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ENGINEERING EVALUATION/FACT SHEET

B ACKGROUND INFORMATION

Application No.:	R13-3254
Plant ID No.:	051-00216
Applicant:	Columbia Gas Transmission LLC
Facility Name:	Lone Oak Station
Location:	Lone Oak
NAICS Code:	486210
Application Type:	Construction
Received Date:	June 5, 2015
Engineer Assigned:	Edward S. Andrews, P.E.
Fee Amount:	$2,000.00
Fee Deposit Date:	June 8, 2015
Complete Date:	September 10, 2015
Due Date:	November 29, 2015
Applicant Ad Date:	June 17, 2015
Newspaper:	*Moundsville Daily*
UTM's:	Easting: 535.8 km Northing: 4,414.8 km Zone: 17
Description:	The application is for the construction of a new compressor station with four (4) Mars 100 combustion turbine/compressors, one process heater, one emergency generator and several small catalytic heaters.

Process Description

Pipeline transmission of natural gas requires that the gas be compressed. The proposed Lone Oak Compressor Station will install four Solar turbine-driven gas compressors. The project also includes the installation of one emergency generator, one process heater, up to forty catalytic space heaters, and numerous insignificant storage tanks.

For the Lone Oak Station, Columbia is proposing to:

- Install four (4) new Solar Mars 100 turbines;
- Install one new 1,175-hp Waukesha emergency generator;
- Install one new 1.0-MMBtu/hr process heater;
- Install a pipeline pig launcher and receiving stations;
- Install 40 new catalytic space heaters (0.072 MMBtu/hr each); and
- Install various small insignificant storage tanks (condensate, waste liquid, lube oil).

