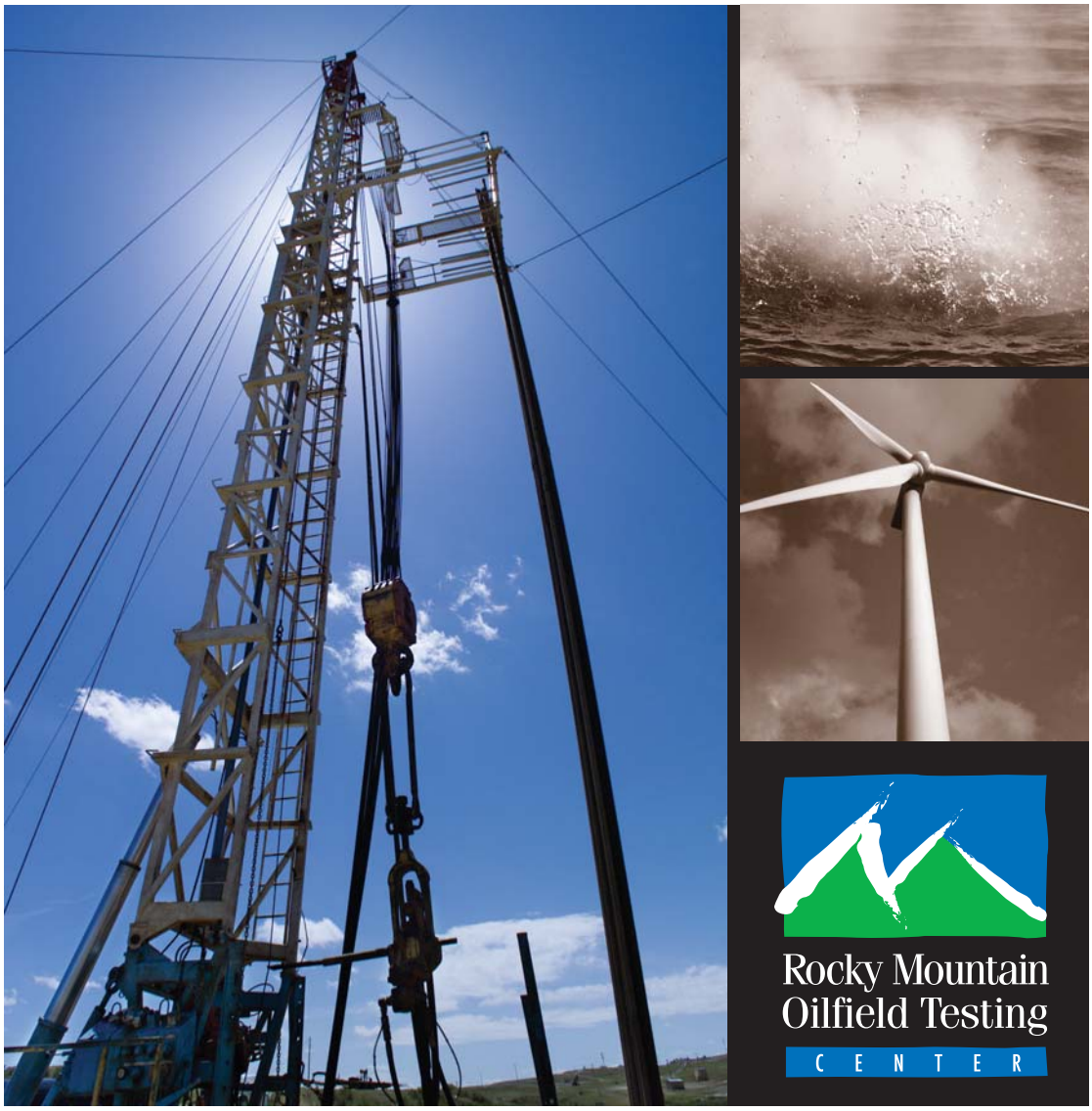

Rocky Mountain Oilfield Testing CENTER

STWA, Inc: Viscosity Reduction Test

An assessment of an in-line viscosity reduction device
Naval Petroleum Reserve No. 3, Teapot Dome Field, Wyoming

Final Report for October 19, 2011

U.S. DEPARTMENT OF ENERGY

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STWA, Inc.: Viscosity Reduction Test

