

**DEPARTMENT OF ENVIRONMENTAL QUALITY  
AIR QUALITY DIVISION  
ACTIVITY REPORT: Scheduled Inspection**

B722039268

<b>FACILITY:</b> ANR Pipeline Co - Woolfolk Compressor Station		<b>SRN / ID:</b> B7220
<b>LOCATION:</b> 11039 150th Ave., BIG RAPIDS		<b>DISTRICT:</b> Grand Rapids
<b>CITY:</b> BIG RAPIDS		<b>COUNTY:</b> MECOSTA
<b>CONTACT:</b> Brad Stermer, Sr. Environmental Specialist		<b>ACTIVITY DATE:</b> 04/04/2017
<b>STAFF:</b> Chris Robinson	<b>COMPLIANCE STATUS:</b> Compliance	<b>SOURCE CLASS:</b> MAJOR
<b>SUBJECT:</b> FY '017 on-site inspection to determine the facility's compliance status with MI-ROP-B7220-2012a and other applicable air quality rules and regulations.		
<b>RESOLVED COMPLAINTS:</b>		

pQD staff Chris Robinson (CR) and Steve Lachance (SL) conducted an on-site scheduled inspection on Tuesday April 4, 2017. AQD staff arrived at ANR Pipeline Company - Woolfolk Compressor Station located at 11039 150<sup>th</sup> Avenue, Big Rapids, MI at approximately 9:30 am and met with Mr. Brad Stermer, Sr. Environmental Specialist and Mr. Larry London, engine specialist. No odors or visible emissions were detected upon arrival. AQD staff presented Mr. Stermer and Mr. London with AQD Identification and informed them of AQD's intent to perform an inspection of the facility to determine compliance status with respect to their ROP No. MI-ROP-B7220-2012a and any other applicable air rules and regulations. In addition, AQD staff reviewed the site's Title V Renewable Operating Permit Application status, received by AQD on September 12, 2016 and 2016 MAERS submittal.

**Facility Description**

The ANR Pipeline Company owns and operates facilities throughout Michigan for natural gas transmission and storage. The Woolfolk compressor station is located near Big Rapids in Austin Township, Mecosta County, in a remote rural area. This facility consists of a Compressor Station and associated naturally occurring underground reservoirs used for storing natural gas. The reservoirs consist of a natural porous rock, therefore ideal for natural gas storage. The reservoirs are located in what is known as the Austin Field or Austin formation, which was discovered in the 1930's.

Woolfolk's purpose is to maintain pipeline pressure while transporting sweet natural gas into storage wells for temporary storage and for transporting natural gas through pipelines to storage and distribution facilities throughout Michigan. Woolfolk consists of a gas-liquid separator, seventeen reciprocating internal combustion engines (RICE), a sorbead dehydrator and auxiliary equipment.

During periods of natural gas withdrawal, the natural gas flows freely from the underground reservoirs into a pipeline, slowly reducing the pressure in the reservoirs. If this pressure becomes too low to allow gas to move freely into the pipeline, one or more of the seventeen internal combustion engines are used to compress the natural gas.

As summarized in **Table 1** below, the facility operates different types of internal combustion engines, all of which are fired on natural gas only. There are six two stroke engines and eleven four-stroke engines. These engines are further characterized as rich burn or lean burn. Rich-burn engines operate near the stoichiometric air-to-fuel ratio (16:1) with exhaust excess oxygen levels less than 4%. Lean-burn engines may operate up to the lean flame extinction limit, with exhaust oxygen levels of 12 percent or greater. The air to fuel ratios of lean-burn engines range from 20:1 to 50:1 and are typically higher than 24:1.

