MEMORANDUM

TO: Amy S. Mann, P.E.

THROUGH: Olayiwola I. Okesola, P.E.

FROM: Eric S. Rowland ESR

SUBJECT: **Croda Inc.**
Atlas Point
"Draft" Permit: APC-2023/0098-CONSTRUCTION (FE)
20" Steam Assisted Flare with 3" Steam Assisted Piggyback Flare

DATE: March 18, 2024

BACKGROUND INFORMATION

Croda Inc. (Croda, the Company, or the Facility) requested a Construction Permit for the installation of a 20" diameter steam assisted natural gas flare with a 3" diameter steam assisted piggyback flare (the "Flare System") in an application dated June 16, 2023.

Croda Inc. manufactures chemical products and surfactants in various reactors, kettles, autoclaves, and other vessels. The Facility currently operates under a Title V permit, **Permit: APC-003/00058-Renewal (03) Revision (07)**, dated April 19, 2023, and is a major source of NO_X and CO_2. In addition, the Facility was previously subject to a Plantwide Applicability Limit (PAL) for NO_X of 54 TPY via **Permit: APC-2012/0120-OPERATION(PAL)(FE)** issued June 25, 2012. This PAL permit was not renewed, and Croda submitted a request dated September 7, 2023, to cancel the permit and distribute the allowed emissions amongst the covered emission units. The emission units at the Atlas Point Facility are listed in Table 1.

Table 1: Atlas Point Emission Units

Emission Unit (EU) # or Designation	Emission Unit Description
EU 108	Boiler No. 5 – 84 MMBtu heat input, fired on landfill gas, natural gas, and No. 2 fuel oil
EU 105	Temporary Boiler – fired on natural gas and No. 2 fuel oil
EU 3 EU 4	Blend Tank Area – two blend tanks, vented to the atmosphere
EU 13	3A and 4 Autoclave Hotwell – vented to atmosphere
EU 14	3A and 4 Autoclave Deodorizer Hotwell – vented to atmosphere
EU 15	4 Kettle Fume Spray Condenser – 22 scfm
EU 16	5 Autoclave Scrubber (Croll Reynolds) – 45 gpm, 14 scfm
EU 18	5 Autoclave Fume & Dust Scrubber (Croll Reynolds) – 15 gpm, 835 scfm
EU 19	5 Autoclave Deodorizer Hotwell – vented to atmosphere
EU 20	7 Kettle Spray Condenser – 105 gpm, 2100 scfm
EU 23	EO/PO Storage Area Scrubber (Croll Reynolds) – 1 gpm, 100 scfm
EU 26	6 Autoclave Scrubber (Croll Reynolds)- 38 gpm, 106 scfm
EU 31 EU 32 EU 33 EU 34 EU 35	Unloading Station Tanks

Emission Unit (EU) # or Designation	Emission Unit Description
MP1EU 1	Multipurpose Plant R-3100 Reactor Condenser (Yula) – 140 °F vent discharge
MP1EU 2	Multipurpose Plant R-3200 Reactor Condenser Vent (Rubicon Industries) – 140 °F vent discharge
MP1EU 3	Multipurpose Plant R-3300 Reactor Condenser Vent (Rubicon Industries) – 100 °F vent discharge
MP1EU 4	Multipurpose Plant R-3400 Reactor Condenser Vent (Rubicon Industries) – 140 °F vent discharge
MP1INV 15	Multipurpose Plant Solid Mix Tank – vented to atmosphere
MP1INV 18 MP1INV 19 MP1INV 20	Multipurpose Plant Vacuum Pumps – vented to atmosphere
MP1EU 21	Laminar Flow Booth – vented to atmosphere
28-7000 28-7001 28-7002 28-7004 28-7010 28-7011 28-7013 28-7015 28-7016 18-7067	Tank Farm
INV270 INV271 INV272 INV273	No. 2 Fuel Oil Fired Emergency Generators – INV270: Main Guardhouse, INV271: Flammable Warehouse, INV272: IT Generator, & INV273: EO/PO
EU 106 EU 107	Two 1100 KW landfill gas fired distributed generators
EU 504	Ethanol Dehydration Furnace, 12.47 MMBtu, fired on natural gas and landfill gas
EU 505	Carbonate Regenerator, process CO_2 recovery unit
CD 505	Catalytic Combustion Unit, 0.81 MMBtu, fired on natural gas
EU 506	Ethylene Oxide Storage Tank, 30,000 gallons
EU 507	Ethylene Oxide Storage Tank, 30,000 gallons
CD 506	Scrubber, ethylene oxide emissions from storage tanks
EU 508	Ethyl Chloride Chemical Addition Pot
T-1290	Ethylene Purification Column (start-up and extended shutdown)
	300 kW Emergency Generator, fired on No. 2 fuel oil
	Two (2) 350 HP Fire Pumps 1 & 2, one (1) existing 235 HP Fire Pump, all fired on No. 2 fuel oil
	Lab Hoods
D-1410A	Ethanol Storage Tank #1, vertical fixed roof, 50,000 gallons
D-1410B	Ethanol Storage Tank #2, vertical fixed roof, 50,000 gallons
F-1203	Ethanol Blowdown Tank, vertical fixed roof, 10,000 gallons
G-336	Anti-foam Tank

Emission Unit (EU) # or Designation	Emission Unit Description
F-615	Crude Ethylene Glycol Tank, 5,000 gallons
D-620A D-620B	Two (2) Glycol Product Receiver Tanks
D-630	Heavy Glycol Tank
F-1261	Propylene Glycol Tank, 200 gallons
F-1430	Propylene Glycol Tank, 1,000 gallons
F-651	MEG Product Storage Tank
	2.108 MW Combined Heat and Power Distributed Generator
	99.9 MMBtu Limited Term Boiler

The facility is subject to the requirements of §112(r) of the 1990 Clean Air Act Amendments. The facility has registered in compliance with 7 DE Admin. Code 1201 "Accidental Release Prevention Regulation." Title VI requirements 40 CFR, Part 82, Subparts A, E, F, and G (labeling and recordkeeping for products using ozone-depleting substances) are applicable.

