Permit Review
Chapter 127

To: Mark J. Wejkszner
Program Manager

Through: Raymond Kempa
Chief, New Source Review Section

From: Neal J Elko
Air Quality Engineer

Region 2	Susquehanna County
Permit Number	58-399-018
Company Name	Laser Northeast Gathering Co. LLC
Source Description	Two (2) Caterpillar G3606 natural gas fired Compressor Engines, Two (2) Dehydration Units with reboilers, Five (5) Storage tanks
Control Equipment	Lean Burn Engines w/ Oxidation Catalyst
Location of Sources	Forest Lake Township, Susquehanna County

THE COMPANY HAS SUBMITTED THE FOLLOWING DOCUMENTATION AS REQUIRED FOR THE PLAN APPROVAL TO BE COMPLETE:

a. A completed Air Pollution Control Act Compliance Review Form dated 6/24/11.
b. Municipal notification received by the host municipality on 6/13/11 as required by Act 14.
c. Municipal notification received by the host county on 6/13/11 as required by Act 14.
d. A check in the amount of $1700 consistent with Subchapter I of Chapter 127 of the Rules and Regulations of the Department of Environmental Protection.
e. The General Information Form was submitted as part of the application on 6/24/11.

THE DEPARTMENT HAS TAKEN THE FOLLOWING ADMINISTRATIVE ACTIONS:

a. The Application Acceptance/Administrative Completeness Letter was sent on 7/5/11.
b. Coordination with other agencies was done and is not required.
c. Notification in the Pennsylvania Bulletin published on 7/16/11 and 1/14/12 to allow an additional 30-day comment period for the public to respond.

GENERAL INFORMATION:

The company has proposed to install two (2) Caterpillar G3606 LE engines with oxidation catalysts, two (2) Dehydration units with reboilers, and five (5) storage tanks.

PROJECT DESCRIPTION:

Laser will gather sweet natural gas from Marcellus Shale wells (Kane Road field receipt point (FRP)) and bring it to this compressor Station. Some of the gas may have gone through initial physical separation at the wellhead. The gas will pass through separators and Triethylene Glycol (TEG) dehydrators to process the gas before being routed to the compressor engines to raise the pressure so that it can enter the pipeline.

Any liquids from the initial separation at the compressor station will be routed to the Wastewater (Condensate) Storage Tank. The wet gas will be routed to either of two (2) medium speed Ariel compressors, each of which are driven by 1775 HP Caterpillar G3606 LE natural gas fired engines. All compressor engines are part of Caterpillar's 3600 Series, lean-burn engines. They are the low NOx producing engines available and so represent Best Available Control Technology (BACT). The 1775 HP engines are four-stroke, six-cylinders (6) with a single turbocharger and a total displacement of 7,762 cubic inches. Emissions from the engines will include NOx, CO, VOC's, and formaldehyde. The Two engines will be equipped with Maxim silencers that include a platinum coated oxidation catalyst. The catalysts will significantly reduce CO, VOC's, and formaldehyde. The engines will be located inside a purpose built compressor building.

The compressed wet gas will enter one of the two triethylene glycol (TEG) dehydrator columns where the gas will pass in the opposite direction to the lean TEG. Any water in the gas is more attracted to the TEG than the gas, and so it moves into the TEG, resulting in rich TEG. The rich TEG from the bottom of the column is heated by one of the two (2) reboilers and, because the boiling point of water (212^0F) is much lower than that for TEG (545^oF), the water is removed from the TEG as steam, which goes to the still vents. The lean TEG is then returned to the dehydrator for reuse. Because of the significant difference in the boiling points of water and TEG, no TEG is vaporized in the regeneration process, so all the TEG is returned to the system. Historically, emissions of TEG have been small, and in the amount of 0.06 gal/MMSCFg. This loss of TEG is attributed to dehydrator tower blow-by into the natural gas pipeline.