Table 1: Engine Summary

Emission Unit ID	Description	Type
EUWL001 - EUWL005	Ingersoll-Rand Compressor Engine Model KVG-103, 1000 hp	4-stroke, rich burn, natural gas fired reciprocating compressor engines
EUWL006 - EUWL009	Ingersoll-Rand Compressor Engine Model KVG-123, 1320 hp	
EUWL010 - EUWL013	Cooper-Bessemer Compressor Engine Model GMW-10, 2500 hp	2-stroke lean burn, natural gas fired reciprocating compressor engines
EUWL014 - EUWL015	Ingersoll-Rand Compressor Engines Model 616-KVH, 4500 hp	4-stroke, lean burn, natural gas fired reciprocating compressor engines
EUWL016	Cooper-Bessemer Compressor Engine Model 16Z-330, 11,000 hp	2-stroke, lean burn, natural gas fired reciprocating compressor engine
EUWL017	Cooper-Bessemer Compressor Engine Model 12Q145H, 4000 hp	--
EUWLGEN001	Natural gas-fired spark ignition 370 hp internal combustion engine emergency generator	--
EUWLGEN002		

EUWLGEM003	Natural gas-fired spark ignition 871 hp internal combustion engine emergency generator.	--
EUWLBOILER001	Natural gas-fired boiler, 5.82 MMBtu/hr	--
EUWLBOILER002	Natural gas-fired boiler, 2.93 MMBtu/hr	--
EUWLBOILER003	Natural gas-fired boiler, 3.35 MMBtu/hr	--
EUWLFURN001	Austin Dehydrator Furnace, 5.00 MMBtu/hr	--

**Regulatory Requirements**

Woolfolk is located in Mecosta County, which is currently designated by the U.S. Environmental Protection Agency (USEPA) as attainment/unclassified for all criteria pollutants. The stationary source is subject to Title 40 of the Code of Federal Regulations (CFR) Part 70, because the potential to emit (PTE) nitrogen oxides and VOCs exceeds 100 tons per year. The PTE of any single Hazardous Air Pollutant (HAP) (formaldehyde and Acetaldehyde) regulated by the federal Clean Air Act, Section 112, is equal to or more than 10 tons per year and the PTE of all HAPs combined is equal to or more than 25 tons per year.

Woolfolk is considered a "synthetic minor" source in regards to the Prevention of Significant Deterioration (PSD) regulations of 40 CFR 52.21 because the stationary source accepted legally enforceable permit conditions limiting the potential to emit of Nitrogen Oxides (NOx) to less than 100 tons per year for compressor engine Model 12Q145H (EGWL017), which was installed in 1980. All of the remaining processes at the facility are currently not subject to the PSD regulations because the process equipment was constructed/installed prior to June 19, 1978, the promulgation date of the PSD regulations. Future modifications to the process equipment at the facility may be subject to the PSD requirements.

Except for Engine 17, all of the reciprocating compressor engines were installed prior to August 15, 1967. As a result, this equipment is considered "grandfathered" and is exempt from New Source Review (NSR) permitting requirements. Although Compressor Engine 16 was installed in 1973, this engine was exempt under an existing permit exemption rule at the time it was installed. The sorbead dehydrator equipment, initially installed prior to August 15, 1967, removes moisture from natural gas extracted from the Austin Field. Therefore, the facility refers to this equipment as the Austin dehydrator. The dehydrator consists of 6 dry bed adsorption towers and a broch furnace for drying the sorbeads. The Broch furnace was replaced in 1986, therefore the sorbead dehydrator is no longer considered to be "grandfathered". ANR is currently considering replacing the Broch furnace again in the near future which may trigger an NSR.

Engines 1-9 are subject to Rule 336.1818, based on size, and considered "Large NOx SIP call engines". A Large NOx SIP call engine is an engine that emits more than 1 ton of oxides of nitrogen per average ozone control period day in 1995. These engines are also subject to the Maximum Achievable Control Technology (MACT) Standards for Reciprocating Internal Combustion Engines (RICE) promulgated in 40 CFR Part 63, Subparts A and ZZZZ.

