



Extend Life of ESP Installations Through Proper Gas Remediation Using Improved BHA

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BACKGROUND

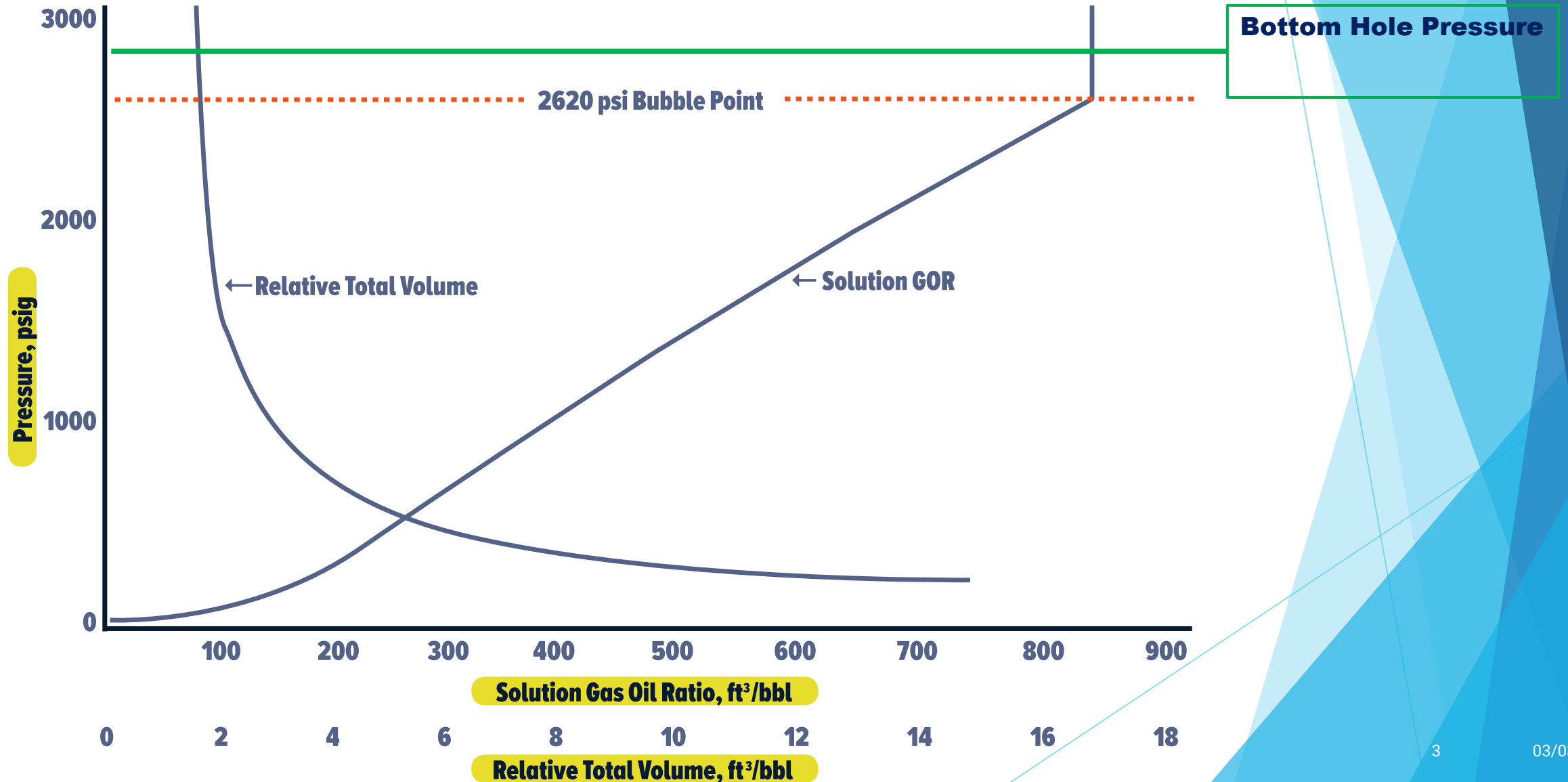
New unconventional wells in the Permian Basin have been very challenging to produce using electric submersible pumps due to high gas to liquid ratio's experienced early in the life of the well.

ESP's by nature are designed to pump only liquids and have difficulty handling a large amount of free gas.

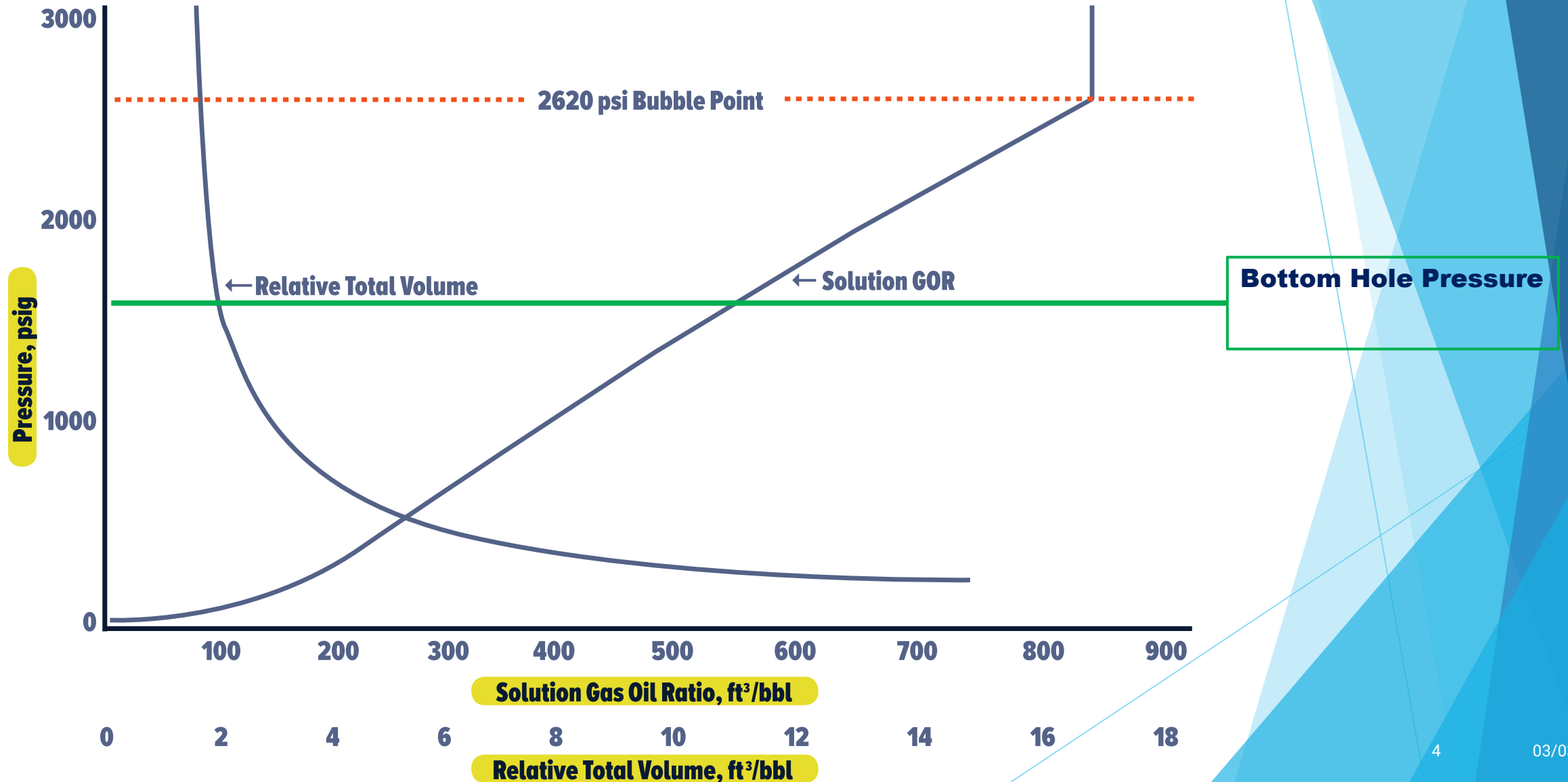
Gas interference in ESP's lead to:

- Decreases in volumetric efficiencies
- Increased motor temperatures due to insufficient cooling
- Erratic run behavior
- Increased operating expense
- Costly well repairs

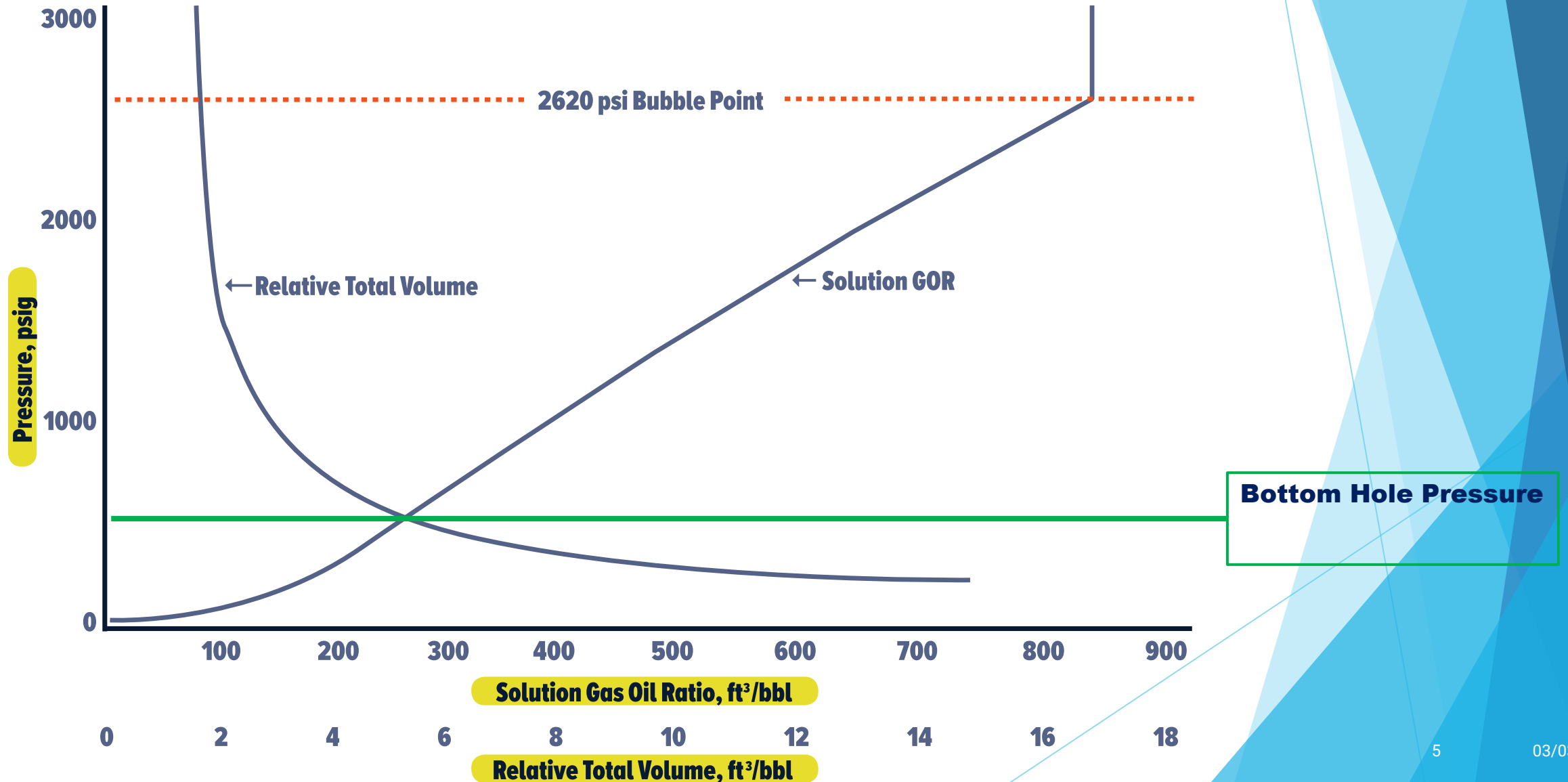
IMPORTANCE OF THE BHA



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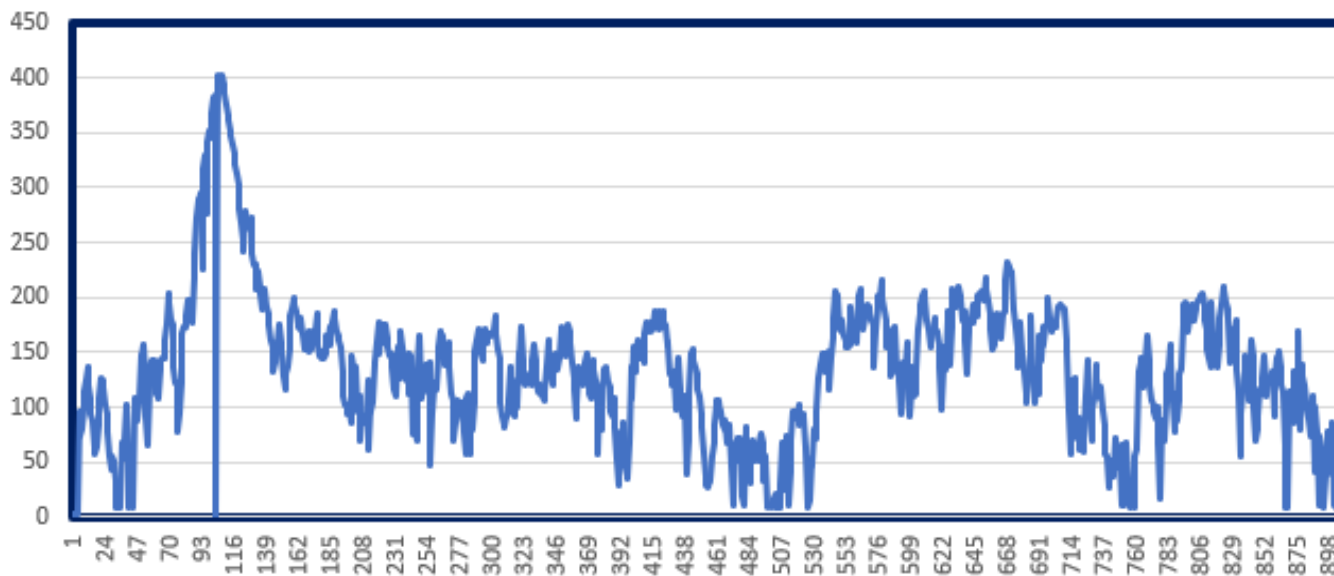