Facility wide Potential to Emit (PTE) is shown in Table 2.

Table 2: Facility Potential to Emit (PTE)[1]

Pollutant	Facility Wide PTE (tons/year)	Major Source Threshold (tons/year)
Nitrogen Oxides (NO_X)	109.4	25
Volatile Organic Compounds (VOCs)	31.8	25
Carbon Monoxide (CO)	48.1	100
Particulate Matter (PM)	9.6	100
Particulate Matter Less Than 10 Microns (PM_{10})	9.6	100
Particulate Matter Less Than 2.5 Microns ($PM_{2.5}$)		25
Sulfur Dioxide (SO_2)	20.7	100
Lead	n/a	10
Carbon Dioxide Equivalent (CO_2e)	115,153	100,000
Other (EO)	1.2	10
Other (PO)	0.6	10

[1] – Facility PTE based off PTE table provided by Croda dated April 16, 2020.

The facility is a major source for nitrogen oxides (NO_X) and carbon dioxide equivalent (CO_2e). They have requested limits and are a synthetic minor source for volatile organic compounds (VOCs) and hazardous air pollutants (HAPs). The permit will be advertised for 30 days and will be incorporated into the Title V permit pursuant to the requirements of 7 DE Admin. Code 1102 Section 12.4.

The Company has not requested confidentiality.

The Company is located within the Coastal Zone. The project has been evaluated by DNREC's Division of Climate, Coastal and Energy (CCE), and as pollution control, the Flare System was found to fall under the category of "Uses Not Regulated".

The Company is current with its annual fees and has paid appropriate construction application fees.

The property is zoned HI (Heavy Industry). The Company has brought this project to the attention of New Castle County's (NCC) Department of Land Use in application number 2022-0264-S. NCC has determined that the Flare System does not trigger the need for a Special Use Permit.

The Facility is located in a Limited English neighborhood. The legal notice will be translated to Spanish. The facility is located near an Equity Focus area. Enhanced outreach regarding the permitting action will be conducted by the Facility.

The following correspondence has taken place between the Company and the Department in regard to the Flare System. Dates given are document or email dates and dates in parenthesis (where applicable) are receipt dates.

Date	From	To	Document
03-13-2023	Croda	DNREC	Draft permit application
06-16-2023	Croda	DNREC	Permit application
11-07-2023	DNREC	Croda	Questions concerning permit application
11-20-2023	Croda	DNREC	Response to 11-07-2023 questions
03-06-2024	DNREC	Croda	Pre-Notification Draft Permit
03-15-2024	Croda	DNREC	Response to Pre-Notification Draft Permit

TECHNICAL INFORMATION

The Flare System consists of a 20" diameter steam assisted flare with a smaller 3" diameter steam assisted piggyback flare. Both flares are fueled with natural gas. Pilots will be operated at all times to support the ignition of the flare in the case of activation. The 20" flare is equipped with 3 pilots and the 3" flare is equipped with 2 pilots.

The 3" flare is fed a purge flow of natural gas at 473 CFH, and so is essentially "on" at all times. When not activated, the 20" flare's emissions are solely from the pilots.

Potential to Emit / Permitted Emissions

The potential to emit (PTE) was calculated based on the emissions factors provided to the Division of Air Quality (DAQ) in the application dated June 16, 2023, as well as from the Environmental Protection Agency's (EPA) AP-42 Compilation of Air Emission Factors. The five (5) pilots at 50 CFH of natural gas and 473 CFH of natural gas purge flow yield a flow of 723 CFH of natural gas usage during idle conditions.

Table 3: Flare System Potential to Emit (PTE)
Idle Condition

Pollutant	Emission Factor	EF Units	EF Source	Emission Rate (lb/hr)	PTE (TPY)
NO_X	100	lb/MMSCF	1	0.072	0.317
CO	84	lb/MMSCF	1	0.061	0.266
SO_X	0.6	lb/MMSCF	2	0.0004	0.002
PM (TPM or PT)	7.6	lb/MMSCF	2	0.005	0.024
VOC	5.5	lb/MMSCF	2	0.004	0.017
CO_2	12,000	lb/MMSCF	2	86.76	380
Methane	2.3	lb/MMSCF	2	0.002	0.007
N_2O	2.2	lb/MMSCF	2	0.002	0.007

Emission Factor (EF) Source
1 – AP-42, Table 1.4-1
2 – AP-42, Table 1.4-2

The Flare System will be fully activated when the incoming pressure of waste gases exceeds a certain pressure and bypasses the liquid seal at the bottom of the 20" steam assisted flare. At that time, no additional gas will be fed to the 3" piggyback flare, but 51,520 CFH of natural gas will be fed to the 20" flare.

The permit application, in the provided emissions calculations, requests usage of the flare for up to 876 hours per year. The additional emissions for 876 hours of malfunction operation and the PTE are shown in Table 4.

Table 4: Flare System Potential to Emit (PTE)
Considering 876 hrs of Malfunction Condition

Pollutant	Emission Factor	EF Units	EF Source	Emission Rate (lb/hr)	PTE (TPY)
NO_X	100	lb/MMSCF	1	5.2	2.6
CO	84	lb/MMSCF	1	4.4	2.2
SO_X	0.6	lb/MMSCF	2	0.03	0.02
PM (TPM or PT)	7.6	lb/MMSCF	2	0.4	0.2
VOC	5.5	lb/MMSCF	2	0.3	0.1
CO_2	12,000	lb/MMSCF	2	6,269.2	3,088
Methane	2.3	lb/MMSCF	2	0.1	0.06
N_2O	2.2	lb/MMSCF	2	0.1	0.06

Emission Factor (EF) Source & Footnotes
1 – AP-42, Table 1.4-1
2 – AP-42, Table 1.4-2

In Table 4 above, the emission rate is the rate of emissions (lb/hr) during a period of malfunction condition. However, the PTE (far right-hand column) is the combination of 876 hours of malfunction condition and the remainder of the year at idle conditions.

New Source Review (NSR) / Prevention of Significant Deterioration (PSD)

An NSR/PSD applicability determination was conducted for all non-exempt physical changes and/or changes in the method of operation. The values required are found in Table 4 above, with the exception of CO_2e.

