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west virginia department of environmental protection

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Joe Manchin, III, Governor  
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## ENGINEERING EVALUATION / FACT SHEET

### **BACKGROUND INFORMATION**

Application No.: R13-2825  
Plant ID No.: 029-00027  
Applicant: Linde, LLC  
Facility Name: Arroyo Facility  
Location: Newell, Hancock County  
SIC Code: 2813 - Industrial Gases  
Application Type: After-the-fact Construction  
Received Date: December 31, 2009  
Engineer Assigned: John Legg  
Fee Amount: \$1,000.00  
Date Fee Received: January 6, 2010  
Complete Date: March 10, 2010  
Due Date: June 10, 2010  
Applicant Ad Date: February 12, 2010  
DAQ Ad Date: April 2010 - Exact date not yet known.  
Newspaper: *The Review* (County of Columbiana, Ohio)  
UTM's: Easting: 448.85 km Northing: 4,465.91 km Zone: 17  
Description: After-the-fact construction permit for natural gas-fired combustion sources located at Linde LLC's Air Separation Facility located at Arroyo/New Cumberland, Hancock County, WV.

### **DESCRIPTION OF PROCESS**

All of the combustion sources discussed in this evaluation, other than the boiler, are used to evaporate liquid oxygen or liquid nitrogen to gaseous oxygen or nitrogen.

#### **Process Overview**

Linde LLC's air separation facility compresses, liquefies, and separates air into three components – nitrogen, oxygen, and small amounts of noble gases (argon, krypton, neon, and xenon).

Ambient air is filtered to remove dust and other solid impurities. The filtered air is then compressed by one of three compressors. The water and carbon dioxide is stripped from the air. The air is then cooled to near its liquefaction point using the

liquid nitrogen product gas from the cryogenic distillation which is moving in the opposite direction and acts as cooling medium in the reverse heat exchanger. After cooling, the liquid air enters the cryogenic distillation column where it is separated into the three components:

- Liquid nitrogen is collected at the top of the column where it is stored after being used in the reverse heat exchanger to liquefy the incoming air.
- The liquid oxygen is recovered at the bottom of the column. It is stored.
- A small amount of noble gases are collected from the separation process and shipped to another facility for further processing into the individual components.

The facility fills gas trucks with the compressed gases for shipment or evaporates and compresses the gases for distribution in their pipeline network. Given below in Table 1 is general information about the constituents found in air and their physical properties.

**Table 1: Properties of Air and Air Constituents.**

Gas	Volume %	Boiling Point °F	Boiling Point °K	Critical Temperature °K	By Weight
Air	100	-317.9	79	132.3	
Nitrogen	78.03	-320.5	77.19	126.0	
Oxygen	20.99	-297.3	90.04	154.2	
Argon	0.94	-302.6	87.16	156	
Hydrogen	0.01 (1)	-423.0	20.56	33.1	
Neon	0.0015	-410.7	26.7	53	1 lb in 44 tons
Helium	0.0005	-452.1	4.02	5.2	1 lb in 173 tons
Krypton	0.00011	-244.6	120.1	210	1 lb in 725 tons
Xenon	0.000009	-163	165.9	258	1 lb in 1,208 tons
Carbon Dioxide (2)	0.03 - 0.07	-109.3	194.0 (3)	304.1	
Water (2)	0.01 - 0.02	+212	373.0	647	

Source: Primary Source - Date tabulated from CE, 54 (3), 127 (1947).  
 Secondary Source - Chemical Process Industries, 3<sup>rd</sup> edition, 1967, R.Norris Shreve, Chapter 7, Industrial Gases, Oxygen and Nitrogen, page 111.

- (1) Variable; sometimes reported much less.  
 (2) Variable constituents.  
 (3) Solid carbon dioxide sublimates.

**Natural Gas-fired Sources**

Summarized below in Table 2 are all the natural gas-fired sources at Linde’s Air Separation Facility located near Arroyo/New Cumberland, Hancock County, WV.