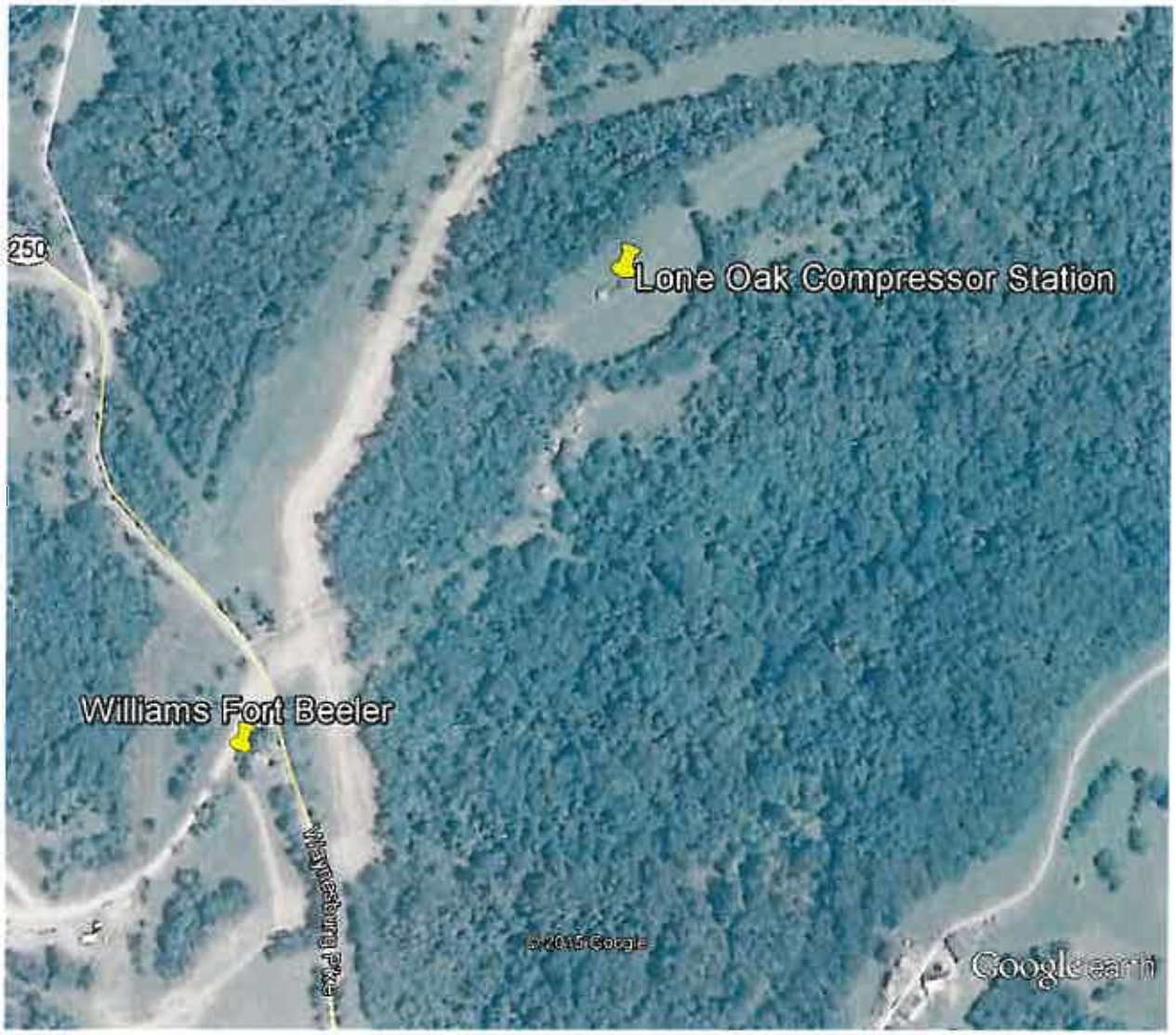
The power output from a natural gas-fired turbine is directly related to the fuel input rate and to the ratio of combustion air to fuel. As ambient temperatures decrease, a turbine's maximum power output will increase due to the increased density of inlet air. The Solar dry low NO_x (DLN) combustion system (known as SoloNO_x) limits formation of NO_x, CO, and VOC by pre-mixing air and fuel prior to combustion. When operating a Solar Mars 100 turbine at ambient temperatures~ 0^0 F and at loads ~ 50%, this DLN system is able to limit the exhaust gas concentration of these pollutants (corrected to 15% 0_2) to 15 ppm NO_x, 25 ppm CO, and 25 ppm unburned hydrocarbons (UHC, containing at least 80% non-VOC methane and ethane; therefore, 5 ppm VOC). At ambient temperatures of 0 to -20^0 F, additional pilot fuel is required by the turbine to maintain flame stability, which increases estimated emission concentrations to 42 ppm NO_x, 100 ppm CO, and 50 ppm UHC (10 ppm VOC). At turbine loads <50%, additional pilot fuel and air flow are required to maintain flame stability and turbine responsiveness. These changes increase estimated emission concentrations to 66 ppm NO_x, 4,400 ppm CO, and 440 ppm UHC (88 ppm VOC). Should loads drop below 50%, Columbia will make every effort to either bring the load back above 50% or shut a turbine down (e.g., shut down another turbine and move that volume to the turbine, or shift the turbine volume to another turbine and shut down the turbine).

Other emissions sources includes an emergency generator set with a reciprocating engine that can generates 830 kilo watts (kW) of electricity. A small process heater is used to pre-heat the fuel gas. The station is supporting a new pipeline. A receiver and launcher will be installed to the pipeline for pigging operation that will be conducted on as needed basis. The applicant notes up to 40 catalytic (natural gas-fired) heaters used for indoor heating during the heating season may be installed at the facility.

SITE INSPECTION

On August 21, 2015, Mr. Gene Coccari of Small Business Assistance Section of the DAQ, and this writer conducted a site visit of the proposed facility. The access road to the site from US 250 is unmarked and straight across from the entrance into William Ohio Valley

Mainstream's Fort Beeler Gas Plant. At the actual site, there were no signs of preconstruction. Other than the existing structures, no other structures were visible from the site. Using Google Earth, the writer located the nearest structure to be 30 degrees at a range of 1,250 feet from the site. The writer determined that this proposed site is acceptable for this particular type of source.