Calculation of the CO_2e proceeds as follows:

$$PTE(CO_2e) = 3{,}088\ \frac{ton}{yr} + \left(0.06\ \frac{ton}{yr} * 25\right) + \left(0.06\ \frac{ton}{yr} * 298\right) = 3{,}107.4\ \frac{ton}{yr}$$

The results of this determination are compared to the NSR/PSD Significance Levels in Table 5 below.

Table 5: Flare System NSR/PSD Applicability Determination
Baseline Period: 2024

Pollutant	Baseline Actual Emissions (tons/yr)	Post-Change PTE (tons/yr)	Emissions Increase (tons/yr)	Significance Level (tons/yr)	Significant Increase? (Yes / No)
NO_X	0	2.6	2.6	25	No
VOC	0	0.1	0.1	25	No
CO	0	2.2	2.2	100	No
SO_X	0	0.02	0.02	40	No
PM (TPM or PT)	0	0.2	0.2	25	No
PM_{10}	0	0.2	0.2	15	No
$PM_{2.5}$	0	0.2	0.20	10	No
Lead	n/a	n/a	n/a	0.6	n/a
CO_2e	0	3,107.4	3,107.4	75,000	No

Table 5 shows that the Flare System alone does not trigger NSR or PSD.

Netting Discussion

The contemporaneous time period is 2020 to 2024. Projects in this period include:

- Addition of Flare System
  - Emissions taken from calculations in this memo
- Addition of 110 MMBtu Boiler (Boiler 6)
  - Emissions taken from calculations in memo esr23014.docx
- Addition of Two (2) 650 hp Fire Pumps
  - Emissions taken from calculations in memo esr23008.docx
- Removal of 75 MMBtu Boiler (Boiler 3)
  - Emissions taken from Croda PTE Summary, Revision 8, dated April 16, 2022
- Addition of 90 MMBtu Boiler (Limited Term Boiler)
  - Emissions taken from calculations in memo esr21071.docx
- Removal of Spray Tower
  - Emissions taken from Croda PTE Summary, Revision 8, dated April 16, 2022

- Addition of 2.1 MW Combined Heat & Power Generator (CHP 3)
    - Emissions taken from calculations in memo mas19041.doc

The baseline period for actual emissions was based on the 2020 Annual Air Emission Inventory and Emissions Statement Report.

Table 6: NSR/PSD Applicability Netting Analysis
Baseline Period: 2019
(All values in TPY)

	NO_X	VOC	CO	SO_X	PM	PM_{10}	$PM_{2.5}$	CO_2e
Baseline	28.63	14.32	12.81	0.62	2.38	2.38	1.78	55,151.6
Flare System	1.43	0.079	1.20	0.009	0.11	0.11	0.11	1,816.2
Boiler 6	21.67	2.60	6.35	4.8	4.46	3.59	3.59	60,177.1
Fire Pumps	1.88	0.043	0.59	0.67	0.06	0.06	0.06	377
Boiler 3	-47.0	-1.8	-0.6	-0.2	-2.4	-2.4	-2.4	-38,647.1
LT Boiler	15.8	1.8	16.4	0.26	2.2	2.2	2.2	51,928.0
Spray Tower		-0.2			-2.5	-2.5	-2.5	
CHP 3	3.95	5.79	2.77	0.28	2.26	2.26	2.26	14,548
Summed Changes	-1.1	6.5	27.7	5.8	4.3	3.4	3.4	91,490.4
Significance Level	25	25	100	40	25	15	10	75,000
Significant?	No	No	No	No	No	No	No	Yes
PTE After Changes	27.5	20.8	40.5	6.4	6.7	5.8	5.2	146,647.3

The major source threshold under the PSD permitting program is a potential to emit (PTE) of greater than or equal to 100 TPY of any criteria pollutant for which the area is in attainment of the National Ambient Air Quality Standards (NAAQS). While the evaluation of the Flare System did not exceed the threshold of any criteria pollutant, the evaluation of the 5-year contemporaneous look-back required by Delaware's dual source definition did show that the 75,000 TPY significance level and the 100,000 TPY major source threshold for CO_2e could be exceeded, triggering PSD for this pollutant. 7 DE Admin. Code 1125 Section 3.2 does not provide increment levels for CO_2e, so modeling could not be conducted. As a result, PSD is satisfied by applying Best Available Control Technology (BACT) which for CO_2e is maintaining good combustion control.

It should be noted that this analysis considers the contribution from Boiler 6 and the Limited Term Boiler. These two boilers are not expected to continue operating simultaneously but were considered in this fashion as no cancellation request for the Limited Term Boiler has yet to be processed (and likely will not be received/processed until Boiler 6 is constructed/commissioned).

Significant Impact Levels (SILs) & AERSCREEN Modeling

The effects of air contaminant emissions from the operation of the Flare System on the public health, safety, and welfare were assessed using Department criteria. The criteria assume no adverse effect when the Maximum Downwind Concentration (MDC) is less than the significant impact level (SIL) for each air contaminant emitted and over each applicable averaging period. For reference the SIL is "the level of ambient impact below which the EPA considers a source to have an insignificant effect on ambient air quality." The current pollutant-specific SILs along with their respective averaging periods are summarized in Table 7 below.

Table 7: Significant Impact Levels for Pollutants of Interest

Pollutant	Averaging Time	Source	Significant Impact Level ($\mu g/m^3$)
CO	1-hour	1	2,000
	8-hour	1	500
NO_2	1-hour	2	7.5
	Annual	1	1.0
SO_2	1-hour	3	7.9
	3-hour	1	25
	24-hour	1	5
	Annual	1	1.0
PM_{10}	24-hour	1	5.0
	Annual	1	1.0
$PM_{2.5}$	24-hour	1	1.2
	Annual	1	0.3
Air Toxics	8-hour	4	TLV/100

1 – 40 CFR 51.165(b)(2)
2 – https://www.epa.gov/sites/production/files/2015-07/documents/appwno2.pdf
3 – https://www.epa.gov/sites/default/files/2015-07/documents/appwso2.pdf
4 – DNREC DAQ Internal Criteria

According to the EPA's 2018 Guidance on SILs, the EPA believes there is a valid analytical and legal basis in most cases for the permitting authority to conclude that the proposed source will not cause or contribute to a violation of a National Ambient Air Quality Standard (NAAQS) only after a permit applicant has shown through air quality modeling that the projected air quality impact from a proposed source for a particular pollutant is not significant or meaningful. In order to show that the proposed source will not have a significant or meaningful impact on air quality, the Department has elected to use these SIL values as a compliance demonstration tool.