**Table 2: Information on Natural Gas-fired Sources at Linde’s Arroyo Plant Site, New Cumberland, WV.**

Emission Unit ID	Emission Point ID	Description of Natural Gas-fired Equipment		Year Installed	Maximum Design Heat Input (MM Btu/hr)	Control Device
S1	E1	Four (4) Oxygen Vaporizers	Six (6) Hot Water Heaters	1997	9.0 each (32 .0 total)	None
S2	E2					
S3	E3					
S4	E4					
S5	E5	Two (2) Nitrogen Vaporizers		2000	9.0 each (18 .0 total)	None
S6	E6					
S7	E7	Nitrogen Pre-Purification Heater		1997	8.2	None
S8	E8	Boiler		1976	8.37	None
Total Design Heat Input (MM Btu/hr)					66.57	

**One (1) Boiler (S8) - 1976**

Used to generate steam to occasionally thaw frozen or iced up valves throughout the plant as needed. The boiler operates < 95% of the time. Its maximum heat input is 8.37 MM Btu/hr. It was installed in 1976.

**Table 3: Linde LLC’s Natural Gas-fired Boiler (S8).**

Item of Interest	Specific Information
Manufacturer	Cleaver Brooks
Model No.	CB200-200
Serial No.	L61625
Use	Primary Plant Heating System
Rated Boiler Horsepower	200 hp
Construction Date	1976
Maximum Design Heat Input	8.4 MM BTU/hr

**Table 3: Linde LLC's Natural Gas-fired Boiler (S8).**

<b>Item of Interest</b>	<b>Specific Information</b>
Steam Production at Maximum Design Output	6,672 lb/hr @ 250 psig
Operating Schedule	24 hr/day; 7 day/wk; 52 wks/yr
Fuel Fired	Natural Gas
Type Draft	Forced
% of Ash Retained in Furnace	Not Applicable
Will Flyash be Rejected?	Not Applicable
Stack/Vent Data	
Inside Diameter	1.5 ft
Gas Exit Temperature	350 °F
Height	40 ft
Gas Flow Rate (ft <sup>3</sup> /min)	Not Specified
Estimate % Moisture	Not Specified
Stack Serves	This Equipment Only
Fuel Requirements	
Natural Gas	8,235 ft <sup>3</sup> /hr
Ash (%)	Not Applicable
BTU Content	1,020 Btu/ft <sup>3</sup>
Source/Supplier	Mountaineer Gas
Monitoring Plan proposed by Linde	
Burner efficiency testing performed by a third party twice per year, once in the spring and again during the fall.	

**Four (4) Oxygen Vaporizers (S1 - S4) - 1997**

This system uses four (4) hot water heaters (HE-810 A through D) rated at a maximum heat input of 9.0 MM Btu/hr each to heat water/glycol and circulate mixture through a heat exchanger. The hot water passes through the exchanger and vaporizes liquid oxygen into oxygen gas that is used as plant customer pipeline backup. The Oxygen Vaporizers were installed in 1997.

## Two (2) Nitrogen Vaporizers (S5 and S6) - 2000

This system utilizes two hot water heaters (HE-814 A and B) rated a maximum heat capacity of 9.0 MM Btu/hr to heat water/glycol and circulates it through an exchanger. The hot water passes through the exchanger and vaporizes liquid nitrogen into nitrogen gas that is used as plant customer pipeline backup. The nitrogen vaporizers were installed in 2000.

**Table 4: Linde's Six (6) Hot Water Heater/Vaporizers.**

Item of Interest	Specific Information		
Manufacturer	Ajax		
Model No.	WGN9000W		
Number of Hot Water Heaters/Vaporizers	Total of Six (6)	Four (4)	Oxygen Vaporizers HE-810 A/B/C/D (S1 - S4)
		Two (2)	Nitrogen Vaporizers HE-814 A/B (S5 - S6)
Use	Hot Water Heater		
Rated Boiler Horsepower	216 hp each		
Construction Date	1997	Four (4)	Oxygen Vaporizers HE-810 A/B/C/D (S1 - S4)
	2000	Two (2)	Nitrogen Vaporizers HE-814 A/B (S5 - S6)
Maximum Design Heat Input per Heater/Vaporizer	9 MM Btu/hr		
Operating Schedule	24 hr/day; 7 day/wk; 52 wks/yr		
Firing Equipment	Natural Gas Burner		
Proposed Type of Burners and Orientation:	Vertical		
Type Draft	Induced		
% of Ash Retained in Furnace	Not Applicable		
Will Flyash be Rejected?	Not Applicable		
Stack/Vent Data			
Inside Diameter	1.5 ft		