IMPORTANCE OF THE BHA



DYNAMIC ESP CASING GAS RATES CAPTURED VIA MVT

Varying Casing Gas Rate (MCF/Day Taken each Minute over 15 hour period



Timestamp	Comparable GS Flow Rates
5/12/2021 18:19	2.708403457
5/12/2021 18:20	2.802735753
5/12/2021 18:21	2.860828042
5/12/2021 18:22	2.782901488
5/12/2021 18:23	95.99070311
5/12/2021 18:24	72.95080662
5/12/2021 18:25	79.11791325
5/12/2021 18:26	98.47662807
5/12/2021 18:27	113.6525345
5/12/2021 18:28	123.5259819
5/12/2021 18:29	135.8888519
5/12/2021 18:30	119.2993891
5/12/2021 18:31	107.2958171
5/12/2021 18:32	93.5522747
5/12/2021 18:33	87.55685627
5/12/2021 18:34	63.74472499
5/12/2021 18:35	56.87545896
5/12/2021 18:36	63.33862245
5/12/2021 18:37	83.05587888
5/12/2021 18:38	108.6962628
5/12/2021 18:39	127.170428
5/12/2021 18:40	123.4034371
5/12/2021 18:41	117.2667682
5/12/2021 18:42	102.9419267
5/12/2021 18:43	93.10886264
5/12/2021 18:44	77.44584024
5/12/2021 18:45	55.14976323
5/12/2021 18:46	42.49020875
5/12/2021 18:47	55.75534165
5/12/2021 18:48	50.37517905
5/12/2021 18:49	33.89851123
5/12/2021 18:50	8.849455789
5/12/2021 18:51	8.44846487
5/12/2021 18:52	8.46319221

Timestamp	Comparable GS Flow Rates
5/12/2021 20:02	401.7685793
5/12/2021 20:03	400.4146671
5/12/2021 20:04	399.6475124
5/12/2021 20:05	401.1078787
5/12/2021 20:06	394.1667509
5/12/2021 20:07	386.820631
5/12/2021 20:08	376.1866808
5/12/2021 20:09	366.2112665
5/12/2021 20:10	362.1615171
5/12/2021 20:11	351.2250137
5/12/2021 20:12	346.5493226
5/12/2021 20:13	339.3072724
5/12/2021 20:14	330.6685638
5/12/2021 20:15	321.9559121
5/12/2021 20:16	312.0459437
5/12/2021 20:17	302.9605508
5/12/2021 20:18	281.3659143
5/12/2021 20:19	267.3262239
5/12/2021 20:20	252.6086426
5/12/2021 20:21	241.6984892
5/12/2021 20:22	278.6292887
5/12/2021 20:23	268.0525017
5/12/2021 20:24	266.037519
5/12/2021 20:25	263.0005503
5/12/2021 20:26	272.8787827
5/12/2021 20:27	239.222188
5/12/2021 20:28	229.5924568
5/12/2021 20:29	230.5603909
5/12/2021 20:30	207.494638
5/12/2021 20:31	224.4757247
5/12/2021 20:32	210.094192
5/12/2021 20:33	202.6232958
5/12/2021 20:34	189.9530554
5/12/2021 20:35	201.1051226
5/12/2021 20:36	206.5196872
5/12/2021 20:37	191.0044813
5/12/2021 20:38	185.9071469
5/12/2021 20:39	174.5528841
5/12/2021 20:40	161.5864313
5/12/2021 20:41	155.3929317

DESIGN

- Production Tubing
- Gas Discharge Port
- ESP Assembly with bypass tubing banded alongside the ESP cable
- Gas Bypass Connection Sub
- Ported Sub
- Dual Cup Packer
- Gas Bypass Port
- Tail Pipe
- Desander/Slotted Sub (45°)
- Mud Joints & Bull Plug

GAS DISCHARGE

FLUID DISCHARGE

**PACKER
GAS BYPASS PORT**

TAIL PIPE

**HELIX INTAKE
AT 45 DEGREES**

MUD JOINTS/BULL PLUG

DESIGN RECOMMENDATIONS

5.5" 20Lb. Casing Scenario

Quantity	Item	Item Length, ft	Total Length, ft	Bottom Depth, ft	OD, in	Weight (#)
306	2-7/8 production tubing*	32.40	9914.40	7,196.01	2.875	
1	Sub	4.00	4.00	7,200.01	2.875	
1	Gas Discharge Port	0.49	0.49	7,200.50	4.25	
5	400 Pump	71.60	71.60	7,272.10	4.00	
1	Pump Intake	2.50	2.50	7,274.60	4.00	
1	Gas Handler	2.50	2.50	7,277.10	4.00	
2	Seal	15.80	15.80	7,292.90	4.00	
2	375 Motor	20.90	41.80	7,334.70	3.75	
1	ESP Sensor	1.50	1.50	7,336.20	3.94	
1	Seat Nipple	0.67	0.67	7,336.87	2.375	
1	Gas Bypass Connection Sub	0.53	0.53	7,337.40	4.25	
1	Perforated Sub (Fluid Discharge)	0.70	0.70	7,338.10	3.705	
1	NR1 Cup Type Packer	1.42	1.42	7,339.51	-	
1	Gas Bypass Sub (Gas Intake)	0.52	0.52	7,340.03	3.625	
14	2-3/8" tail pipe*	32.40	453.60	7,793.63	2.375	2131.92
1	Lift Sub	4.00	4.00	7,797.63	2.375	
1	Slotted Sub @ 45 degrees	9.00	9.00	7,806.63	3.75	200.00
4	2-7/8" mud joints**	32.40	129.60	7,936.23	2.875	2203.20
1	Bull Plug	0.20	0.20	7,936.43	-	5.00