In the case where a pollutant-specific SIL was not available, TLVs for pollutants were obtained from the *2024 TLVs and BEIs* publication from the American Conference of Governmental Industrial Hygienists (ACGIH). When compared against TLVs, the MDC must be at a level no greater than 100 times less than the published TLV in order to demonstrate that public health and safety are protected.

According to the December 19, 1980 letter by EPA's Administrator Douglas Costle to Senator Jennings Randolph:

> *"…the exemption from ambient air is available only for the atmosphere over land owned or controlled by the source and to which public access is precluded by a fence or other physical barriers."*

The Division of Air Quality's Model Application Guidance document includes the following interpretation:

> *"Based on this definition, if general public access is effectively precluded by a fence or other physical barriers, the facility is assumed to be controlled and public access effectively precluded, and the ambient air boundary can be set at where the fence line or other physical barriers are located."*

(See also the December 2, 2019, *Revised Policy on Exclusions from "Ambient Air"* by Andrew Wheeler, EPA Administrator.)

In each case, the MDC of the air contaminant is computed using AERSCREEN air dispersion modeling. AERSCREEN is EPA's recommended screening-level air quality model based on AERMOD.

AERSCREEN is an interactive command-prompt application that interfaces with MAKEMET for generating the meteorological matrix, but also interfaces with AERMAP and BPIPPRM to automate the processing of terrain and building information, and interfaces with the AERMOD model utilizing the SCREEN option to perform the modeling runs. The AERSCREEN program also includes averaging time factors for worst-case 3-hr, 8-hr, 24-hr and annual averages.

In utilizing AERSCREEN, elevated flares such as those used in the Flare System are a unique case. As the combustion in a flare occurs at the end of, and past the flare stack, the stack diameter is not truly the diameter of the emission, as used for a Point Source. AERSCREEN can treat flares as a point source, in which case certain equivalent diameters and temperatures need to be estimated before modeling, or it treat it as a Flare source, where AERSCREEN estimates these unknown values. Flare source variables in AERSCREEN are air contaminant emission rates (lb/hr), stack height (ft), total heat release rate (cal/sec) and radiative heat lost fraction (optional), and the urban/rural land use options.

In the case of this Flare System, the two flares (3" piggyback flare and 20" flare) are in close enough proximity that they will be modeled in AERSCREEN as a single Flare source.

For the idle condition, the heat release rate for the 3" piggyback flare is calculated as:

$$\left((473 + 50 + 50)\frac{scf}{hr}\right)\left(1{,}020\frac{Btu}{scf}\right)\left(\frac{1\ hr}{60\ min}\right)\left(\frac{1\ min}{60\ sec}\right)\left(252\frac{cal}{Btu}\right) = 40{,}912\ \frac{cal}{sec}$$

and the heat release rate for the 20" flare is calculated at:

$$\left((50 + 50 + 50)\frac{scf}{hr}\right)\left(1{,}020\frac{Btu}{scf}\right)\left(\frac{1\ hr}{60\ min}\right)\left(\frac{1\ min}{60\ sec}\right)\left(252\frac{cal}{Btu}\right) = 10{,}710\ \frac{cal}{sec}$$

Yielding a total heat release rate for the Flare System in an idle condition of:

$$40{,}912\ \frac{cal}{sec} + \ 10{,}710\ \frac{cal}{sec} = \ 51{,}622\ \frac{cal}{sec}$$

Next to be considered is the malfunction condition. When a malfunction occurs, and waste gas is sent to the Flare System in sufficient quantity to break through the water seal, an additional 25,500 scf/hr of natural gas is expected to be fed to the 20" flare, however a maximum of 51,520 scf/hr could be sent to the flare. Therefore, the heat release rate for this additional flow of natural gas must be considered:

$$\left(51{,}520\,\frac{scf}{hr}\right)\left(1{,}020\,\frac{Btu}{scf}\right)\left(\frac{1\ hr}{60\ min}\right)\left(\frac{1\ min}{60\ sec}\right)\left(252\,\frac{cal}{Btu}\right) = 3{,}678{,}528\ \frac{cal}{sec}$$

During a malfunction condition, the 3" piggyback flare and 5 pilots (2 for the 3" flare, 3 for the 20" flare) will still be activated. Therefore, the total heat release rate for the Flare System itself is calculated as:

$$40{,}912\ \frac{cal}{sec} + \ 10{,}710\ \frac{cal}{sec} + 3{,}678{,}528\ \frac{cal}{sec} = \ 3{,}730{,}150\ \frac{cal}{sec}$$

The parameters used in AERSCREEN modeling of the Idle and Malfunction Conditions are shown in Table 8.

Table 8: AERSCREEN Point Source Variables for the Flare System

Parameter	Idle Condition	Malfunction Condition
Emission Rate (lb/hr)[1]	1	1
Stack Height (ft)	65	65
Total Heat Release Rate (cal/sec)	51,622	3,730,150
Radiative Heat Loss Fraction	Default	Default
Land Use	Rural	Rural
Population Estimate	n/a	n/a
Minimum Distance to Ambient (ft)	Not provided	Not provided
$MDC_{1\text{-}hr}$ (µg/m^3):	11.38	0.9766
$MDC_{3\text{-}hr}$ (µg/m^3):	11.38	0.9766
$MDC_{8\text{-}hr}$ (µg/m^3):	10.24	0.8789
$MDC_{24\text{-}hr}$ (µg/m^3):	6.829	0.5859
MDC_{Annual} (µg/m^3):	1.138	0.09766

[1] – AERSCREEN was run at an emission rate of 1 lb/hr, and this result used to compute a value for each contaminant.

