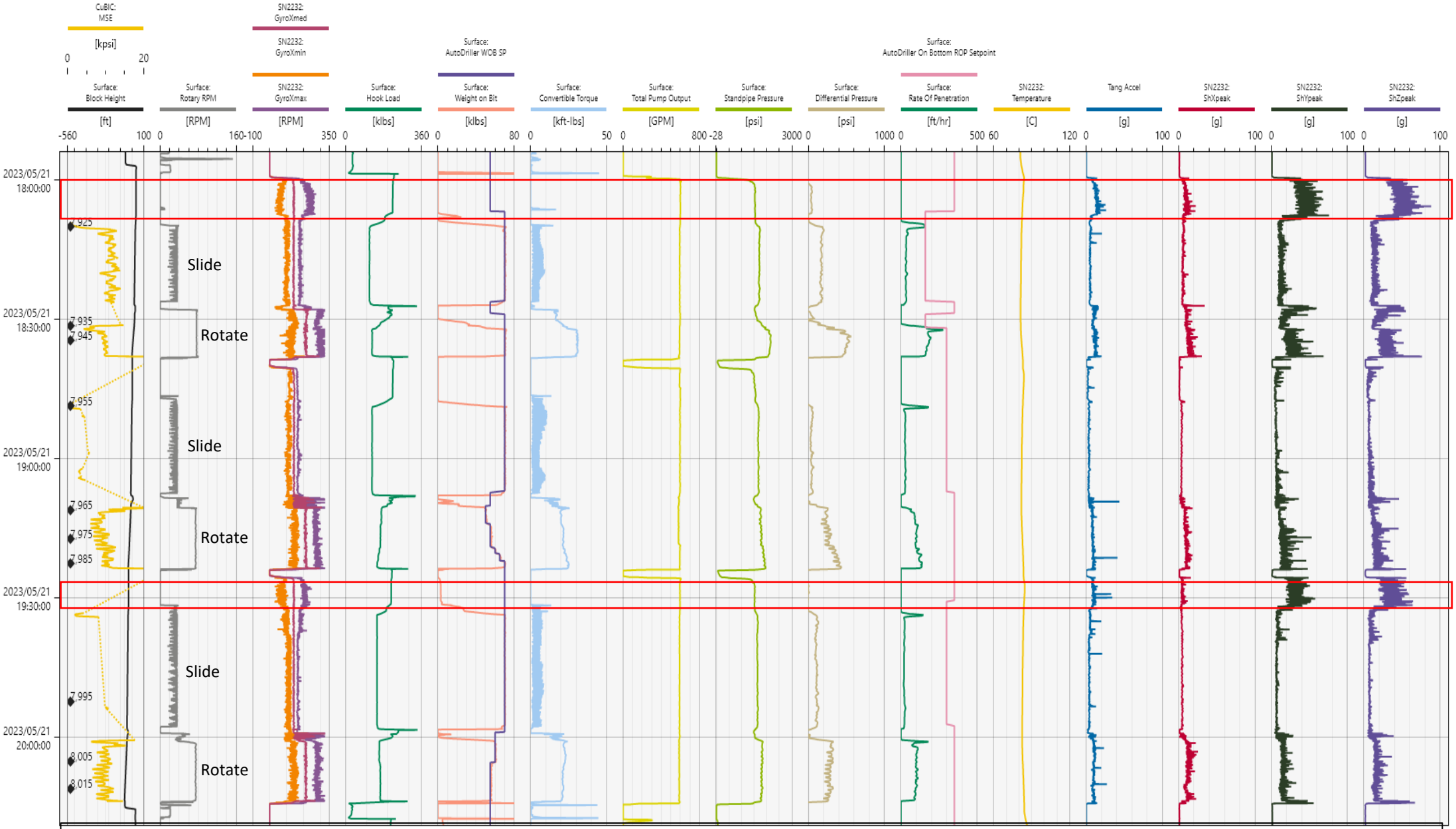
Sliding and rotating ahead. Dynamics normal.