ESTIMATE OF EMISSIONS BY REVIEWING ENGINEER

Solar Combustion Turbines

The applicant classified the operation of the turbine into five operating modes, which are normal operation, startup/shutdown, low-load, below zero, and extreme below zero. The emissions from the proposed turbines can vary significantly between these different operating modes. Solar refers to these modes as non-SoLoNO$_x$ modes except for normal operation, which is referred to as SoLoNO$_x$ Mode.

Normal Operation: Normal operation is classified as loads above 50% of peak power output with ambient temperatures above zero degrees Fahrenheit. The Solar's SoLoNO$_x$, which is Solar's gas turbine dry low NO$_x$ emission combustion system, works very well to minimize emissions generated from the combustion turbine. Typically, the system can maintain NO$_x$ emissions at 15 ppm with the oxygen corrected to 15% in this mode. Carbon Dioxide (CO) and unburnt hydrocarbons (UHC) are maintained at 25 ppm with the oxygen level corrected to 15%. Pipeline quality natural gas has less than 10% of VOC; typically the VOC content is less than 1%. Columbia assumed that the unburnt hydrocarbons would only be 20%, which is a reasonable assumption. The VOC emission concentration is 5 ppmvd at 15% oxygen. Hourly emissions from a Mars-100 turbine under normal operating conditions are presented in the following table.

Table #1 Normal Operations of a Mars-100									
Pollutant	NO$_x$	CO	VOC	PM(total)	PM$_{10}$	PM$_{2.5}$	SO2	Total HAPs	CO$_2$e
lb/hr	7.42	7.53	0.86	0.90	0.90	0.90	0.10	0.14	16,054

Startup/Shut Down: Startup and Shutdown events should take approximately 10 minutes per event (10 min. startup & 10 min. shutdown) or 20 minutes for a complete startup/shut down cycle. Solar has published Product Information Letter (PIL) 170 Revision 5 for customers to estimate emissions during startup/shut down events of their turbines. To determine the annual potential emissions, Columbia used 50 complete events per year to determine the annual potential to emit per each turbine. CO emissions are 272.7 pounds per complete cycle with NO$_x$ being only 3.10 pounds per cycle. VOC emissions are predicted to be 3.12 pounds per cycle.

Low-Load Operations: Low-load operation would be considered to be non-startup/shutdown modes with the turbine operating below 50% load (as determined by ambient temperatures). Solar provided an estimate of NOx, CO, and UHC emissions in PIL 167 Revision 4. For annual estimation purposes, Columbia anticipates operating the combustion turbines during this condition for 25 hours per year. CO emissions are 653.41pounds per complete cycle with NO$_x$ being only 16.10 pounds per cycle. VOC emissions are predicted to be 7.42 pounds per cycle.

Below Zero Operations: Cold weather operations would be considered to be when the turbine is operating at loads above 50% when ambient conditions are below zero degrees Fahrenheit. Solar provided an estimate of NOx CO and UHC emissions in PIL 167 Revision 4 for customers to estimate emissions during non-SoLoNO$_x$ modes, which includes conditions below zero. For annual estimation purposes, Columbia used 50 hours per year. CO emissions are 30.91 pounds per hour with NO$_x$ emissions being 21.33 pounds per hour for operating the turbines during these conditions. VOC emissions are predicted to be 1.77 pounds per hour.

Extreme Below Zero Operations: In addition to regular below zero operations, although very limited, there are times when the ambient temperatures fall below negative twenty degrees Fahrenheit. In PIL 167 Revision 4, Solar has additional guidelines for determining emissions of NOx, CO, and UHC at these extreme conditions. For annual estimation purposes, Columbia did not anticipate operating these combustion turbines during this condition.

Compressor Venting

Columbia used a conservative assumption that one blowdown occurs per shutdown. It is not expected that a blowdown will occur after each shutdown. The Solar Mars 100 has pneumatic actuator vents with a vent rate of 3 standard cubic feet per hour per actuator. The proposed compressor will be equipped with 2 dry seals with an estimated leakage rate of 0.5 scf per minute per seal. Using the specific features of the compressor, Columbia estimated the blowdown emissions would be 103 pounds of VOCs per event (shutdown). These turbines will be using electric starters instead of pneumatic start, which has no potential for losses. Carbon dioxide equivalent was predicted to be 66,327 pounds per startup & shutdown cycle.