Using the MDC values computed for 1 lb/hr, the MDC values for each pollutant were computed and compared to the applicable Significant Impact Level (SIL). The results for the Flare System at idle conditions are shown in Table 9 and at malfunction conditions in Table 10.

Table 9: Comparison of Calculated MDC Values versus Significant Impact Levels For the Flare System at Idle Conditions

Pollutant	Emission Rate (lb/hr)	Averaging Period	MDC (µg/m³)[1]	SIL (µg/m³)	MDC<SIL?
CO	0.061	1-hour	0.69	2,000	Yes
		8-hour	0.62	500	Yes
NO_X	0.072	1-hour	0.82	7.5	Yes
		Annual	0.08	1	Yes
SO_2	0.0004	1-Hour	0.005	7.8	Yes
		3-Hour	0.005	25	Yes
		24-Hour	0.003	5	Yes
		Annual	0.0005	1	Yes
PM_{10}	0.005	24-Hour	0.03	5	Yes
$PM_{2.5}$	0.005	24-Hour	0.03	1.2	Yes
		Annual	0.01	0.2	Yes

[1] – Sample Calculation: (MDC @ 1 lb/hr) * (Emission Rate)

Table 10: Comparison of Calculated MDC Values versus Significant Impact Levels For the Flare System at Malfunction Conditions

Pollutant	Emission Rate (lb/hr)	Averaging Period	MDC (µg/m³)[1]	SIL (µg/m³)	MDC<SIL?
CO	4.4	1-hour	4.3	2,000	Yes
		8-hour	3.9	500	Yes
NO_X	5.2	1-hour	5.1	7.5	Yes
		Annual	0.5	1	Yes
SO_2	0.03	1-Hour	0.03	7.8	Yes
		3-Hour	0.03	25	Yes
		24-Hour	0.02	5	Yes
		Annual	0.003	1	Yes
PM_{10}	0.4	24-Hour	0.2	5	Yes
$PM_{2.5}$	0.4	24-Hour	0.2	1.2	Yes
		Annual	0.04	0.2	Yes

[1] – Sample Calculation: (MDC @ 1 lb/hr) * (Emission Rate)

As there are no Significant Impact Levels (SIL) established for Air Toxics, an evaluation was performed on Volatile Organic Compound (VOC) emissions. In the case of the Flare System's idle and malfunction conditions, the VOC emissions to be modeled are those emitted from natural gas combustion. The generalized group of VOCs from natural gas combustion as a whole does not have an assigned TLV. Benzene is often used as a worst-case scenario, however the recent changes in its TLV value makes it a particularly stringent worst-case. VOCs will be evaluated as Benzene even though it is expected to be present in the emissions of the Flare System at only extremely low levels. (The emissions factor for benzene is 2.1E-03 lb/10^6 scf of natural gas, versus an emissions factor of 5.5 lb/10^6 scf for VOCs as a whole.) This evaluation is shown in Table 11.

Table 11: TLV:MDC Evaluation of VOC Emissions
Idle Condition

Pollutant	TLV_{TWA} (ppm)	TLV_{TWA} (mg/m^3)	Emission Rate (lb/hr)	$MDC_{8\text{-}hr}$ ($\mu g/m^3$)[1]	TLV:MDC
VOC as Benzene (Idle Condition)	0.05	0.16	0.004	0.041	3,902
VOC as Benzene (Malfunction Condition)	0.05	0.16	0.287	0.168	952

[1] – Sample Calculation: ($MDC_{8\text{-}hr}$ @ 1 lb/hr) * (Emission Rate)

When calculated via AERSCREEN the maximum downwind concentration (MDC) occurs at 28 meters from the Flare System at idle conditions and 174 meters at malfunction conditions. At both idle and malfunction conditions, the criteria pollutants are shown to be below the SILs, as shown in Table 9 and 10. For air toxics, VOC emissions are shown in Table 11 to yield TLV:MDC ratios well above the 100:1 requirement for the protection of public health, safety, and welfare.

These results are based on a total heat rate that is representative of the end of a malfunction when little or no waste gas is flowing to the Flare System. These are the emissions to be permitted by the Flare System permit. The addition of any waste gas to be flared, and therefore any additional heat generated, needs to be evaluated on a case-by-case basis after each flaring episode to determine if emissions limitations from any other applicable permits were exceeded, and to determine if the protection of public health, safety, and welfare was maintained.

REGULATORY REVIEW

✓ 7 DE Admin. Code 1102:	Permits
✓ 7 DE Admin. Code 1104:	Particulate Emissions from Fuel Burning Equipment
× 7 DE Admin. Code 1108:	Sulfur Dioxide Emissions from Fuel Burning Equipment
× 7 DE Admin. Code 1112:	Control of Nitrogen Oxides Emissions
✓ 7 DE Admin. Code 1114:	Visible Emissions
✓ 7 DE Admin. Code 1119:	Control of Odorous Air Contaminants
× 7 DE Admin. Code 1120:	New Source Performance Standards
× 7 DE Admin. Code 1124:	Control of Volatile Organic Compound Emissions
× 7 DE Admin. Code 1125:	Requirements for Preconstruction Review
× 7 DE Admin. Code 1130:	Title V State Operating Permit Program
× 7 DE Admin. Code 1138:	Emission Standards for Hazardous Air Pollutants for Source Categories
× 40 CFR Part 60 Subpart A §60.18:	General control device and work practice requirements

7 DE Admin. Code 1102: Permits

> 7 DE Admin. Code 1102 Section 2.1 states, "…no person shall initiate construction, install, alter or initiate operation of any equipment or facility or air contaminant control device which will emit or prevent the emission of an air contaminant prior to receiving approval of his application from the Department…"

The equipment described in the application is not exempted in 2.2, and so 7 DE Admin. Code 1102 is applicable.

7 DE Admin. Code 1104: Particulate Emissions from Fuel Burning Equipment

7 DE Admin. Code 1104 Section 1.2 states, "The provisions of this Regulation shall not apply where the heat input capacity of the equipment is less than 1,000,000 BTU per hour."