Jeanette Buelt, RMOTC

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ABSTRACT

The Rocky Mountain Oilfield Testing Center (RMOTC) conducted a field test on the STWA in-line viscosity reduction device at the Naval Petroleum Reserve No. 3 (NPR-3) located 35 miles north of Casper in Natrona County, Wyoming. The in-line viscosity reduction device is designed to reduce the line-loss of crude oil traveling through a commercial pipeline and thereby reduce the energy required to transport crude oil through pipelines. Gains in pump operation efficiency were observed on the 4.4 mile, 6 inch, schedule 80 buried pipeline test loop.

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INTRODUCTION:

The Rocky Mountain Oilfield Testing Center (RMOTC) conducted a field test on the STWA in-line viscosity reduction device (Applied Oil Technology, AOT) at the Naval Petroleum Reserve No. 3 (NPR-3) located 35 miles north of Casper in Natrona County, Wyoming.

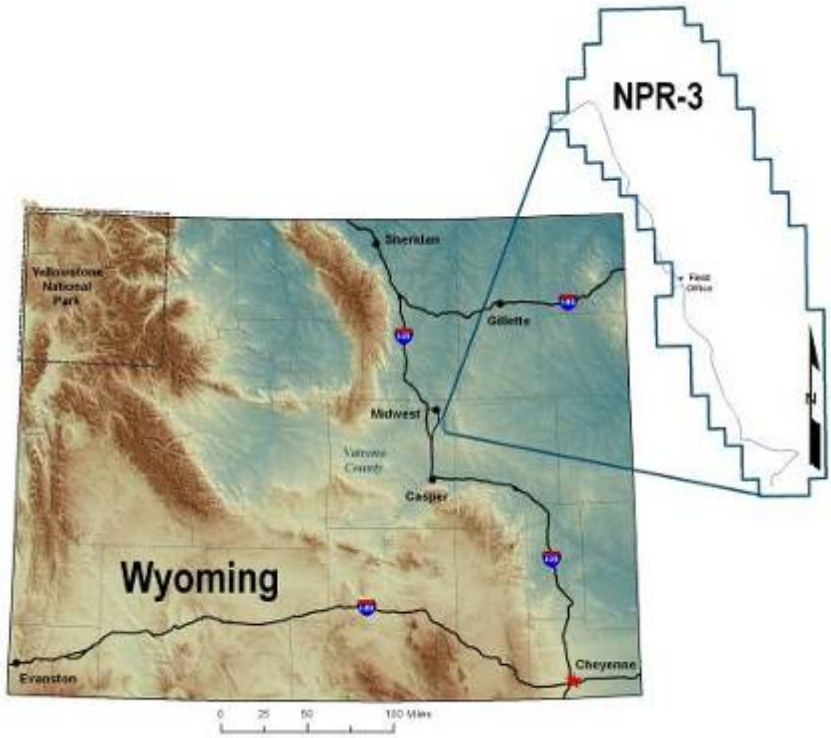


Figure 1. State Map of NPR-3

STWA, Inc. (STWA) of Santa Barbara, California, together with Temple University of Philadelphia's physics department, designed and created the AOT device to reduce the energy required to transport crude oil through commercial pipelines.

The device exposes passing crude oil to a precisely controlled electric field to reduce the oil viscosity. This is intended to reduce line-loss (fluid drag) and pressure, without changing the oil temperature or composition. In a commercial pipeline operation, the intended results would translate into reduced pump power required to maintain constant flow rates, and would thereby deliver energy savings for crude oil transportation.

Figure 2. Viscosity Reduction Unit and Test Site Tank Battery

TEST RESULTS:

Test results are detailed within Appendix A.

OBSERVATIONS:

In 2011, the AOT device was installed on a flow loop located at the RMOTC field test site in NPR-3. The flow loop – a 4.4 mile, 6 inch, schedule 80 buried pipeline -- was modified specifically to support this viscosity reduction test. RMOTC validated overall system integrity after AOT installation, and filled the loop with field-produced API 34° oil to facilitate testing.

The oil was circulated through the loop to establish baseline hertz, amperage, kilowatt, temperature, and pressure rates. After establishing baseline performance, the AOT device was turned on to measure its impact on these variables. Both pump motor power consumption and pressure inside the flow loop were measurably reduced with the device in operation. Temperature was not measurably affected by the device operation.