There will also be five (5) aboveground storage tanks: (1) a 300-barrel condensate wastewater (pipeline fluids) tank which will receive any pipeline liquids from the inlet separators and pigging operations, as well as any liquids collected from equipment skids; (2) a 550-gallon TEG storage tank; (3) 550-gallon coolant storage tank; (4) a 550-gallon lube (mineral) oil storage tank; and, (5), a 550-gallon methanol storage tank. The composition of the liquids in the condensate wastewater tank is anticipated to be mostly water with trace amounts of condensate and/or oil. The methanol is a spray additive to the natural gas as it enters the Susquehanna Pipeline for anti-freeze purposes during the winter, or if the dehydrator should fail to remove sufficient moisture.

Caterpillar G3606LE Engines – These 1,775 HP engines have a rated heat input capacity of 11.8 MMBTU/hr and fire on only pipeline quality natural gas. The engine will be equipped with Maxim silencers (Model QAC6-67-20) that include platinum coated oxidation catalysts for additional control of VOC, carbon monoxide (CO) and formaldehyde.

Dehydration units – Two (2) dehydration units each rated at 40MMSCF/D will be installed as part of this project. Each unit will be equipped with boilers rated at 1.1 MMBtu/hr.

Equipment Specifications

Source ID	Source	Description
101	ENGINE #1	1,775 hp CAT G3606 W/OX CAT (MAXIM)
102	ENGINE #2	1,775 hp CAT G3606 W/OX CAT (MAXIM)
DEHY 1	DEHY #1 W/REBOILER	40 MMSCF/D w/1.1 MMBTU/hr reboiler
DEHY2	DEHY #2 W/REBOILER	40 MMSCF/D w/1.1 MMBTU/hr reboiler
C101	Catalyst Engine 1	Maxim QAC Model: QAC6-67-20
C102	Catalyst Engine 2	Maxim QAC Model: QAC6-67-20

CONTROL DEVICE INFORMATION:

All engines at the site utilized Lean Burn Technology to reduce the emissions from the engine. Each compressor engine will be equipped with a catalytic converter to control CO, VOC, and CH_2O emissions from each engine.

POTENTIAL AND ACTUAL EMISSIONS:

POTENTIAL EMISSIONS SUMMARY

Emission Source	PM/ PM_{10}	NO_X	CO	VOC	CH_2O	vHAPs
Compressor Engines G3606	0.05 g/bhp-hr	0.5 g/bhp-hr	0.055 g/bhp-hr	0.27 g/bhp-hr	0.007 g/bhp-hr	trace
Dehy/reboiler 1 & 2	0.008 lb/hr	0.114 lb/hr	0.096 lb/hr	0.006 lb/hr	-	-

FACILITY EMISSIONS:

FACILITY-WIDE EMISSIONS IN TPY

Source	NOx	CO	VOC	PM	SOx	HAP[1]
Compressor Engine No. 1 w/catalyst	8.57	0.94	4.64	0.86	-	0.12
Compressor Engine No. 2 w/catalyst	8.57	0.94	4.64	0.86	--	0.12
Dehydrator No. 1Still Vent	--	--	0.01	--	-	0
Dehydrator No.2 Still Vent	--	-	0.01	--	--	0
Reboiler No. 1Flue Vent	0.48	0.40	0.03	0.03	0.003	0.04
Reboiler No.2 Flue Vent	0.48	0.40	0.03	0.03	0.003	0.04
Condensate Storage Tank	--	-	0.802	--	--	--
Tanker Truck Loading	--	--	0.570	--	--	--
TEG Storage Tank	-	--	0	-	--	--
Coolant Storage Tank	-	--	0	--	-	--
Lube Oil Storage Tank	-	-	0	--	-	--
Methanol Storage Tank	--	-	0.003	--	--	--
Fugitive Emissions	--	--	0.03	--	--	--
TOTAL	**18.1**	**2.68**	**10.765**	**1.78**	**0.006**	**0.32**
Major Source Thresholds	**100**	**100**	**50**	**100**	**100**	**10/25**

Notes: 1. Formaldehyde

All yearly totals are based on 8,760 hours of operation for compressor engines.

The proposed Best Available Technology (BAT) for each engine is lean-burn technology. The method to limit emissions is called lean-burn. The combustion is considered "lean" when excess air is introduced into the engine along with the fuel. This produces two positive effects. The first is that the excess air reduces the

temperature of the combustion process and this reduces the amount of oxides of nitrogen. The second is that with the excess air you have complete combustion and therefore a higher efficiency, which in turn produces more power with less fuel being utilized. The company was assured by Caterpillar Corp. that these engines could be operated at a very lean gas-to-air ratio so as not to emit more than 0.5 g/bhp-hr NOx.