Woolfolk has three (3) emergency generators (EUWLGEM001, EUWLGEM002 and EUWLGEM003) subject to the RICE MACT, 40 CFR Part 63, Subparts A and ZZZZ and three (3) natural gas-fired boilers (EUWBOILER001, EUWBOILER002, EUWBOILER003) and a sorbead dehydrator (EUWLFURN001) subject to the National Emission Standard for HAPs for boilers/process heaters promulgated in 40 CFR Part 63, Subparts A and DDDDD.

**On-site Observations & Records Review**

All of the engines located at the Woolfolk Compressor station are equipped with continuous monitoring systems (CMS) and are monitored and operated from the control room. Monitoring data and records are also kept in the control room for a minimum of 5 years. All emission units on-site and discussed further below, are natural gas only. The facility continuously monitors and records fuel consumption and operating hours (**Attachment A**) for every engine. The operating status of each engine, as observed during this inspection, is detailed in Table 2 below.

Table 2: Engine Status

Engine No.	Operating Status
1	Available
2	Available
3	Running
4	Available
5	Running
6	Running
7	Unavailable
8	Unavailable
9	Running
14	Running
15	Running

16	Available
17	Running

During this inspection, CR did not specifically measure any stack height or diameters. However, visual inspections appear to reflect the measurements specified in the ROP. The facility submitted semi-annual reports and annual certifications as required and on time. No issues or problems were reported.

➤ **ROP Emission Unit EUWL017 (Engine 17)**

Engine 17 was offline for repairs for most of 2016, returning to service in September 2016 and operating during this inspection. NOx testing for this engine is required to be completed at least once within the five year ROP cycle. AQD received the facility's test protocol and notification, as required, for this engine on March 27, 2017 with a testing date of April 25, 2017. Woolfolk was unable to complete this test due to a metal particulate alarm. Repairs were completed and the test was rescheduled and completed on May 11, 2017 (CA\_B722039866).

Engine 17 is typically operated at approximately 90% speed and torque, however, for this test the engine was operated at nearly 100%. Preliminary NOx test data indicates that Engine 17 operated with an emission rate of less than 9.7 g/bhp-hr. The 9.7g/bhp-hr calculates out to a lb/hr emission limit of 85.7 for a 4,000HP engine. Monthly records for January 2016 through March 2017 indicate that the highest NOx emission rate was in January 2016 at 21.5lbs/hr, 1.299mmscf of fuel consumed and 54 hours of operation that month. The following records were provided and are included in **Attachment A**:

- Monthly engine fuel consumption
- Monthly engine hours of operation
- Calculations of hourly NOx emissions average over each month with an emissions factor based on the previous stack test.

➤ **ROP Flexible Group FG-RICE-818-WLENGINES (Engines 1-9)**

Engines 1-9 are subject to Rule 336.1818 and the NESHAP RICE MACT (40 CFR Part 63, Subparts A and ZZZZ) requirements. Upon arrival, Engines No. 2, 5 and 6 were operating. During this inspection, CR and SL were able to observe the startup of Engine 9. No visible emissions or odors were observed during startup.

Woolfolk is subject to a 76%, or greater, formaldehyde reduction limit. The facility meets this limit by operating the engines with a properly maintained Non-Selective Catalytic Reduction (NSCR) unit. Each unit has a pressure and temperature sensor installed as required.

The facility continuously monitors and records atmospheric pressure and NSCR inlet pressure and temperature and maintains the catalyst so that the pressure drop across the catalyst does not change by more than 2 inches of water at 100 percent load plus or minus 10 percent from the pressure drop across the catalyst measured during the initial performance test and a catalyst inlet temperature of greater than or equal to 750°F and less than or equal to 1250°F (40 CFR Part 63.6600). NSCR units are tested as required when replaced and differential pressure is continuously monitored to determine if maintenance or replacement is necessary. Control room screen shots capturing the operating conditions during this inspection were provided for the operating engines (**Attachment B**) and summarized in Table 3 below. All NSCR units appeared to be operating properly at the time of this inspection.