**Table 4: Linde's Six (6) Hot Water Heater/Vaporizers.**

Item of Interest		Specific Information
Gas Exit Temperature		350 °F
Height		0.5 ft
Gas Flow Rate (ft <sup>3</sup> /min)		Not Specified
Estimate % Moisture		Not Specified
Stack Serves		This Equipment Only
Fuel Requirements		
Natural Gas		8,800 ft <sup>3</sup> /hr
Ash (%)		Not Applicable
BTU Content		1,020 Btu/ft <sup>3</sup>
Source/Supplier		Mountaineer Gas
Gas Burner	Mode of Control	Automatic Full Modulation
	Manufacturer:	Ajax
Monitoring Plan - Proposed by Linde		
Burner efficiency testing performed by a third party twice per year, once in the spring and again during the fall.		

**One (1) Pre-purification Unit (PPU) Regeneration (Regen) Heater (S7) - 1997**

This process consists of a natural gas-fired heater (HE-163) that heats nitrogen gas at ambient temperatures to 350°F. The heated nitrogen gas is then used to regenerate the pre-purification units. HE-163 has a maximum heat capacity of 8.2 MM Btu/hr. The PPU regeneration heater was installed in 1997.

**Table 5: Linde's Pre-purification Unit (PPU) Regeneration (Regen) Heater (S7).**

Item of Interest	Specific Information
Manufacturer	Thermoflux
Model No.	Multiflux
Serial No.	TH4242

**Table 5: Linde's Pre-purification Unit (PPU) Regeneration (Regen) Heater (S7).**

Item of Interest		Specific Information
Use		Process Heater
Rated Boiler Horsepower		Not Applicable
Construction Date		1997
Maximum Design Heat Input		8.2 MM Btu/hr
Operating Schedule		6 hr/day; 7 day/wk; 52 wks/yr
Firing Equipment		Natural Gas Burner
Proposed Type of Burners and Orientation:		Tangential
Type Draft		Forced
% of Ash Retained in Furnace		Not Applicable
Will Flyash be ReinjecteD?		Not Applicable
Stack/Vent Data		
Inside Diameter		1.5 ft
Gas Exit Temperature		350 °F
Height		40 ft
Gas Flow Rate (ft <sup>3</sup> /min)		Not Specified
Estimate % Moisture		Not Specified
Stack Serves		This Equipment Only
Fuel Requirements		
Natural Gas		8,040 ft <sup>3</sup> /hr
Ash (%)		Not Applicable
BTU Content		1,020 Btu/ft <sup>3</sup>
Source/Supplier		Mountaineer Gas
Gas Burner	Mode of Control	Automatic Full Modulation
	Manufacturer:	Maxon
Monitoring Plan - Proposed by Linde		
Burner efficiency testing performed by a third party twice per year, once in the spring and again during the fall.		

## **SITE INSPECTION**

Linde's Arroyo facility is inspected on a routine bases by enforcement personnel from DAQ's Northern Panhandle/Wheeling Office.

The last (most recent) inspection was a full onsite inspection conducted February 27, 2009 by Steve Sobutka. The facility was found to be in compliance and was issued the Inspection Status Code of 30. In reference to the inspection, the following notes were found in the DAQ Web Airtrax database:

AP-42 calculations for NG burning units show facility may above PTE minimum for requiring R13 permit (NO<sub>x</sub>)...See also note dated 3/30/09:

March 30, 2009 - After consulting with Jesse Adkins, it was determined to send a letter requesting a permit determination be sent first. There is some issue of needing or not needing a permit depending on when some of the units at the facility were installed.