The pneumatic actuators and seals are contributing to fugitive leaks during continuous operations. The dry seals are losing 60 scf per hour and the actuators are losing 84 scf per hour. For annual estimates, it was assumed continuous operation. VOCs emissions were estimated to be 0.14 tpy from the actuators and 0.40 tpy from the seals.

Process Heater

The process heater is 1.00 MMBtu/hr natural gas fired heater. Columbia used emission factors from Tables 1.4.1-1 and 1.4.1-3 of AP-42 and Subpart C of Part 98 to estimate emissions from these heaters. Presented in the following table is the estimate of emissions from the heater.

Table #2 – Emissions from Process Heater

Pollutant	Emission Factor	Hourly Rate (lb/hr)	Annual Rate (TPY)
PM/PM$_{10}$/PM$_{2.5}$ Filterable	1.9 lb/MMcf	0.002	0.009
PM Condensable Fraction	5.7 lb/MMcf	0.006	0.026
Total PM	7.6 lb/MMcf	0.007	0.03
Sulfur Dioxide (SO$_2$)	20 grain/100 scf	0.06	0.26

Oxides of Nitrogen (NO_x)	100 lb/MMcf	0.10	0.44
Carbon Monoxide (CO)	84 lb/MMcf	0.05	0.22
Volatile Organic Compounds (VOCs)	5.5 lb/MMcf	0.005	0.02
Total Hazardous Air Pollutants (HAPs)	1.89 lb/MMscf	0.002	0.01
Carbon Dioxide Equivalent (CO_2e)	116.98 lb/MMBtu	116.98	512.37

Equipment Leaks

Columbia has measured leaks throughout their pipeline systems and developed emission factors based on component leaks per compressor by type of component. The VOC emissions were estimated as a total for the compressors and other components to be 0.80 tpy. These fugitive leaks have the potential to release greenhouse gases, which are methane and carbon dioxide. The potential CO_2e from these leaks was estimated to be 517 tpy.

Emergency Generator

The applicant used several sources of data, which included manufacturer's data (engine and catalytic converter), to estimate emissions from the proposed engine. Presented in the following table is the estimate of emissions from the emergency generator.

Table #3 – Emissions from the Engine for the Emergency Generator Set		
	Waukesha Engine	
Engine Maximum Power Output (bhp)	1,175	
	Emissions	
Pollutant	(lb/hr)	(TPY)
Oxides of Nitrogen (NO_x)	5.18	1.30
Carbon Monoxide (CO)	3.36	0.84
Volatile Organic Compounds (VOCs)	0.10	0.03
Formaldehyde (HCOH)	0.48	0.12
Carbon Dioxide Equivalent (CO_2e)	1,198.29	299.57

Emissions from the proposed new sources are indicated in the following table.