4540.12 lbs total weight
below sensor w/
full mud joints

Total Length of ESP Components (ft):	135.8
Additional Gas Bypass Components (ft):	8.34
Total Estimated Length of Single 1/2" Bypass Tube (ft):	169.14

includes additional 25' safety factor

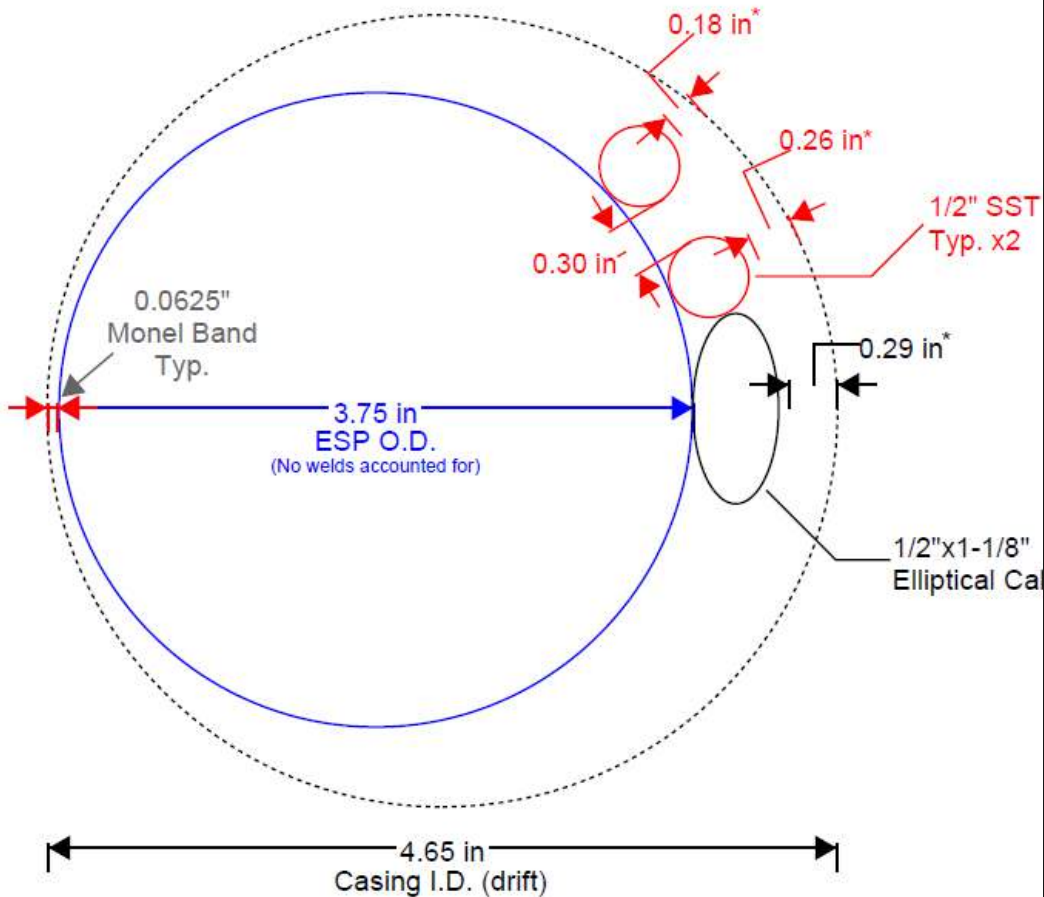
Note: Slotted sub weight is estimated at 150#, remaining 50# accounts for other items below sensor