On August 26, 2009 Linde LLC submitted a permit determination requesting that the DAQ decide if the natural gas-fired combustion sources located at the Arroyo facility need a 45CSR13 construction permit. On August 27, 2009, Tracy Rothwell, DAQ Permitting Engineer, responded in a letter to Linde LLC stating that the company did need to submit an permit application and pay a \$1,000 application fee for a construction permit. On December 31, 2009, Linde LLC submitted permit application R13-2825. The \$1,000.00 application was paid on January 6, 2010.

Directions to the facility as found in the DAQ Web Airtrak database are as follows:

Take WV Rte 2 North towards Newell. Turn left onto Dry Run Road just before Marsh Bellofram company. Facility is at end of the road towards river.

## **ESTIMATE OF EMISSIONS BY REVIEWING ENGINEER**

Linde LLC's emission calculations were provided in Attachment N to the permit application. The writer reviewed the calculations and found them to be logical and accurate. Emissions are summarized in Tables 6 and 7 below:

**Table 6: Potential Emissions from Linde LLC's Arroyo/  
New Cumberland, Hancock County, WV Air  
Separation Facility.**

Pollutant	Maximum Limit (ton/yr)
Nitrogen Oixde (NO <sub>x</sub> )	30.30
Carbon Dioxide (CO <sub>2</sub> )	25.45

Particulate Matter (PM)	2.3
Sulfur Dioxide (SO <sub>2</sub> )	0.18
Volatile Organic Compounds (VOC)	1.67

**Table 7: Information on Natural Gas-fired Sources at Linde's Arroyo Plant Site, New Cumberland/Newell, WV.**

Equipment		Emission ID		Max Design Heat Input	Emissions <sup>(1)</sup> (lb/hr)				
					100	120	7.6	0.6	5.5
Description	ID	Unit	Point	Btu/hr	No <sub>x</sub>	CO <sub>2</sub>	PM*	SO <sub>2</sub>	VOC
Four (4) Oxygen Vaporizers	HE-810A	S1	E1	9,000,000	0.88	0.74	0.07	0.01	0.05
	HE-810B	S2	E2	9,000,000	0.88	0.74	0.07	0.01	0.05
	HE-810C	S3	E3	9,000,000	0.88	0.74	0.07	0.01	0.05
	HE-810D	S4	E4	9,000,000	0.88	0.74	0.07	0.01	0.05
Two (2) Nitrogen Vaporizers	HE-814A	S5	E5	9,000,000	0.88	0.74	0.07	0.01	0.05
	HE-814B	S6	E6	9,000,000	0.88	0.74	0.07	0.01	0.05
Nitrogen Pre-Purification Heater	HE-163	S7	E7	8,200,000	0.80	0.68	0.06	0.00	0.04
Boiler	-----	S8	E8	8,369,000	0.82	0.69	0.06	0.00	0.05
Total (lb/hr)					6.92	5.81	0.53	0.04	0.38
Total (ton/yr)					30.30	25.45	2.30	0.18	1.67

\* All PM from natural gas combustion is estimated to be less than 1 micron in size per AP 42 Fifth Edition Volume 1.

(1) Emissions = (Btu/hr) \*scf/1020 Btu) \*(Emission Factor\* lb/10<sup>6</sup> scf)

## **REGULATORY APPLICABILITY**

Linde LLC's after-the-fact construction of an air separation facility is viewed by the DAQ as being a non-major source requiring a 45CSR13 construction permit.

The following state regulations apply to Linde LLC's after-the-fact construction:

45CSR2 - **To Prevent and Control Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers**

Linde's boiler is less than 10 MM Btu/hr and is therefore exempt from sections 4 (PM weight standard), 5 (Control of fugitive PM), 6 (Registration), 8 (Testing, Monitoring, Record-keeping, and Reporting), and 9 (Start-up, Shutdowns, and Malfunctions) of Rule 2.