Table #4 – Potential Emissions from the Proposed New Emissions Units

Source	Operating Mode	Cycles	Hr/Yr	NO_x (tpy)	CO (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	VOC (tpy)	SO_2 (tpy)	CO_2e (tpy)
T01 Solar Mars 100 CT #1	Normal Load @ 32^0 F		8,668	32.16	32.64	3.90	3.90	3.73	0.37	62,681.66
	Low Temperature (< 0^{0}F)		50	0.53	0.77	0.02	0.02	0.04	0.002	361.57
	Very Low Temperature (< 20^{0}F)		0	0	0	0	0	0	0	0
	Low Load (< 50%)		25	0.05	8.17	0.01	0.01	0.09	0.001	100.34
	Startup/Shutdown	50	17	0.08	6.82	0.01	0.01	0.08	0.001	136.46
	Total		8,760	32.82	48.4	3.94	3.94	3.94	0.374	63,280.03
T02 Solar Mars 100 CT #2	Normal Load @ 32^0 F		8,668	32.16	32.64	3.90	3.90	3.73	0.37	62,681.66
	Low Temperature (< 0^{0}F)		50	0.53	0.77	0.02	0.02	0.04	0.002	361.57
	Very Low Temperature (< 20^{0}F)		0	0	0	0	0	0	0	0
	Low Load (< 50%)		25	0.05	8.17	0.01	0.01	0.09	0.001	100.34
	Startup/Shutdown	50	17	0.08	6.82	0.01	0.01	0.08	0.001	136.46
	Total		8,760	32.82	48.4	3.94	3.94	3.94	0.374	63,280.03
T03 Solar Mars 100 CT #3	Normal Load @ 32^0 F		8,668	32.16	32.64	3.90	3.90	3.73	0.37	62,681.66
	Low Temperature (< 0^{0}F)		50	0.53	0.77	0.02	0.02	0.04	0.002	361.57
	Very Low Temperature (< 20^{0}F)		0	0	0	0	0	0	0	0
	Low Load (< 50%)		25	0.05	8.17	0.01	0.01	0.09	0.001	100.34
	Startup/Shutdown	50	17	0.08	6.82	0.01	0.01	0.08	0.001	136.46
	Total		8,760	32.82	48.4	3.94	3.94	3.94	0.374	63,280.03
T04 Solar Mars 100 CT #4	Normal Load @ 32^0 F		8,668	32.16	32.64	3.90	3.90	3.73	0.37	62,681.66
	Low Temperature (< 0^{0}F)		50	0.53	0.77	0.02	0.02	0.04	0.002	361.57
	Very Low Temperature (< 20^{0}F)		0	0	0	0	0	0	0	0
	Low Load (< 50%)		25	0.05	8.17	0.01	0.01	0.09	0.001	100.34
	Startup/Shutdown	50	17	0.08	6.82	0.01	0.01	0.08	0.001	136.46
	Total		8,760	32.82	48.4	3.94	3.94	3.94	0.374	63,280.03
Venting/Seals	Normal							12.41		8,034
Equip. Leaks	Fugitive								0.80	517
G1 – Em. Gen.	Normal		500	1.30	0.84	0.02	0.02	0.03	0.001	266
HT1 –Line Heater	Normal		8,760	0.44	0.22	0.03	0.03	0.02	0.26	512.37
SH1 – Catalytic Heaters	Normal		8,760	1.24	1.04	0.09	0.09	0.07	0.01	1,477
Pigging Ops.	Fugitive							0.014		24.53
Total				134.26	195.70	15.90	15.90	28.304	2.57	263,951.02
PSD major Source Threshold Values (45 CSR 14)				250	250	250	250	250	250	N/A
Major Source Title V (45 CSR 30)				100	100	100	100	100	100	N/A

REGULATORY APPLICABLILITY

Columbia Gas' proposed Lone Oak Compressor Station does not meet the definition of a Major Source under Prevention of Significant Deterioration (PSD), which is State Rule 45 CSR 14, and is classified as an area source for Hazardous Air Pollutants for applicability purposes under 40 CFR 63. The application as filed requires a construction permit issued under 45 CSR 13 (West Virginia's minor source permitting program). Potential NO_x and CO emissions are greater than 100 tpy, and therefore the station will be required to submit an application for a Title V Operating Permit under 45 CSR 30.

Rule 2 (45 CSR 2)

The process heater is only subject to the opacity requirement of 45 CSR §2-3.1. according to 45 CSR §2-11.1. Natural gas units are exempt for the visible emission monitoring plan requirements of this rule due to the nature of burning pipeline quality natural gas.

NSPS (40 CFR Part 60)

New Source Performance Standards (NSPS) apply to certain new, modified, or reconstructed sources meeting criteria established in 40 CFR 60.

The process heater is rated for 1.00 MMBtu/hr. The definition of affected source in Subpart Dc (Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units) is units between 10 MMBtu/hr and up to 100 MMBtu/hr. Thus, the proposed process heater is not an affected source and is not subject to the standards under Subpart Dc.

Subpart KKKK

U.S. EPA has promulgated NSPS for stationary combustion turbines constructed, modified, or reconstructed after February 18, 2005, in Subpart KKKK. Subpart KKKK applies to combustion turbines with a peak heat input of 10 MMBtu/hr and greater. The proposed Solar Taurus turbines are rated at 71.3 MMBtu/hr (at 0^0 F). Therefore, the purposed turbines are affected sources under this subpart.