The facility prefers to use multiple engines at reduced workloads rather than a single engine at maximum load for reliability and flexibility purposes. These levels of operation, for which conventional MACT differential pressure monitoring might not be appropriate, are covered by their EPA-approved alternative monitoring supplement for load conditions less than 90%. These hours are tracked and totaled each semi-annual operating period.

Each engine has passed required MACT testing and annual NOx testing. If an engine experiences a MACT excursion, then (per their MACT plan) it is shut down, catalyst replaced and re-tested.

Table 3: Engine Operating Conditions

Engine No	Catalyst Operating Parameters		DP Limits (based on most recent Stack Test, "w.c.)	
	Inlet Temp (F)	DP ("w.c.)	Min/DP	Max D/P
1	--	--	3.52	7.52
2	--	--	2.99	6.99
3	1,045.2	4.21	2.07	6.07
4	--	--	2.91	6.91
5	1,067.9	4.00	2.93	6.93
6	1,062.6	3.12	1.47	5.47

7	--	--	1.35	5.35
8	--	--	0.40	4.40
9	899.2	1.37	1.28	5.28

Rule 336.1818 818 requires the engines to be tested annually for NOx. The engines were previously tested in June 2016. Testing notification and protocols were submitted to AQD, as required. Based on the 2016 test report, these engines are compliant with the 20.50 g/bhp emission testing limit specified in special condition I.2 of the ROP. The 2016 test results are summarized in Table 4 below. As proven by the calculations below the 20.50 g/bhp test limit calculates out to an emission limit of 45.19 lbs/hr for 1,000HP engines (engines 1-5) and 59.66 lbs/hr for 1,320 HP engines (engines 6-9). Per Rule 336.1818 these emission limits only apply during the annual ozone season (May 1<sup>st</sup> through September 30<sup>th</sup>). The underlying applicable requirement (UAR) provided in the Emission Limits table Special Condition I.3 and I.4 are incorrect (R336.1213(2)(c)) and should be R336.1213(2). This UAR will be corrected in the next ROP Renewal.

Table 4: 2016 NOx testing Results

Engine No.	Limit (g/bhp-hr)	% Load	
		Emission Rate (g/bhp-hr)	% Load
1	20.50 / engine	8.7	96.6
2		8.4	90.8
3		9.8	95.9
4		11.2	94.6
5		9.2	96.4
6		5.6	92.3
7		5.1	91.5
8		8.1	93.0
9		7.0	91.3

$(20.50 \text{ grams/brake HP Hour} \times (1\text{lb}/453.59237 \text{ grams})) \times 1,000 \text{ HP} = 45.19 \text{ lbs/hr}$

$(20.50 \text{ grams/brake HP Hour} \times (1\text{lb}/453.59237 \text{ grams})) \times 1,320 \text{ HP} = 59.66 \text{ lbs/hr}$

The 2016 Monthly NOx emission calculations were provided by the facility and are included in Attachment A and summarized in Table 5.

Table 5: 2016 Calculated NOx Emissions

Month	Engine No.								
	1	2	3	4	5	6	7	8	9
May	10.2	*	*	14.6	9.3	8.8	7.4	11.9	10.9
June	9.8	13.1	10.0	13.5	11.1	8.9	8.3	11.6	11.6
July	*	*	9.3	13.8	*	5.7	6.8	11.7	11.4
Aug.	*	*	12.6	*	*	*	*	10.6	9.7
Sept.	8.8	*	10.9	13.7	10.4	7.6	5.1	11.2	10.9
lb/hr limit per engine	**45.19					**59.66			

\* Denotes an engine that did not operate during the month.

\*\* The ROP NOx emission limits specified in the table for engines 1-5 (SC I.3) and engines 6-9 (SC I.4) does not specify whether the limit is for the group of engines or individual engines. These limits are meant to be on a per engine basis. A note clarifying this will be added to the next ROP renewal.