Any fuel burning units having a heat input under ten (10) million B.T.U.'s per hour will be exempt from sections 4, 5, 6, 8, and 9. All of Linde LLC's natural gas-fired combustion sources are less than 10 MM Btu/hr.

All Linde LLC's equipment was taken by the writer to be indirect heat exchangers and not process heaters. Therefore emissions have to have an opacity of 10% or less per section 3.1. Because all of Linde LLC's equipment is natural-gas fired which from experience has shown to have little to no visible emissions, the following statement was put into the permit:

4.3.1. If requested by the Secretary, in order to determine compliance with the opacity limit given in section 4.1.3. the permittee shall either perform testing in accordance with 40 CFR Part 60, Appendix A, Method 22, or install a certified continuous opacity monitoring system. If any emissions are observed during Method 22 testing, the permittee shall immediately investigate the cause(s), take corrective action, and repeat the Method 22 test. If emissions are observed during the repeat test, the permittee shall perform testing in accordance with 40 CFR Part 60, Appendix A, Method 9 with 3 days.

45CSR4 - **To Prevent and Control the Discharge of Air Pollutants into the Open Air Which Causes or Contributes to an Objectionable Odor or Odors**

Linde LLC can not release objectionable odors at any location occupied by the public.

45CSR10 - **To Prevent and Control Air Pollution from the Emission of Sulfur Oxides**

All of Linde LLC's natural gas-fired combustion sources are less than 10 MM Btu/hr.

10.1. Any fuel burning units having a design heat input under ten (10) million BTU's per hour will be exempt from section 3 and sections 6 through 8. However, failure to attain acceptable air quality in parts of some urban areas may require the mandatory control of these sources at a later date.

**45CSR13 - Permits for Construction, Modification, Relocation and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Administrative Updates, Temporary Permits, General Permits, Permission of Commence Construction, and Procedures for Evaluation**

A facility has to have a permit if it discharges or has the potential to discharge more than six (6) pounds per hour and ten (10) tons per year, or has the potential to discharge more than 144 pounds per calendar day, of any regulated air pollutants.

**45CSR22 - Air Quality Management Fee Program**

3.3.a. A person applying for a permit to construct, modify or relocate shall pay a fee when submitting the application. The fee shall be paid by a negotiable instrument (check, draft, warrant, money order, etc.) made payable to the "Air Pollution Control Fund". Any application for a permit to construct, modify or relocate shall not be deemed to have been received nor complete unless payment of the application fee is included.

4.1.a. No person may operate nor cause to operate a plant or stationary source of air pollution without first obtaining and having in effect a valid certificate to operate.

Based on Linde LLC's permit application (R13-2825) as submitted, the writer could not no applicable federal requirements, i.e., no NSPS (40 CFR 60) or MACTS (40 CFR 63) rules apply.

**TOXICITY OF NON-CRITERIA REGULATED POLLUTANTS**

Various HAP/VOC/ non-criteria regulated pollutants are emitted from the incomplete combustion of natural gas. However, it is the writer's opinion that these emissions will not adversely impact the quality of the surrounding ambient air at the concentrations and discharge rates described in the permit application.

## **AIR QUALITY IMPACT ANALYSIS**

No air modeling studies were conducted for this review.

## **MONITORING OF OPERATIONS**

Natural gas usage for the entire facility is to be monitored:

- 4.2.1. Compliance with the fuel usage limit given in section 4.1.2. shall be determined using a rolling yearly total. A twelve (12) month rolling total shall mean the sum of the natural gas consumed for the entire facility for the previous twelve (12) consecutive months.

## **CHANGES TO PERMIT R13-2825**

R13-2825 is a new permit generated by this review.

## **RECOMMENDATION TO DIRECTOR**

Linde's after-the-fact construction of natural gas-fired combustion sources and their air separation facility located near Arroyo/New Cumberland/Newell, Hancock County, WV meets all the requirements of applicable rules and should be granted an air permit (R13-2825).

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John Legg  
Permit Writer

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May 7, 2010  
Date