**estimated lengths, will depend on tubing tally*

***total mud joint weight is based off of 17#/ft estimated full mud joint weight*

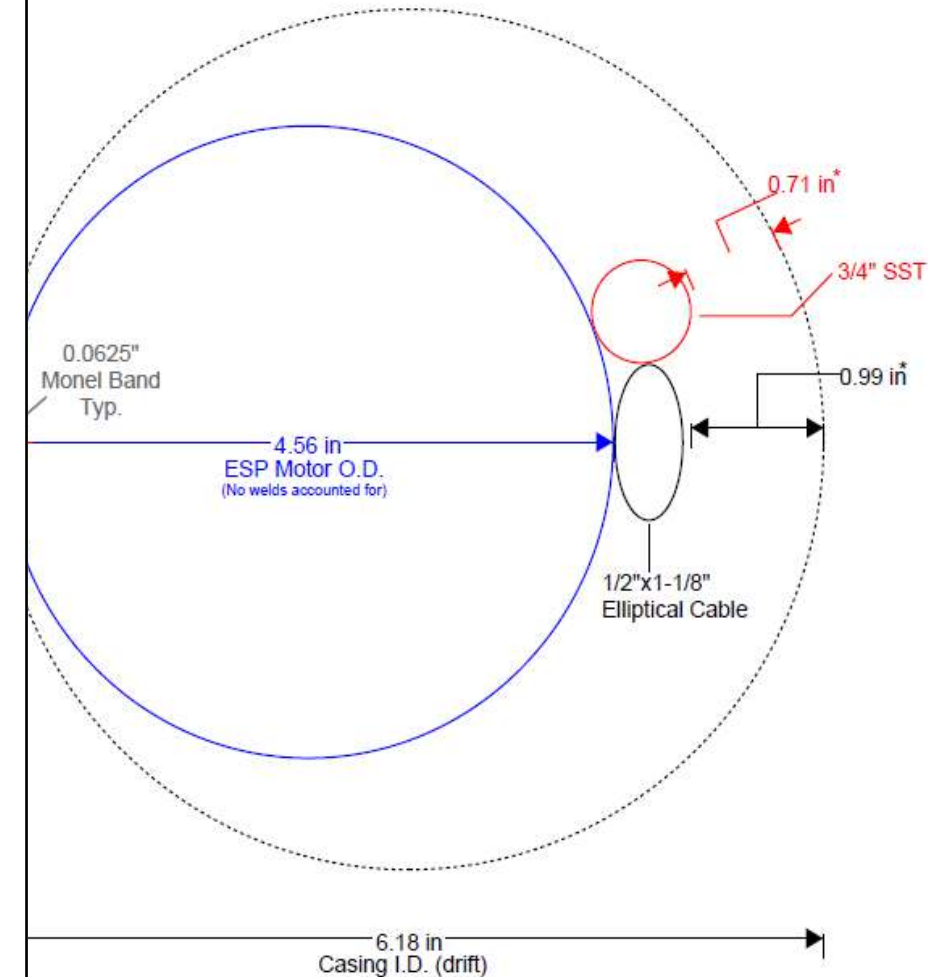
SYSTEM CLEARANCES

5.5" 20Lb. Casing Scenario



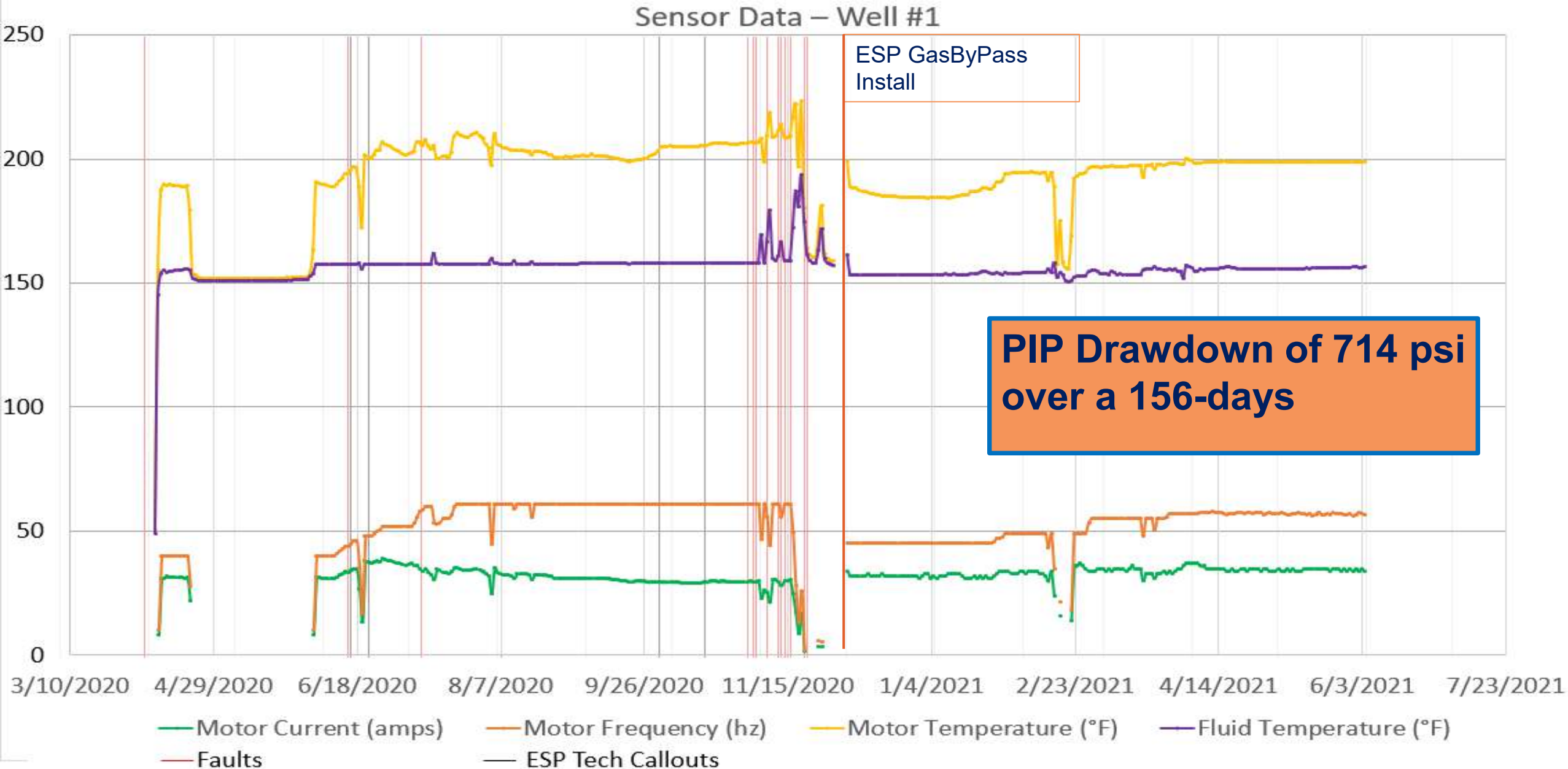
*Dimension accounts for Monel Band Thickness of 0.0625"

7" 29Lb. Casing Scenario

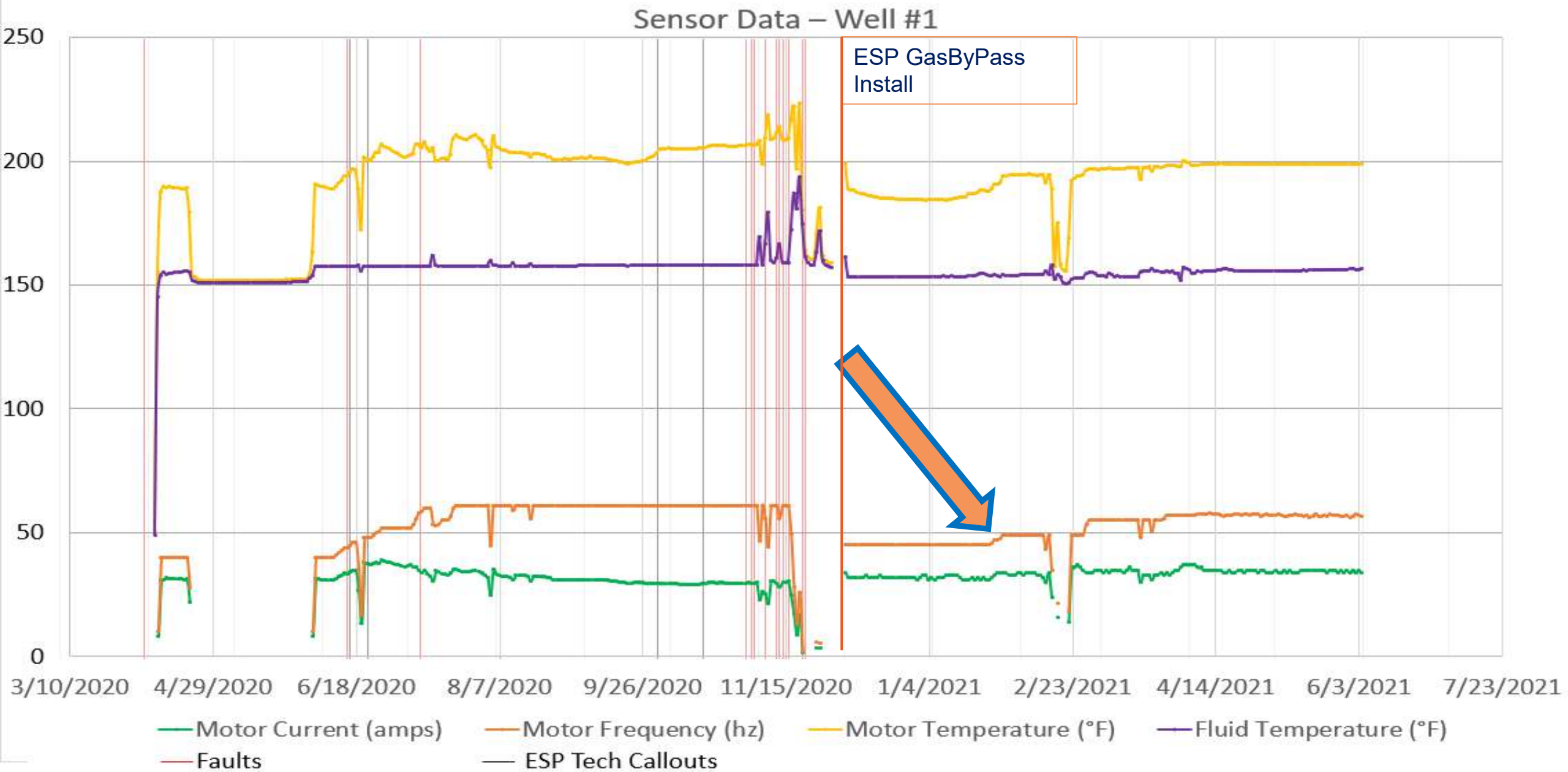


*Dimension accounts for Monel Band Thickness of 0.0625"