At idle conditions, the Flare System's heat input capacity falls short of the 1,000,000 BTU per hour provision of this regulation as shown below.

$$\left(\frac{(473+50+50)\ scf}{hr}\right)\left(\frac{1020\ Btu}{scf}\right) = 584{,}460\ \frac{Btu}{hr}$$

However, when operated under malfunction conditions, the heat input capacity of the Flare System exceeds 1,000,000 Btu per hour, and the provisions of this regulation apply.

$$\left(\frac{25{,}500\ scf}{hr}\right)\left(\frac{1020\ Btu}{scf}\right) = 26{,}010{,}000\ \frac{Btu}{hr}$$

7 DE Admin. Code 1104 Section 2.1 states, "No person shall cause or allow the emission of particulate matter in excess of 0.3 pound per million BTU heat input, maximum two-hour average, from any fuel burning equipment."

$$\frac{0.005\ \frac{lb}{hr}\ PM}{0.584\ \frac{MMBtu}{hr}} = 0.0086\ \frac{lb\ PM}{MMBtu}\ during\ idle\ operation$$

$$\frac{0.20\ \frac{lb}{hr}\ PM}{26.01\ \frac{MMBtu}{hr}} = 0.0077\ \frac{lb\ PM}{MMBtu}\ when\ fired\ on\ Natural\ Gas$$

The Flare System complies with the 0.3 pounds per million BTU heat input limit of Section 2.1. This requirement will be added to the permit.

7 DE Admin. Code 1108: Sulfur Dioxide Emissions from Fuel Burning Equipment

7 DE Admin. Code 1108 Section 2.3 states, "On and after July 1, 2016, no person shall offer for sale, sell, deliver, or purchase any fuel having a sulfur content greater than the limits specified in 2.3.1 through 2.3.3 of this regulation, when such fuel is intended for use in any fuel burning equipment in Delaware, and no person shall use any fuel having a sulfur content greater than the limits specified in 2.3.1 through 2.3.3 of this regulation in any fuel burning equipment in Delaware."

The Flare System is fired on natural gas which inherently contains sulfur at levels lower than prescribed in 7 DE Admin. Code 1108.

7 DE Admin. Code 1112: Control of Nitrogen Oxides Emissions

7 DE Admin. Code 1112 Section 1.0 states, "Except, as provided in 4.0 of this regulation, the provisions of this regulation are applicable to major stationary sources of nitrogen oxides (NO_x)."

While the Company is a major source of nitrogen oxides, Section 1.0 is referring to a major stationary source in terms of the described equipment. The Flare System itself is a minor source of nitrogen oxides.

7 DE Admin. Code 1114: Visible Emissions

7 DE Admin. Code 1114 Section 2.0 states, "No person shall cause or allow the emission of visible air contaminants or smoke from a stationary or mobile source, the shade or appearance of which is greater than 20% opacity for an aggregate of more than three minutes in any one hour or more than 15 minutes in any 24 hour period."

This condition is applicable to the described equipment and has been included in the permit.

7 DE Admin. Code 1119: Control of Odorous Air Contaminants

7 DE Admin. Code 1119 Section 2.0 states, "No person shall cause or allow the emission of an odorous air contaminant such as to cause a condition of air pollution."

This condition has been included as a state enforceable condition of the permit.

7 DE Admin. Code 1120: New Source Performance Standards

The Flare System is not covered by any of the listed source types.

7 DE Admin. Code 1124: Control of Volatile Organic Compound Emissions

7 DE Admin. Code 1124 is not applicable to the Flare System as it does not emit more than 15 pounds of volatile organic compounds (VOC) per day.

7 DE Admin. Code 1125: Requirements for Preconstruction Review

7 DE Admin. Code 1125 Section 2.1 states, "Applicability – The provisions of Section 2.0 of this regulation shall apply to any person responsible for any proposed new major stationary source or any proposed major modification." While the facility is a major source for NO_X, the Flare System (source) is not. A facility wide netting analysis was considered in the case of the Flare System.

Section 2 is not applicable to the Flare System or the facility as a result of its addition.

While the facility is a major source for NO_X, the Flare System does not meet the definition of a Major Stationary Source shown in 7 DE Admin. Code 1125 Section 3.1. A facility wide netting analysis was considered in the case of the Flare System.

Section 3 is not applicable to the described equipment or the facility as a result of its addition.

7 DE Admin. Code 1125 Section 4.4 states in part, "has a potential to emit of equal to or greater than five tons per year of volatile organic compounds (VOC's) or, nitrogen oxides (NOx), or sulfur dioxide (SO_2) or sulfur trioxide (SO_3) or both [also termed sulfur oxides (SOx)] or, fine particulate matter ($PM_{2.5}$), or, the potential to emit of equal to or greater than five tons per year, in the aggregate, of any of the hazardous air pollutants (HAP's) listed in Section 112(b) of the federal Clean Air Act."

The Flare System does not have the potential to emit greater than 5 tons per year of these compounds. Therefore, Section 4 is not applicable.

7 DE Admin. Code 1130: Title V State Operating Permit Program

7 DE Admin. Code 1130 Sections 3.1 through 3.1.5 state, "Covered Sources. Except as exempted from the requirement to obtain a permit under 3.2 of this regulation and elsewhere herein, the following sources are subject to the permitting requirements under this regulation:

3.1.1 Any major source;
3.1.2 Any source, including an area source, subject to a standard, limitation, or other requirement under Section 111 (Standards of Performance for New Stationary Sources) of the Act;
3.1.3 Any source, including an area source, subject to a standard or other requirement under section 112 (National Emissions Standards for Hazardous Air Pollutants) of the Act, except that a source is not required to obtain a permit solely because it is subject to regulations or requirements under section 112® of the Act;
3.1.4 Any affected source; and
3.1.5 Any source that is subject to applicable requirements."

The source (facility) is a major source and currently holds a Title V permit. The Flare System is not one of the sources in Section 3.1.1 through 3.1.5. The construction permit will be issued as a Federally Enforceable Regulation 1102 permit in accordance with 7 DE Admin. Code 1102 Section 12.4. Upon construction of the Flare System, the terms will be incorporated into the Title V permit via the administrative amendment process in accordance with 7 DE Admin. Code 1130 Section 7.4.1.5.