Power consumption was observed to decrease by 13.55% when the device was operating at one third its power capacity. After running for 70 minutes, the device was deactivated, and pump motor power consumption returned to baseline pre-treatment numbers within 56 minutes.

Power consumption was observed to decrease by 13.14% when the device was operating at one fourth its power capacity. After running for 75 minutes, the device was deactivated, and pump motor power consumption returned to baseline pre-treatment numbers within 15 minutes.

Figure 3. RMOTC, STWA and Temple University Personnel Gathering Data

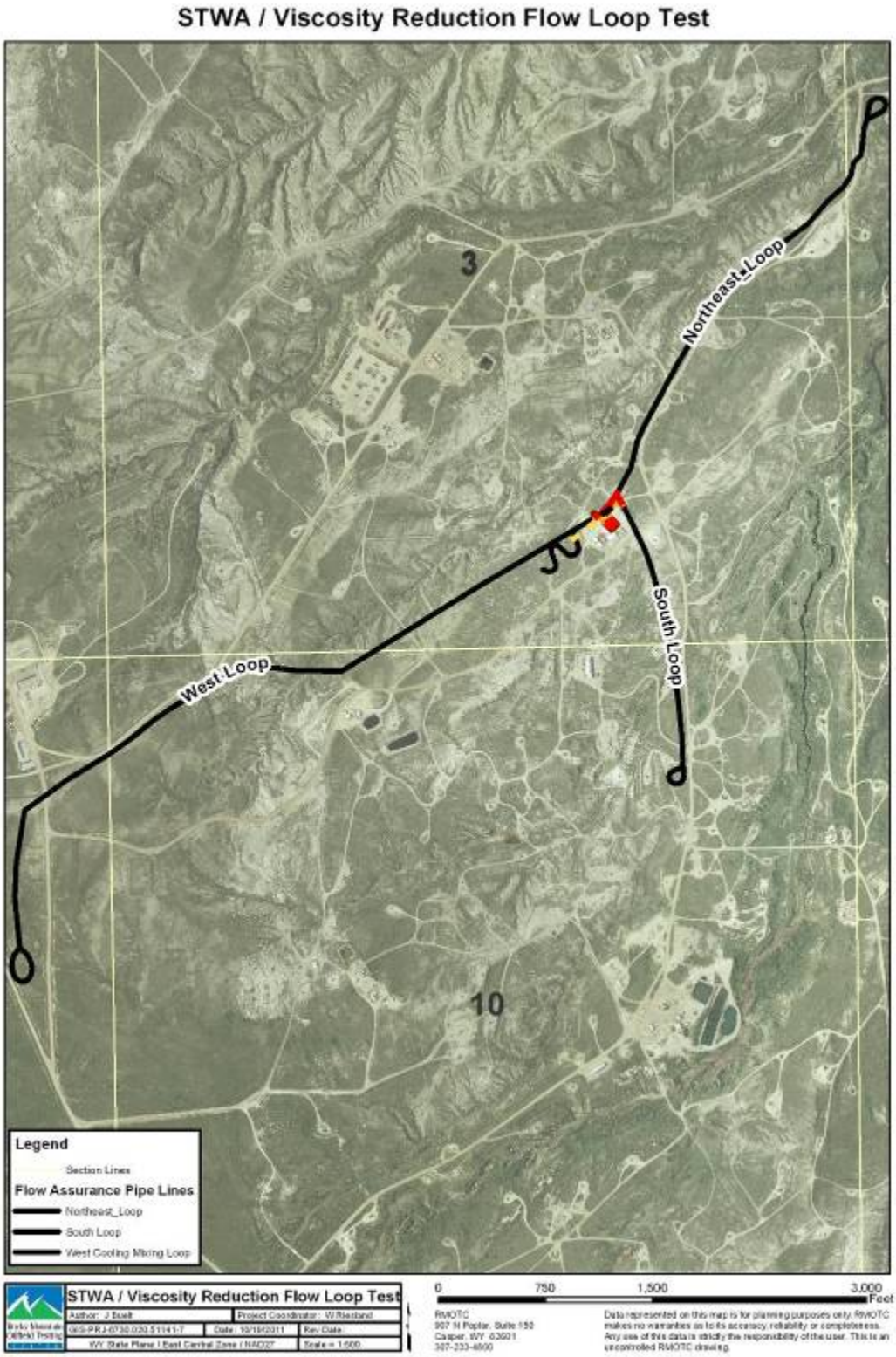


Figure 4. NPR-3 Flowloop Map

CONCLUSION:

Preliminary test results indicate that the viscosity reduction device operated successfully. Pipeline line-loss and pump motor power consumption were reduced for a given flow rate during the observed test. The device may hold potential for energy savings and increased pipeline flow rates for the oil production and transportation industry.

Figure 5. RMOTC and Temple University Personnel briefing

Figure 6. STWA's Viscosity Reduction Unit, Post-Testing

Figure 7. RMOTC, STWA, and Temple University Personnel

This research was co-funded by STWA, Inc. and the Pipeline Research Council International (PRCI). Work was directed by Clarke Turner, Brian Haight, Wes Lintz, Wes Riesland, George Hughes and Jeanette Buelt.

APPENDIX A

Raw Data

RMOTC - STWA - AOT 1st Test 10.18.2011 Data Sheet

Oct. 18, 2011	Device Run at 1/3 Power										
TEST 1	**Device Off Pump On (Baseline) (Untreated)**	**Device On Pump On**	**Device On Pump On**	**Device On Pump On**	**Device On Pump On**	**Device Off Pump On (Treated)**	**Device Off Pump On (Treated)**	**Device Off Pump On (Treated)**	**Device Off Pump On (Treated)**	**Device Off Pump On (Treated)**	**Device Off Pump On (Treated)**
Time	**Pre 11:00**	11:01	11:21	11:57	12:10	**13:15**	13:46	13:49	13:55	13:59	**14:11**
AOT mA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AOT kV	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hertz (Hz)	30	15	15	15	15	30	30	30	30	30	30
Amps	85	76.8				81.6	82.8	83.1	83.7	83.8	83.9
Kilowatt (kw)	**15.5**	4.8				**13.4**	14.3	14.7	14.9	15	**15.1**
Temp F°	59.7	59.7				59.6	59.6	59.6	59.6	59.6	59.6
Temp C	15.33	15.33				15.33	15.33	15.33	15.33	15.33	15.33
P1 psi		7	7	6	6			8			
P2 psi		77	76	76	76			122			
P3 psi		77	78	78	78			118			
P4 psi		74	74	74	75			106			
P5 psi		69	68	68	68			88			
P6 psi		3	3	3	3			2			
P7 psi			57					93			