BHA #17 (10) – Stand Zoom



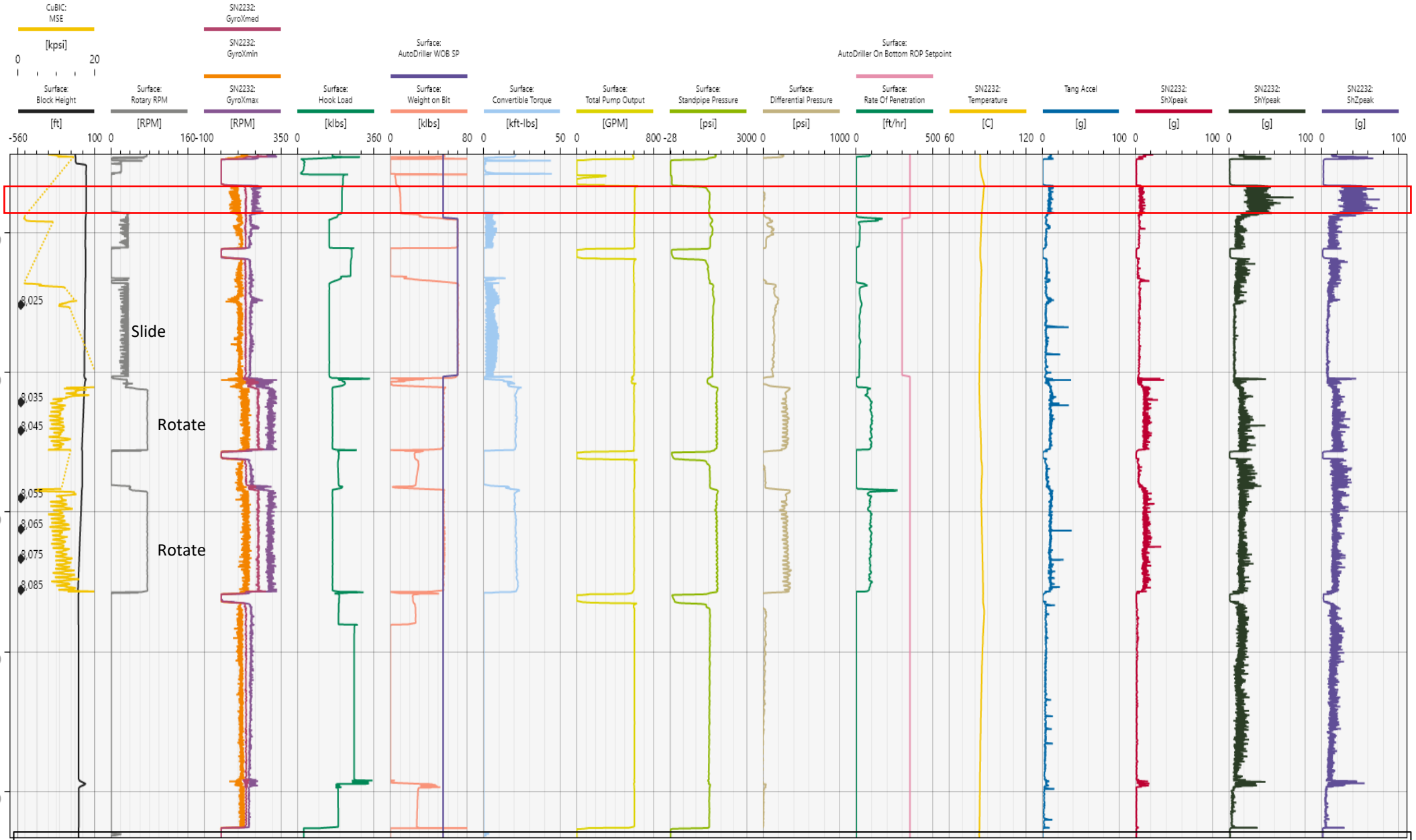
Higher gyro spread and 3-axis Peak Shock off-bottom with pumps on and no rotary.

BHA #17 (10) – Stand Zoom



Sliding and rotating ahead. Dynamics highest off bottom with pumps on and no rotation.

BHA #17 (10) – Stand Zoom



Sliding and rotating ahead. Dynamics highest off bottom with pumps on and no rotation.

BHA #17 (10) – Discussion

- Offset wear on stabilizer.
- Bit shoulder cutters starting to wear.
- Bit dynamics are at highest when off bottom with pumps on and no surface rotation.
- Either bit whirl or unloaded bit grabbing on wellbore.

Final Thoughts