7 DE Admin. Code 1138: Emission Standards for Hazardous Air Pollutants for Source Categories

The Flare System is not covered by any of the listed source categories.

40 CFR Part 60 Subpart A §60.18: General control device and work practice requirements

40 CFR Part 60 Subpart A §60.18(c)(1) through (c)(6) states:

(c)

(1) Flares shall be designed for and operated with no visible emissions as determined by the methods specified in paragraph (f), except for periods not to exceed a total of 5 minutes during any 2 consecutive hours.

(2) Flares shall be operated with a flame present at all times, as determined by the methods specified in paragraph (f).

(3) An owner/operator has the choice of adhering to either the heat content specifications in paragraph (c)(3)(ii) of this section and the maximum tip velocity specifications in paragraph (c)(4) of this section, or adhering to the requirements in paragraph (c)(3)(i) of this section.

(i)

(A) [Not Applicable]
(B) [Not Applicable]

(ii) Flares shall be used only with the net heating value of the gas being combusted being 11.2 MJ/scm (300 Btu/scf) or greater if the flare is steam-assisted or air-assisted; or with the net heating value of the gas being combusted being 7.45 MJ/scm (200 Btu/scf) or greater if the flare is nonassisted. The net heating value of the gas being combusted shall be determined by the methods specified in paragraph (f)(3) of this section.

(4)

(i) Steam-assisted and nonassisted flares shall be designed for and operated with an exit velocity, as determined by the methods specified in paragraph (f)(4) of this section, less than 18.3 m/sec (60 ft/sec), except as provided in paragraphs (c)(4)(ii) and (iii) of this section.

(ii) Steam-assisted and nonassisted flares designed for and operated with an exit velocity, as determined by the methods specified in paragraph (f)(4), equal to or greater than 18.3 m/sec (60 ft/sec) but less than 122 m/sec (400 ft/sec) are allowed if the net heating value of the gas being combusted is greater than 37.3 MJ/scm (1,000 Btu/scf).

(iii) Steam-assisted and nonassisted flares designed for and operated with an exit velocity, as determined by the methods specified in paragraph (f)(4), less than the velocity, Vmax, as determined by the method specified in paragraph (f)(5), and less than 122 m/sec (400 ft/sec) are allowed.

(5) [Not Applicable]

(6) Flares used to comply with this section shall be steam-assisted, air-assisted, or nonassisted.

(d) [Not Applicable]

(e) [Not Applicable]

(f)

(1) Method 22 of appendix A to this part shall be used to determine the compliance of flares with the visible emission provisions of this subpart. The observation period is 2 hours and shall be used according to Method 22.

(2) The presence of a flare pilot flame shall be monitored using a thermocouple or any other equivalent device to detect the presence of a flame.

(3) The net heating value of the gas being combusted in a flare shall be calculated using the following equation:

$$H_T = K \sum_{i=1}^{n} C_i H_i$$

where:

H_T = Net heating value of the sample, MJ/scm; where the net enthalpy per mole of offgas is based on combustion at 25 °C and 760 mm Hg, but the standard temperature for determining the volume corresponding to one mole is 20 °C;

K = Constant, $1.740\ x\ 10^{-7}\ \left(\frac{1}{ppm}\right)\left(\frac{g\ mole}{scm}\right)\left(\frac{MJ}{kcal}\right)$

C_i = Net heat of combustion of sample component i, kcal/g mole at 25 °C and 760 mm Hg. The heats of combustion may be determined using ASTM D2382–76 or 88 or D4809–95 (incorporated by reference as specified in § 60.17) if published values are not available or cannot be calculated.

H_i = Net heat of combustion of sample component i, kcal/g mole at 25 °C and 760 mm Hg. The heats of combustion may be determined using ASTM D2382–76 or 88 or D4809–95 (incorporated by reference as specified in § 60.17) if published values are not available or cannot be calculated.

(4) The actual exit velocity of a flare shall be determined by dividing the volumetric flowrate (in units of standard temperature and pressure), as determined by Reference Methods 2, 2A, 2C, or 2D as appropriate; by the unobstructed (free) cross sectional area of the flare tip.

(5) The maximum permitted velocity, Vmax, for flares complying with paragraph (c)(4)(iii) shall be determined by the following equation.

$$Log_{10}(V_{max}) = (H_T + 28.8)/31.7$$

where:

V_{max} = Maximum permitted velocity, M/sec

H_T = The net heating value as determined in paragraph (f)(3).

(6) [Not Applicable]

The Flare System is not a required control device by any of the NSPS sections listed in 40 CFR Part 60. Therefore, the regulatory sections above are not applicable requirements pursuant to 40 CFR Part 60. However, some of the applicable requirements above do provide accepted and well established operational limitations for the flare. 40 CFR Part 60 Subpart A §60.18 (c)(1), (c)(2), c(3)(ii), (f)(1), and (f)(2) will be added to the permit to ensure practical enforceability.

ADDITIONAL DISCUSSION

The Flare System is a unique permitting circumstance in that normal operation consists of the Flare System standing ready for activated use in an idle condition. It is only the emissions from the Flare System that are attributable to normal operation, and therefore able to be permitted. Any emissions due to gases flowed to the Flare System during startup, shutdown or malfunction of another ethylene oxide plant system are therefore not able to be permitted, and their emission to the atmosphere must either be within the permitted limits of another 7 DE Admin. Code Section 1102 Permit or Section 1130 TV Permit or considered as excess emissions.

Due to this fact, particular attention is given in the permit to the monitoring, recordkeeping and reporting requirements to ensure compliant operation. A particular issue is that since the permitted emissions are due solely to the Flare System, the addition of new process units (and their associated tie-in points) to the Flare System does not have an effect on the permitted emission limits, nor the monitoring, recordkeeping or reporting requirements. However, that is not to say that the addition of these tie-in points should be allowed/accepted without Department oversight.