Pre-Treatment Baseline Power Consumption

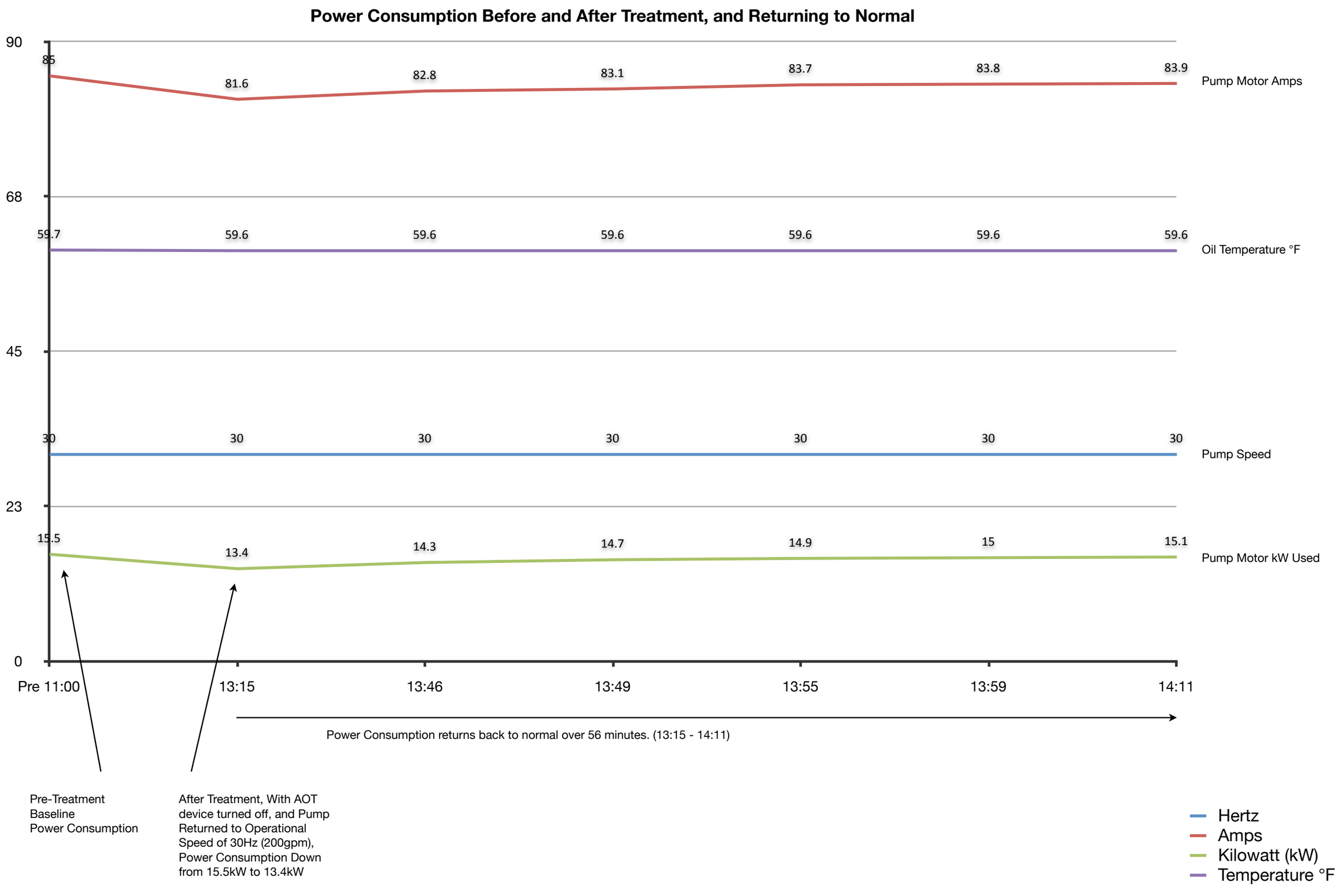
Pre-Treatment Pump Slowdown to Minimum Safe Operational Speed 15Hz (100gpm) to Maximize Field Exposure Time

Treatment Begins at Minimum Safe Pump Operational Speed

After Treatment, With AOT device turned off, and Pump Returned to Operational Speed of 30Hz (200gpm), Pump Motor Power Consumption Reduced from 15.5kW to 13.4kW

Power Consumption returns back to normal over 56 minutes (13:15 - 14:11)

RMOTC - STWA - AOT 1st Test 10.18.2011 Data Sheet



RMOTC - STWA - AOT 1st Test 10.18.2011 Data Sheet

Oct. 18, 2011	Device Run at 1/4 Power									
TEST 2	**Device Off Pump On (Baseline) (Untreated)**	**Device On Pump On**	**Device On Pump On**	**Device On Pump On**	**Device On Pump On**	**Device On Pump On**	**Device Off Pump On (Treated)**	**Device Off Pump On (Treated)**	**Device Off Pump On (Treated)**	**Device Off Pump On (Treated)**
Time	**15:28**	15:42	15:46	16:03	16:18	17:02	**17:05**	17:11	17:20	**17:26**
AOT mA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AOT kV	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hertz (Hz)	30	15	15	15	15	15	30	30	30	30
Amps	83.2	76					80.8	82.6	83.2	83.5
Kilowatt (kw)	**14.85**	7.9					**12.9**	14.5	14.9	**15.1**
Temp F°	61.3									61.1
Temp C	16.3									16.2
P1 psi	8	8	7	7	7	7	7	7	7	7
P2 psi	123	74	74	76	78	80	105	115	121	125
P3 psi	119	74	75	77	79	81	102	112	119	122
P4 psi	107	71	73	74	76	78	94	102	107	110
P5 psi	87	67	67	68	69	70	80	86	87	88
P6 psi	1	1		2	2	2	3	1	1	1
P7 psi	94	53		56		60	77	87	93	96