REGULATORY ANALYSIS:

The construction and operation of the sources are subject to the following air quality regulations:

Visible Emissions:

25 PA Code Section 123.41- Visible Emissions:
The emission of visible air contaminants equal to or exceeding 10% opacity for more than three minutes per hour, or equal to or greater than 30% opacity at any time, is prohibited.

NSR, PSD, offsets and air toxics do not apply at these emission rates.

NSPS (40 CFR Part 60 Subpart JJJJ) and NESHAP MACT (40 CFR Part 63 Subpart ZZZZ) do apply and will be incorporated in the plan approval.

Emissions of malodorous compounds are limited by 25 PA Code Section 123.31 which prohibits the emission of malodors that are detectable beyond the facility property line

25 PA Code 27.12(a)(5)- BAT Requirements

Laser proposes to install Caterpillar G3606LE lean-bum compressor engines. The Caterpillar 3600 series engines employ large amounts of excess air to reduce combustion temperatures to minimize NOx formation. The proposed G3606LE engines are designed to meet a NOx emission limit of 0.5 g/bhp. The use of lean-bum combustion technology to minimize NOx emissions is considered to represent best available technology (BAT) for control of NOx emissions from natural gas compressor engines. Laser proposes to equip the engines with oxidation catalysts to control emissions of CO, VOC, and formaldehyde. The Maxim catalyst system will achieve CO and formaldehyde removal efficiencies of 98% and VOC removal efficiency of 57%. The use of oxidation catalysts is considered to represent BAT for control of CO and VOC emissions from natural gas compressor engines.

In summary, Laser is proposing to install natural gas compressor engines equipped with lean bum low-NOx combustion technology and oxidation catalysts to reduce CO and VOC emissions. The manufacturer's guaranteed NOx emission rate of 0.5 g/bhp-hr represents BAT for the G3606LE model engines.

Greenhouse Gas Reporting (Part 98)

USEPA requires large combustion sources to report greenhouse gas (GHG) emissions beginning in January 2010 under 40 CFR Part 98. The Part 98 applicability threshold for combustion sources is 30 MMBtu/hr combined heat input capacity. Laser will comply with the Part 98 reporting requirements.

At the compressor station, there are four sources which produce emissions: the engines, boilers, the dehydrator, and fugitive leaks. These emissions are composed of numerous chemicals, several of which are classified as greenhouse gases (GHG's). GHG's each have different 'CO_2-equivalent values', which express the magnitude of the chemical's global warming potential (GWP). In order to determine the system's total CO_2-equivalent emissions, speciated emissions for each device are first calculated in Section 1. Subsequently, CO_2-equivalent emissions (CO_2-e) are determined for each GHG, and summed in Section 2.

Section 1: Speciated Emissions Calculations at Station, by Device

1A. Emissions From Caterpillar G3606LE Engines (2)

	Engine Power (BHP)	*Emission Factor*[1] *(g/bhp-hr)*	*Emissions, per Engine (g/hr)*	*Emissions, per Engine (TPY)*	*Emissions, both Engines (TPY)*[2]
Carbon Dioxide (CO_2)	1775	442	784,550	7580.8	**15,151.6**
Total Hydrocarbons (THC)	1775	6.31	11,200.25		
Non-Methane Hydrocarbons (NMHC)	1775	0.95	1,686.25		
Methane[3] *(CH_4)*			9,514	91.9	**183.8**

[1] Emission factors are from G3606LE engine technical data sheet.