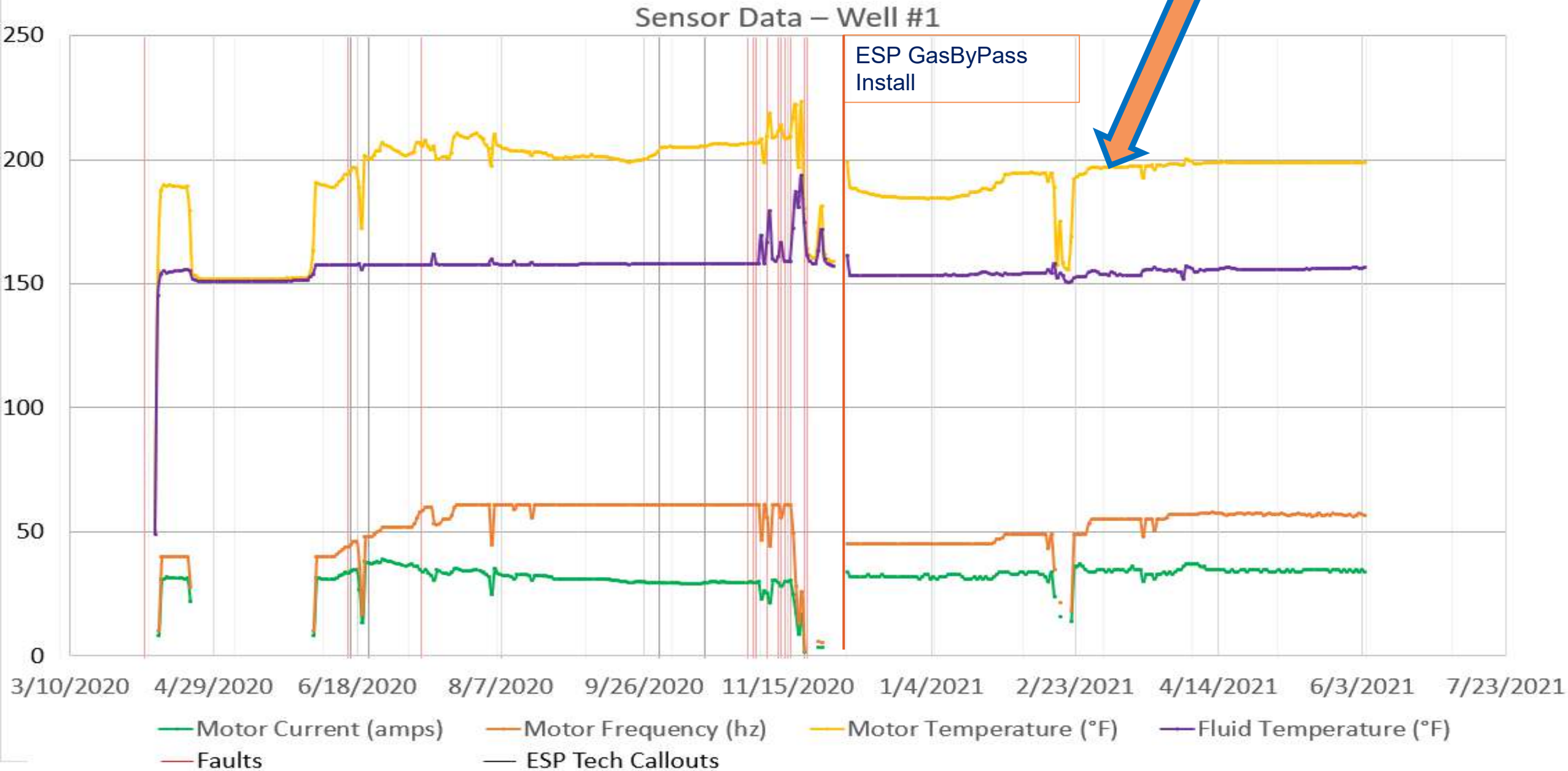
CASE STUDY WELL #1



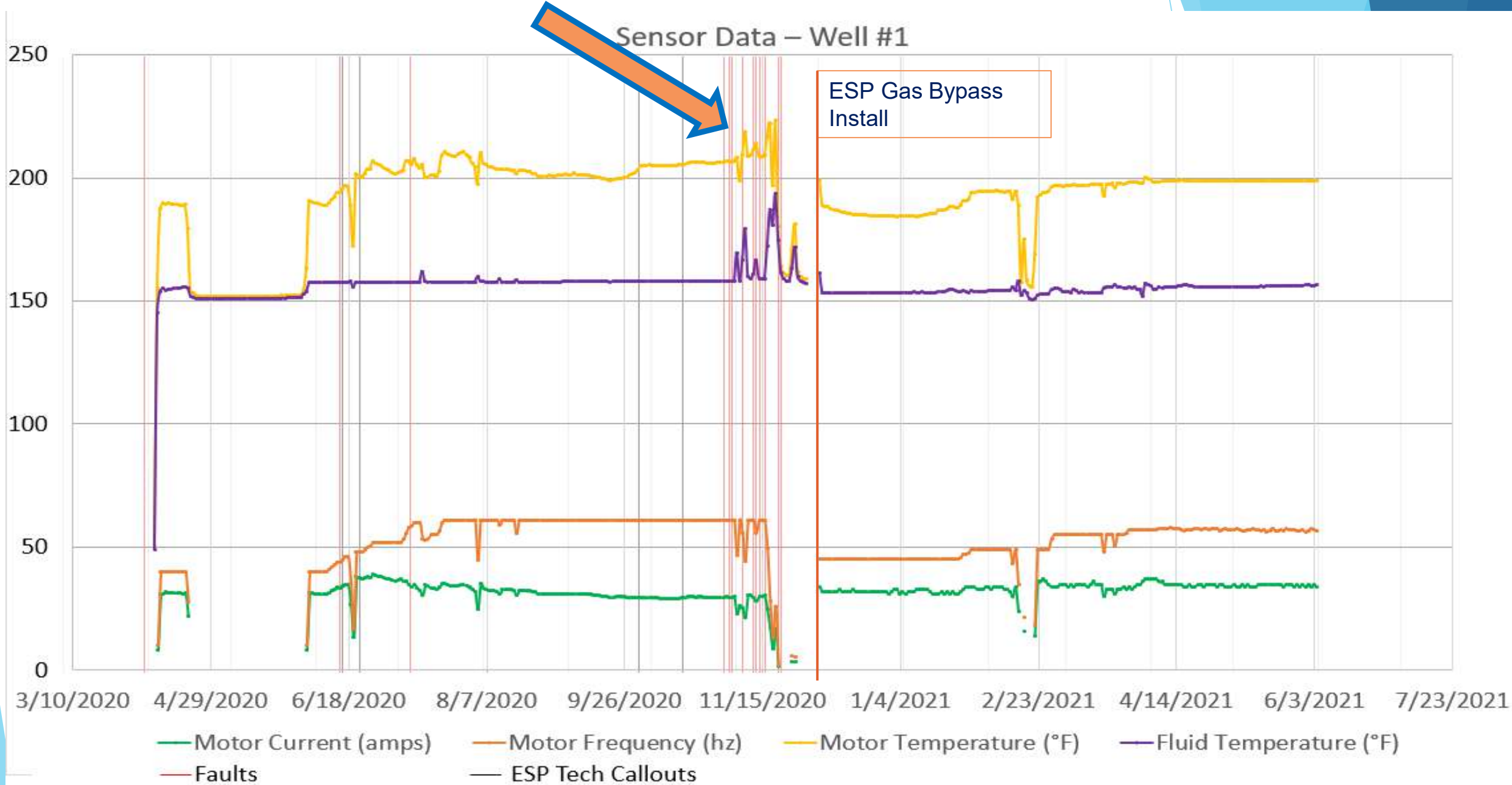
Drive speed increased from 45 Hz – 55 hz