Sources subject to Subpart KKKK are exempt from the requirements of Subpart GG (NSPS for combustion turbines constructed/modified/reconstructed after October 3, 1977).

This subpart establishes emissions standards for NO_x and SO_2. These turbines would be limited to 0.060lb of SO_2 per MMBtu/hr of heat input. These turbines will be burning pipeline quality natural gas with a maximum sulfur content of 20 grains per 100 standard cubic feet of gas. Under 40 CFR §60.4365, a source is exempt from monitoring fuel sulfur content if the source burns natural gas that is covered by an transportation agreement (Federal Energy Regulatory Commission tariff limit) with a maximum of 20 grains of sulfur per 100 standard cubic feet of gas (40 CFR §60.4365(a)).

40 CFR §60.4325 establishes NO_x standards for affected units as specified in Table 1 of Subpart KKKK. The proposed units are new turbines firing natural gas with a heat input of greater than 50 MMBtu/hr and less than 850 MMBtu/hr. In this subcategory, these turbines are limited to a NO_x standard of 25 ppm at 15 percent oxygen (O_2) content or 150 nanagram /Joule of useful output. The selected turbines are equipped with a dry low NO_x emission combustion system, known as SoLoNO$_x$™, which has been developed to provide the lowest emissions possible during normal operating conditions. Solar Taurus (manufacturer) predicts that the NO_x emissions with the SoLoNO$_x$™ combustion controls from the turbine to be 15 ppm when the ambient temperatures are at or above 0^0 F.

There are alternative standards for units operating at less than 75 percent of peak load or when operating temperatures are less than 0^0 F. The alternative limit is 150 ppm at 15% O_2 is listed in Table 1 to Subpart KKKK. The manufacturer predicts that the NO_x rate for the proposed turbines would increase up to 120 ppm for subzero operations. For low load operations, the manufacturer predicts the NO_x concentrations to increase slightly to 70 ppm for loads at or less than 50% of peak output and 50 ppm at idle conditions. The proposed turbines are capable of meeting the NO_x limitations under this subpart at normal and other than normal conditions.

This subpart requires sources to use one of two options in monitoring compliance with the standard, which are testing or a continuous emission monitoring system. Sources can conduct testing every year and reduce the subsequent testing to every two years if the NO_x results are at or less than 75% of the standard, which equates to 15 ppm for these two turbines. The applicant has elected to use the testing option at this time. The permit will be structured on the 15 ppm as the short term limit, which is 75% of the applicable limit, for the short term limit with initial testing and subsequent testing every two years. Under the subpart, sources electing to conduct testing are only required to submit test reports of the results in lieu of submitting excess emissions and monitor downtime in accordance with 40 CFR §60.7(c).

Subpart JJJJ

Subpart JJJJ (Standard of Performance for Stationary Spark Ignition Internal Combustion Engines) applies to stationary spark ignition engines manufactured after July 1, 2007. The generator set will be equipped with a spark ignition engine manufactured after July 1, 2007. Thus, the engine would be subject the standards of this subpart and subject to the emission limitations of Table 1 to Subpart JJJJ of Part 60, which includes the following requirements for emergency engines greater than 130 bhp.

- For NO_x, the limit is 2.0 grams per horsepower-hour (g/hp-hr) or 160 ppmvd at 15 % O_2.
- For CO, the limit is 4.0 g/hp-hr or 500 ppmvd at 15 % O_2.
- For VOC, the limit is 1.0 g/hp-hr or 86 ppmvd at 15 % O_2.

The proposed engine for the generator set is manufactured by Waukesha. The manufacturer claims that the NO_x rate is predicted at 2 g/hp-hr; CO is 1.30 g/hp-hr; and VOC (Non-Methane Hydrocarbon) is 0.24 g/hp-hr. According to the manufacturer's data, this engine should be capable of meeting the emission standards of this subpart. However, the manufacturer did not certify the engine as specified under 40 CFR Part 90, 40 CFR Part 1048 or 40 CFR Part 1054. Therefore, the permit will require the applicant to conduct an initial performance test and either conduct subsequent performance testing every 8,760 hours of operation or once every 3 years, whichever is sooner.