[2] *Example*: CO_2 emissions calculation:

$$1775\ BHP \times \frac{442 g}{bhp\text{-}hr} \times \frac{1\ lb}{453.6\ g} \times \frac{1\ ton}{2000\ lb} \times \frac{8760\ hr}{yr} \times 2\ engines = 15{,}151.6\ TPY\ CO_2$$

[3] Methane emissions = THC – NMHC

1B. Emissions from 1.1 MMBtu Boilers (2)

	Annual Nat. Gas Consumption[2] *(scf/yr)*	*Emission Factor*[1] *(lb/10^6 scf)*	*Emissions, per Boiler (lb/yr)*	*Emissions, per Boiler (TPY)*	*Emissions, both Boilers*[3] *(TPY)*
Carbon Dioxide (CO_2)	9.64 x 10^6	120,000	1.16 x 10^6	578.4	**1156.8**
Methane (CH_4)	9.64 x 10^6	2.3	22.17	0.0111	**0.0222**
Nitrous Oxide (N_2O)	9.64 x 10^6	2.2	21.21	0.0110	**0.0212**

[1] Emission factors are from AP-42 Table 1.4-2.

[2] Annual gas consumption by a 1.1 MMBtu boiler is calculated below:

$$\frac{1.1 \times 10^6\ Btu}{hr} \times \frac{1 ft^3}{1000\ Btu} \times \frac{8760 hrs}{yr} = \frac{9.64 \times 10^6 scf}{year}$$

[3] *Example*: N_2O emissions calculation:

$$\frac{9.64 \times 10^6\ scf}{yr} \times \frac{2.2\ lb}{10^6\ scf} \times \frac{1\ ton}{2000\ lb} \times 2\ boilers = 0.0212\ TPY\ N_2O$$

1C. Emissions from Dehydrators (2)

GRI-GLYCalc v 4.0 determined that each of the 2 dehydrators has the potential-to-emit 329.8 TPY of methane, at worst case conditions (**for a total of 659.6 TPY of methane**). No other greenhouse gases are emitted from this source.

1D. Emissions from Fugitive VOC Leakage

Total fugitive emissions from the compressor station were determined to be 6.986 TPY. A fractional analysis of the natural gas determined its composition to be 97.77% Methane and 0.015% CO_2.
Therefore, the following amounts of gasses were emitted annually:

$$CO_2:\ 6.986\ TPY\ Natural\ Gas \times \frac{0.015\%}{100\%} = 0.0011\ TPY\ CO_2$$

$$CH_4:\ 6.986\ TPY\ Natural\ Gas \times \frac{97.77\%}{100\%} = 6.830\ TPY\ CH_4$$

Section 2: Total CO2-Equivalent Emissions Calculations

In the table below, speciated emissions are summed.

	Emissions, by Device				
	(2) G3616LE Engines (TPY)	*(2) Boilers (TPY)*	*Dehydrator (TPY)*	*Fugitive Leaks (TPY)*	***Sum of Emissions (TPY)***
Carbon Dioxide (CO_2)	15,151.6	1156.8	0	0.0011	**16,308 TPY CO_2**
Methane (CH_4)	183.8	0.0222	659.6	6.830	**850.3 TPY CH_4**
Nitrous Oxide (N_2O)	0	0.0212	0	0	**0.212 TPY N_2O**

Example: CO_2 Emissions Calculation:
$15{,}151.6\ TPY + 1156.8\ TPY + 0.0011\ TPY = 16{,}308\ TPY\ CO_2$

The CO_2-equivalents are then calculated and summed in the table below.

Total CO_2-Equivalent Emissions from Compressor Station

	Sum of Emissions (TPY)	*CO_2-Equivalent Factor[1] (GWP)*	*CO_2-Equivalent (TPY)*
Carbon Dioxide (CO_2)	16,308	1	16,308
Methane (CH_4)	850.3	21	17,856.3
Nitrous Oxide (N_2O)	0.212	310	65.7
		Total:	**34,230 TPY of CO_2-e**

[1] CO_2-equivalent factors are from EPA Emissions Facts.

Therefore, the annual CO_2-equivalent emissions is **34,230 TPY of CO_2-equivalents/year.**

MONITORING, TESTING AND RECORDKEEPING REQUIREMENTS:

The Applicant will monitor and record fuel usage for each engine on an annual basis. Testing will be conducted 180 days after start-up and annually there after. Test results will be reported to the department. In addition Engine run hour, station throughput, and fuel usage will be reported annually. These records will be maintained on site and be made available to the Department upon request.

RECOMMENDATION:

The application be approved.