More production, more gas but only 12° F motor temperature increase

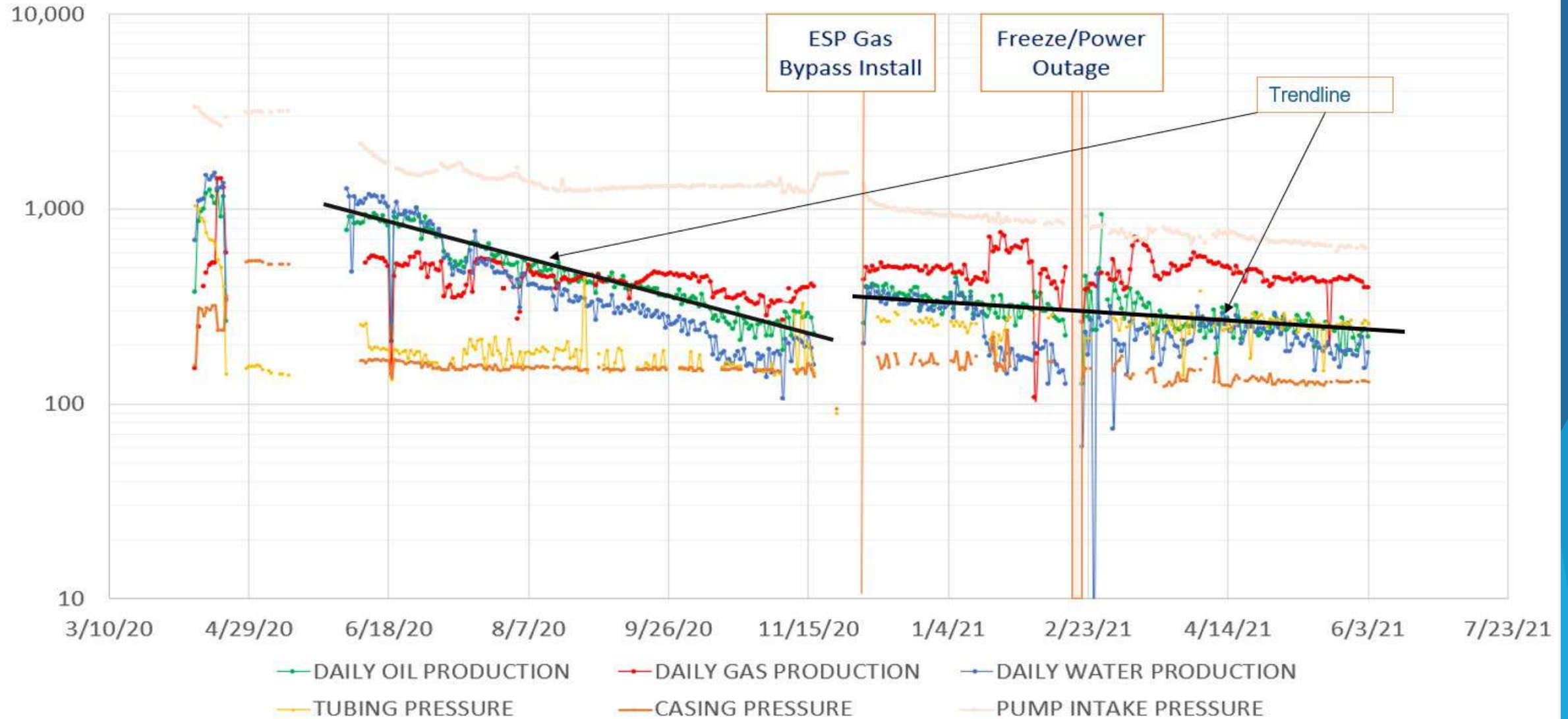


\$10K in service call outs prior to install. None since ESP Gas Bypass was ran

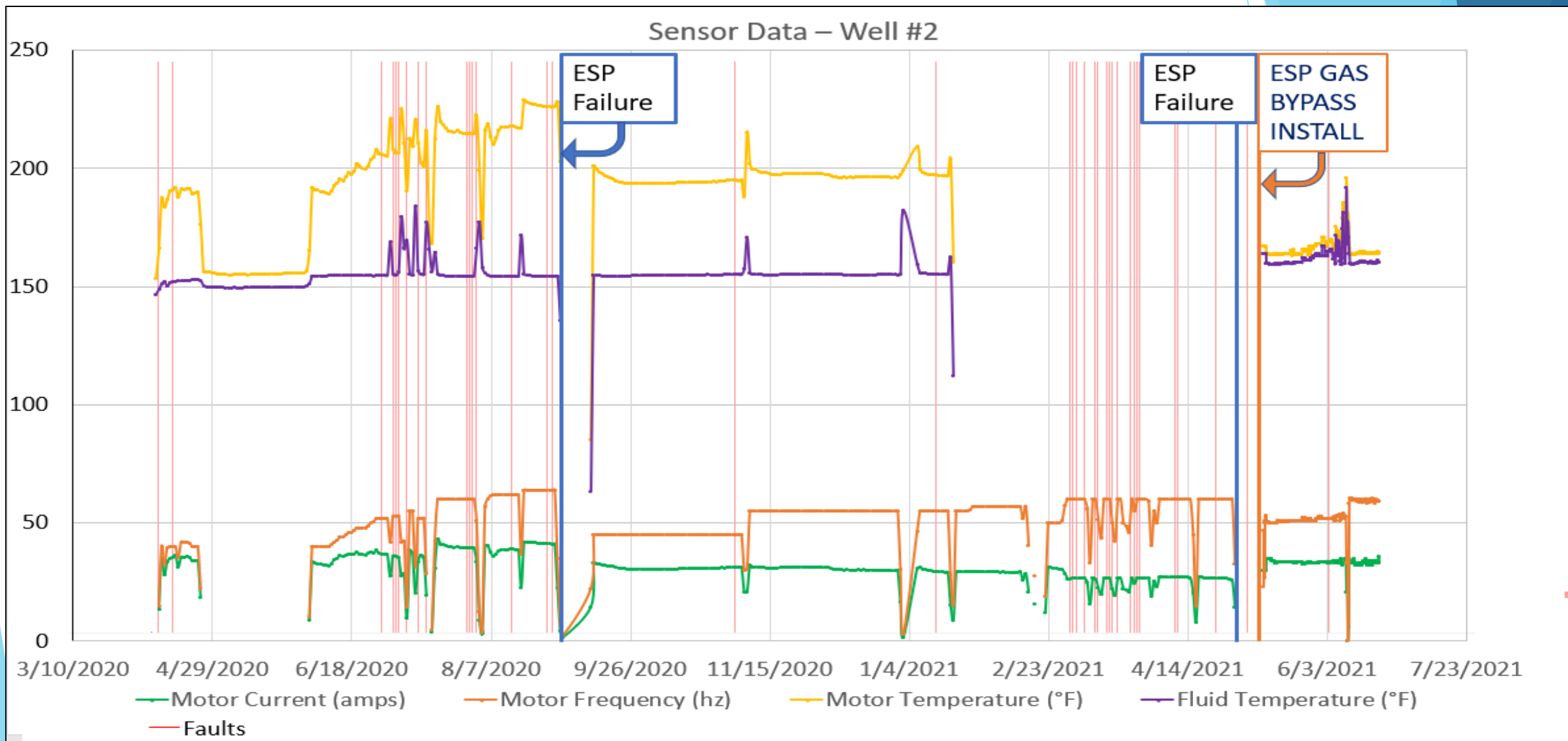


CASE STUDY WELL #1

Production Data – Well #1

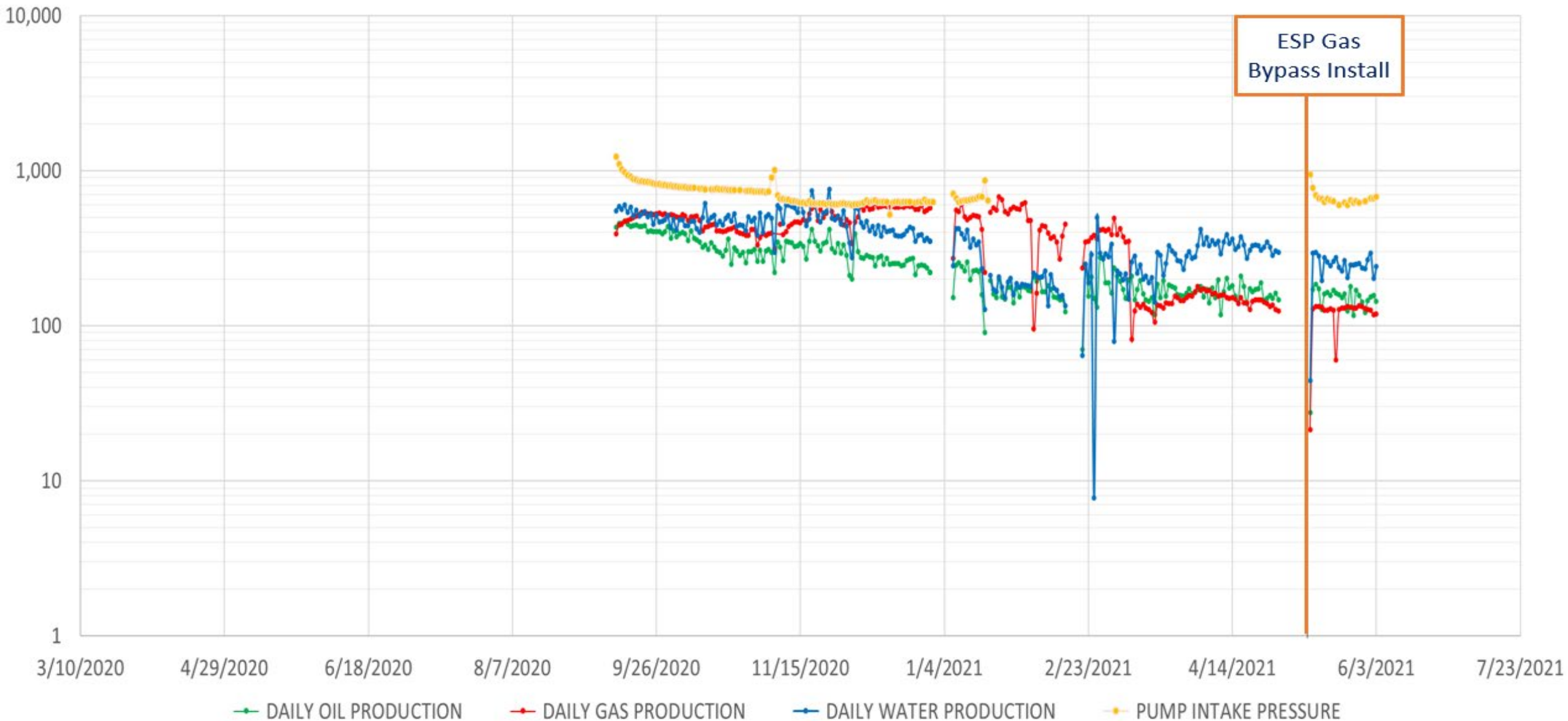


CASE STUDY WELL #2



CASE STUDY WELL #2

Production Data – Well #2



CONCLUSION

- **Operating conditions can be significantly improved by utilizing the ESP Gas Bypass, an innovative technology, when paired with proper ESP design and operational practices.**
- **This technology can play a key part in substantially reducing ESP failures, decreasing operating expense, increasing runtimes and production.**
- **Case studies have shown improved ESP efficiencies, optimized production and stabilized runtimes utilizing the ESP Gas Bypass system.**
- **Without the utilization of the ESP Gas Bypass system, all free gas that does not naturally bypass the ESP has to be produced through the pump, causing operational issues and ultimately decreases the life of the ESP.**

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