➤ ROP Flexible Group FGWLENGINES (Engines 10-16)

Engines 14 & 15 were operating during this inspection. Engine 16, which was not operating, is equipped with 6 compressors with hydraulic loaders. The hydraulic loaders allow the operator to load all 6 compressors simultaneously or independently as needed. No visible emissions were observed. The facility continuously monitors and records engine operating hours and natural gas consumption. These records were provided and are included in Attachment A. Printouts of the CMS data for these engines are included in Attachment B.

➤ ROP Flexible Group FGSI-RICEMACT (Generators 1 & 2)

Emergency generators 1 and 2 were not operating at the time of this inspection. These generators are subject to 40 CFR Part 63, Subparts A and ZZZZ maintenance work practice standards, monitoring of engine use, identification of emergency use and testing/readiness checks. All requirements appear to be properly addressed and implemented. Hour meters and operation logs were readily accessible on each unit's control panels. Metered operating hours through the date of this inspection were 436 hours (Generator 1) and 813 hours (Generator 2). Since the last inspection, Generator 1 did not run and

Generator 2 ran for 37 hours. Generators at this facility typically do not operate for more than 500 hours per year. Therefore, the facility has opted to utilize an oil analysis program in order to extend the oil change requirement. Otherwise, the facility inspects the air cleaner every 1,000 hours of operation or annually, and inspects all hoses and belts every 500 hours of operation or annually as required. The most recent oil analysis and maintenance records are provided in Attachment E.

> ROP Flexible Group FGLIMITED-RICEMACT

Emergency generator No. 3 is located adjacent to Engine 17 and was not operating during this inspection. This generator is subject to 40 CFR Part 63, Subparts A and ZZZZ. All requirements appear to be properly addressed and implemented. Required hour meter and operating logs were readily accessible on the control panel. Metered hours through the date of this inspection for this generator was 363.4 hours. In addition, 2016 and 2017 generator logs were provided by the facility (Attachment E). Generator 3 operated for emergency use in March 2017 for 4.1 hours and 2.1 hours for maintenance. Generators at this facility typically do not operate for more than 500 hours per year. Therefore, the facility has opted to utilize an oil analysis program in order to extend the oil change requirement. Otherwise, the facility inspects the air cleaner every 1,000 hours of operation or annually, and inspects all hoses and belts every 500 hours of operation or annually as required. The most recent oil analysis and maintenance records are provided in Attachment E.

> ROP Flexible Group FGWL-BOILERMACT

The facility operates three (3) boilers and (EUWBOILER001, EUWBOILER002, and EUWBOILER003) and one process heater (EUWLFURN001) throughout the facility. These units are subject to the NESHAP BOILER MACT 5(D) requirements. Conditions for these boilers have been added to the facility's Draft Title V Renewable Operating Permit. AQD staff Steve Lachance requested and received documentation of required Energy Assessment and tune-up work for subject natural gas-fired boilers during his 6/18/2015 inspection (CA\_B722029850). The facility is required to complete a tune-up every five (5) years for boilers/process heaters less than or equal to 5mbtu/hr and every two (2) years for boilers greater than 5mbtu/hr and less than 10mbtu/hr. The next required tune up will be in 2018 for the Sorbead dehydrator furnace (EUWLFURN001). The facility is current and up-to-date with all boiler MACT 5(D) regulations and requirements

**Conclusion**

Based on observations made during this inspection and a records review, Woolfolk appears to be in compliance with ROP MI-ROP-B7220-2012a, Boiler MACT 5D, and any other applicable air rules and regulations.

Attachments

- A - Fuel Usage, Operating Hours & Engine 17 NOx emission Records
- B - Operations Screen Shots & RICE-MACT Catalyst D/P Set Points
- C - 2016 MAERS Report
- D - RICE MACT 24hr logs
- E - Emergency Generator Operating logs, Oil Analysis and Maintenance Logs

NAME Chris Robinson

DATE 6/21/2017

SUPERVISOR [Signature]