Pre-Treatment Baseline Power Consumption

Pre-Treatment Pump Slowdown to Minimum Safe Operational Speed 15Hz (100gpm) to Maximize Field Exposure Time

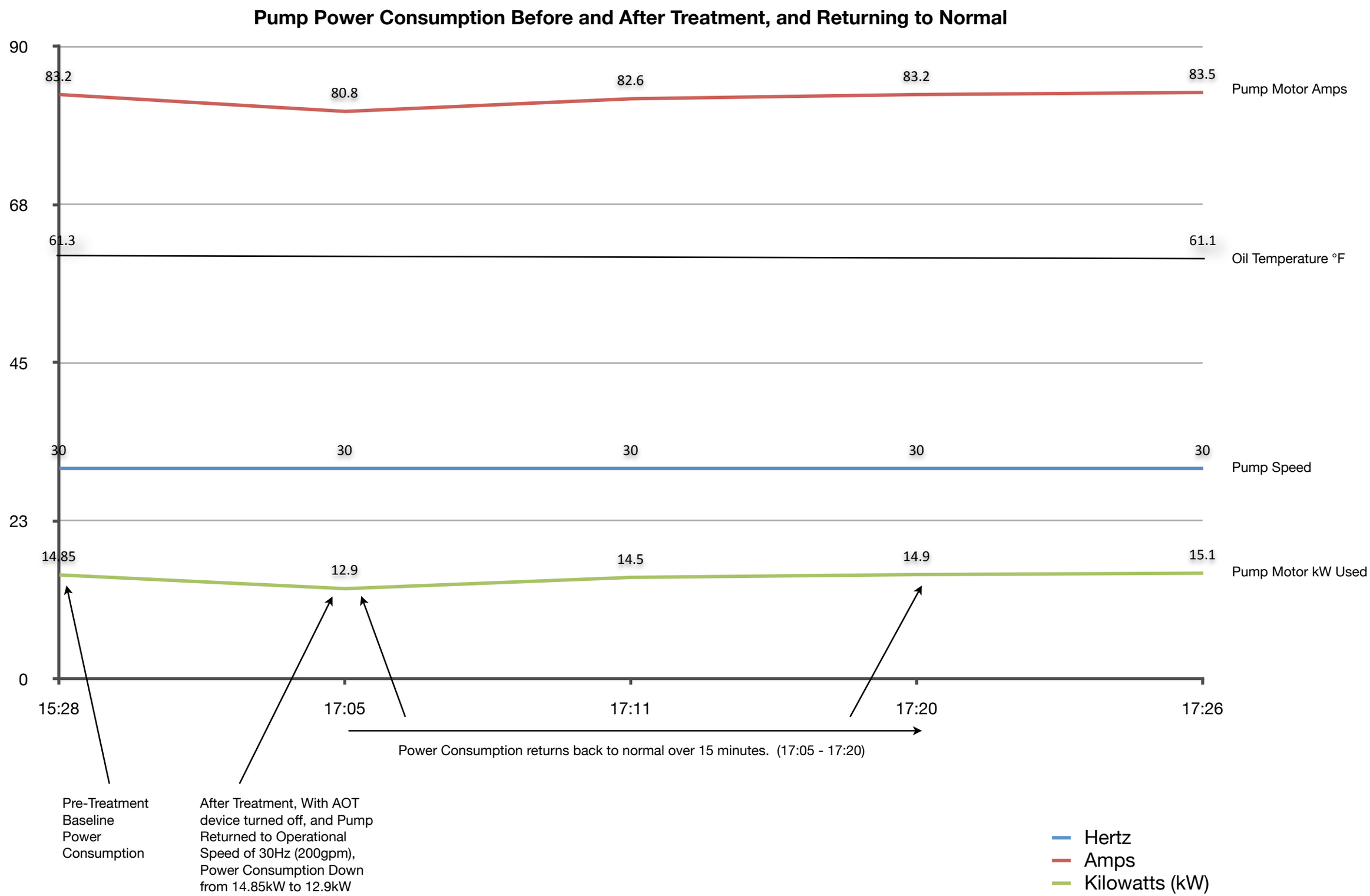
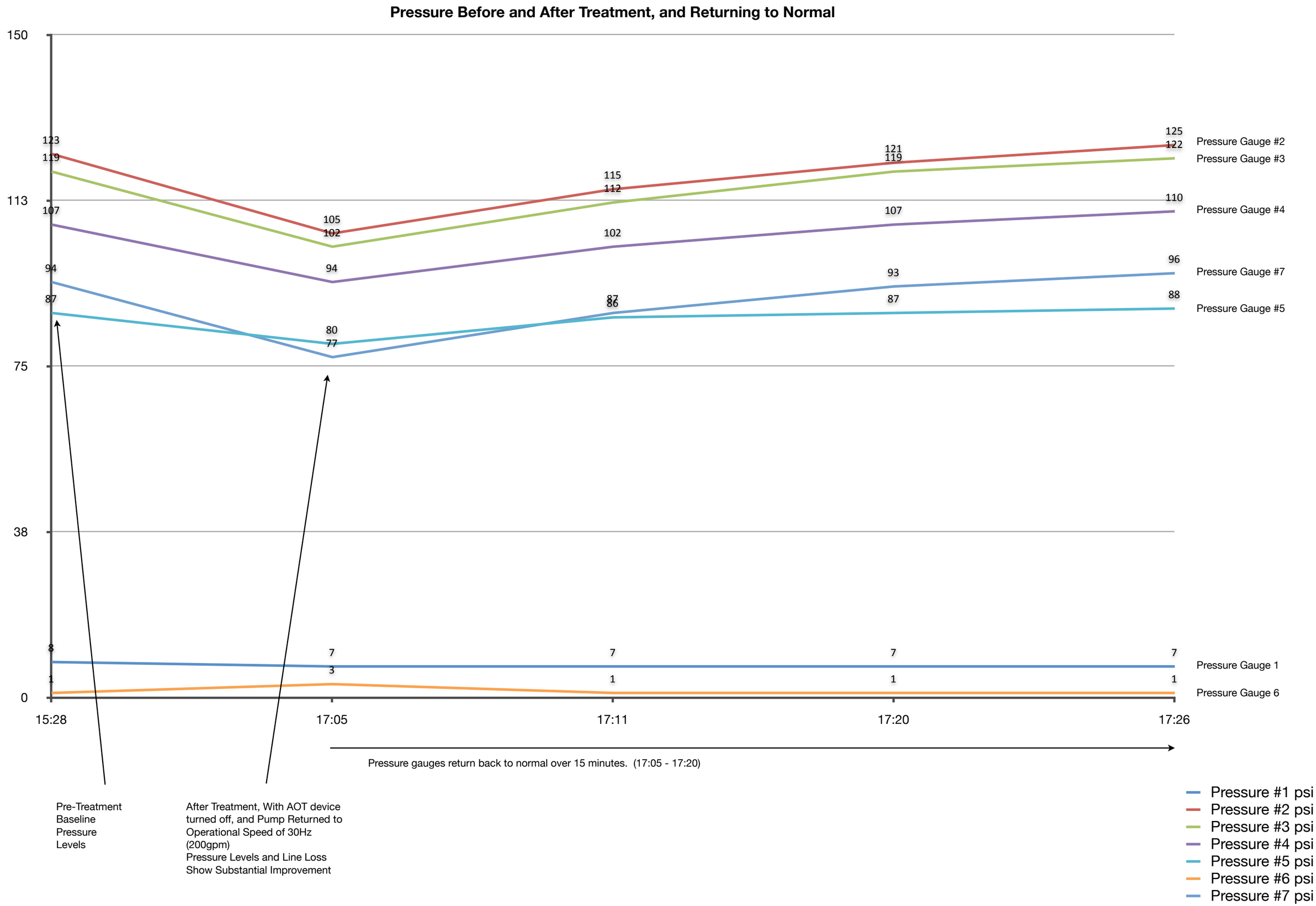
Treatment Begins at Minimum Safe Pump Operational Speed

After Treatment, With AOT device turned off, and Pump Returned to Operational Speed of 30Hz (200gpm),

Pump Motor Power Consumption Down from 14.85kW to 12.9kW

Power Consumption returns back to normal within 15 minutes (17:05 - 17.20)

RMOTC - STWA - AOT 1st Test 10.18.2011 Data Sheet



RMOTC - STWA - AOT 1st Test 10.18.2011 Data Sheet