Therefore the addition of new process units (and their associated tie-in points) has been established in the permit via the use of the administrative amendment process. It will be the owner or operator's responsibility to ensure that the administrative amendment was received by the Department. The Department will have 30 days to review the administrative amendment and to object or request additional information regarding the addition of the new process units and/or new tie-in points. After 30 days, if no objection or request for additional information has been received from the Department, the owner or operator may proceed with the addition of the listed process units and/or tie-in points even if the amended permit has not been received.

Given that the gas flows to the Flare System are due to startup, shutdown or malfunctions, the permit has included the requirement that a root cause analysis be performed for each activation of the Flare System. The root cause analysis should include the source of the gas flowed to the Flare System, the gas flow rate (or estimate), the identification of the gas flow, and the duration. This information should be recorded and will be provided to the Department in a quarterly report.

As discussed in Regulatory Review, above, certain portions of 40 CFR Part 60 Subpart A §60.18 have been added to the permit even though this Flare System is not required by any 40 CFR Part 60 Subpart. Their inclusion is meant to provide well established operation limitations for flare systems of this type. These operational limitations include having a flame present at all times, the existence of no visible emissions, and maintaining a minimum net heating value. Applicable monitoring and recordkeeping conditions to address these actions have been added as well.

PRE-NOTIFICATION DRAFT

A pre-notification draft of the permit was supplied to the Company for review on March 6, 2024. Comments from the Company were received on March 15, 2024. The changes made in response to the Company's comments are shown in Table 12.

Table 12: Permit Changes Made in Response to Company Comments

Condition	From	To
2.1.1	NO_X emissions from operation of the flare system shall not exceed 2.62 pounds per hour and 1.43 tons per twelve (12) month rolling period;	NO_X emissions from operation of the flare system shall not exceed 5.2 pounds per hour and 2.6 tons per twelve (12) month rolling period;
2.1.2	SO_X emissions from operation of the flare system shall not exceed 0.016 pounds per hour and 0.009 tons per twelve (12) month rolling period;	SO_X emissions from operation of the flare system shall not exceed 0.03 pounds per hour and 0.02 tons per twelve (12) month rolling period;
2.1.3	CO emissions from operation of the flare system shall not exceed 2.20 pounds per hour and 1.20 tons per twelve (12) month rolling period;	CO emissions from operation of the flare system shall not exceed 4.4 pounds per hour and 2.2 tons per twelve (12) month rolling period;
2.1.4.1	VOC emissions from operation of the Flare System shall not exceed 0.14 pounds per hour and 0.079 tons per twelve (12) month rolling period;	VOC emissions from operation of the Flare System shall not exceed 0.3 pounds per hour and 0.1 tons per twelve (12) month rolling period;
2.1.5.1	Total Particulate Matter (TPM or PT) emissions from operation of the flare system shall not exceed 0.20 pounds per hour and 0.11 tons per twelve (12) month rolling period;	Total Particulate Matter (TPM or PT) emissions from operation of the flare system shall not exceed 0.4 pounds per hour and 0.2 tons per twelve (12) month rolling period;
3.2	The Flare System shall be activated only during process malfunctions.	The Flare System shall be activated only during periods of start-up, shut-down and malfunction.
3.4	The Flare System shall be designed for and operated with no visible emissions except for periods not to exceed a total of 5 minutes during any 2 consecutive hours. **[This condition will be transferred to Permit: AQM-003/00058-Renewal (03) Revision (07)]** *[Reference 40 CFR Part 60 Subpart A §60.18(c)(1) dated 12/22/2008 and 7 DE Admin. Code 1130 Section 6.1.1 dated 08/11/2022]*	The Flare System shall be designed for and operated with no visible emissions except for periods not to exceed a total of 5 minutes during any 2 consecutive hours, or periods of startup, shutdown, and malfunction of the Flare System. The provisions of Condition 2.2 of this permit apply at all times. **[This condition will be transferred to Permit: AQM-003/00058-Renewal (03) Revision (07)]** *[Reference 40 CFR Part 60 Subpart A §60.11(c) dated 10/17/2000, 40 CFR Part 60 Subpart A §60.18(c)(1) dated*

Condition	From	To
		12/22/2008 and 7 DE Admin. Code 1130 Section 6.1.1 dated 08/11/2022]
3.7	The owner or operator shall conduct a root cause analysis within ten (10) business days of each process malfunction that activates the Flare System. A root cause analysis shall include, but is not limited to:	The owner or operator shall conduct a root cause analysis within thirty (30) business days of each process malfunction that activates the Flare System. A root cause analysis shall include, but is not limited to:
5.5	The owner or operator shall keep a log of odor complaints to demonstrate compliance with Condition 4.5.	The owner or operator shall keep a log of odor complaints and any associated monitoring/testing to demonstrate compliance with Condition 4.5.
Appendix A T220	XV-22108	XV-2210B
Appendix A T320	(New entry)	PSV-3302
Appendix A T430	(New entry)	PSV-4202
Appendix A	D131	D431
Appendix A D431	(New entry)	PSV-4207
Appendix A E1220	(New entry)	PSV-12101
Appendix A D1260	PSV12610	PSV-12610
Appendix A D1260	(New entry)	PSV-12611
Appendix A R1260	(New entry)	PSV-12603
Appendix A T1270	(New entry)	PSV-12700
Appendix A T1290	(New entry)	PSV-12902
Appendix A D1410A	(New entry)	PSV-14111
Appendix A D1410B	(New entry)	PSV-14121

RECOMMENDATIONS

It is recommended that the following actions be taken:

- On March 24, 2024, the attached "Draft" permit and associated public hearing be advertised pursuant to the requirements of 7 DE Admin. Code 1102 Sections 12.4.2 and 12.4.4.2.

- On or before the date listed above, this memorandum and the attached "Draft" permit be sent by email to the EPA Region III office pursuant to the requirements of 7 DE Admin. Code 1102 Section 12.4.3.2. EPA has thirty (30) days to either approve or deny the "Draft" permit.
- On or before the date listed above, the attached email with Section A and Section B be sent by email to the affected states pursuant to the requirements of 7 DE Admin. Code 1102 Section 12.4.3.2.
- On or before the date listed above, the attached letter and "Draft" permit be sent by email to the Company pursuant to the requirements of 7 DE Admin. Code 1102 Section 12.4.3.2.

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