Subpart OOOO

Turbines are driving compressors at a transmission station for a natural gas pipeline system. Subpart OOOO (Standards of Performance for Crude Oil and Natural Gas Production) establishes standards for certain process equipment at oil and natural gas production sites. This regulation defines sites from the wellhead and the point of custody transfer to the natural gas transmission and storage segment. The Lone Oak Compressor is downstream of the custody transfer point of Columbia's transmission system. Therefore, the proposed compressors are not affected sources and not subject to the performance standards of Subpart OOOO.

However, this subpart does include storage tanks that have a VOC potential of 6 tpy or greater that are located at natural gas transmission segments. 40 CFR §60.5365(e) is clear that the potential must be calculated using a generally accepted model or calculation methodology, based on the maximum average daily throughput determined for a 30-day period of production prior to the applicable emission determination deadline. For the proposed condensate tank, this time period would be the first 30 days the vessel was placed into service. Thus, the draft permit will require the applicant to record the daily production of pipeline fluids from the station being stored in the new vessel for the first 30 days of being in service and determine if the potential VOC emissions from the vessel, which includes the flash, working, and breathing loses, are at or greater than 6 tpy. If the VOC emissions is at or greater than 6 tpy, the vessel is an affected Group 2 source under the Subpart OOOO, which requires these emissions to be controlled.

The writer used ProMax Version 3.2 to predict the amount of pipeline liquids that would be collected in the gas filter/separators. This simulation predicted the total VOC emissions from the condensate tank to be 0.001 tons per year, which includes working, breathing & flashing losses from the condensate entering into the storage vessel.

NESHAP (40 CFR Part 63)

With a potential to emit of 2.53 tpy of total HAPs, the station is classified as an area source of HAPs. Subpart YYYY, which is for combustion turbines, and Subpart DDDDD, which is for boilers and process heaters, are only applicable to affected units of the subparts operating at a major source of HAP. Thus, these regulations are not applicable to the station. The following will discuss the key applicable parts of each affected source with its corresponding subpart.

Subpart ZZZZ

The internal combustion engine for the emergency generator set is classified as an affected source under the NESHAP for Stationary Reciprocating Internal Combustion Engines (Subpart ZZZZ). The proposed facility is classified as an area source and the engine will be require to comply with the requirement of Subpart JJJJ to Part 60. Thus, the criteria of 40 CFR §63.6590(c) and (c)(1) is satisfied, which means no further requirements of Subpart ZZZZ to Part 63 apply to this engine.

Subpart JJJJJJ

This subpart covers boilers located at an area source of HAPs. The proposed heater is natural gas fired, which is not listed as a subcategory in 40 CFR §63.11200. Thus, this regulation is not applicable to the process heater.

TOXICITY OF NON-CRITERIA REGULATED POLLUTANTS

The Lone Oak Compressor Station will only have the potential to emit of 2.53 tons per year of HAPs. Therefore, no information about the toxicity of these HAPs is presented in this evaluation.

AIR QUALITY IMPACT ANALYSIS

The proposed construction is not classified as a major source as defined by 45CSR14, so air quality modeling was not required.

MONITORING OF OPERATIONS

Columbia proposed to monitor the different operating modes (i.e. normal, low load, low temperature, etc.) in terms of hours per month. This monitoring will be used to determine actual emissions to show compliance with the annual limits. The applicable rules and regulations require tracking hours of operation for the generator set through the hour-meter, fuel used by the heater, testing, and maintenance records. The turbines and emergency engine are required to conduct periodic compliance testing by regulation. No further monitoring is warranted for this particular facility.

RECOMMENDATION TO DIRECTOR

The information provided in the permit application indicates that the Lone Oak Station should meet all applicable requirements of state rules and federal regulations. It is recommended that Columbia Gas Transmission, LLC be granted a 45CSR13 construction permit for the proposed modification to Lone Oak Compressor Station.

Edward S. Andrews, P.E.
Engineer

December 7, 2015
Revised Date