Shell Chemical Appalachia LLC
300 Frankfort Rd
Monaca, PA 15061

August 9, 2023

Mark Gorog P.E., Regional Manager Air Quality Program
Pennsylvania Department of Environmental Protection (PADEP)
Southwest Regional Office
400 Waterfront Drive
Pittsburgh, PA 15222

RE: PA-04-00740C Ethylene Manufacturing Line (Source ID 201), HP Ground Flares (Source IDs C205A and C205B), and HP Elevated Flare (Source ID C205C) Visible and Excess Emissions Malfunction Report

Dear Mr. Gorog,

Shell Chemical Appalachia LLC ("Shell") is submitting this malfunction report to the Pennsylvania Department of Environmental Protection (PADEP) for flaring visible and excess emissions from the HP Ground Flares #1 and #2 and the HP Elevated Flare stemming from an Ethane Cracking Unit[1] malfunction on July 10, 2023.

This malfunction did not pose an imminent and substantial danger to the public health and safety or the environment.

- **Name and location of the facility**
  Shell Polymers Monaca
  300 Frankfort Road, Monaca PA, 15061

- **Nature and cause of the incident**
  On July 10, 2023, at approximately 08:55, the Ethane Cracking Unit (ECU) Acetylene Reactor system tripped, resulting in flaring to high pressure flare system[2]. The flaring caused two discrete smoking events of the HP Elevated Flare on the morning July 10, 2023, in addition to excess emissions through the evening of July 11, 2023. The ECU trip also indirectly resulted in the temporary shutdown of the Polyethylene Manufacturing Lines (PE units) (Source ID 202). The PE unit restarts resulted in additional flaring to HP Ground Flares that continued through the afternoon of July 13, 2023.

  Investigation of the cause of the initiating event, the ECU trip, was determined to stem from the activation of an Emergency Isolation System switch from the central control building. Since the switch was not intentionally activated, further investigation revealed that there was a loose wire inside of the EIS/EDS (Emergency Isolation System/Emergency Depressuring System) panel located in the control building, which defaulted the switch to an activated state.

- **Time when the malfunction or breakdown was first observed**
  July 10, 2023 at 08:55

- **The date and time that the malfunction started and ended**

[1] Identified as Ethylene Manufacturing Line (Source ID 201) PA-04-00740C
[2] Identified as High Pressure (HP) Header System (Source ID 205) PA-04-00740C

July 10, 2023, at 08:55 and ended on July 13, 2023 at 13:30 when the Polyethylene Manufacturing Line flaring ceased. Note that the HP Elevated Flare smoking ceased on July 10, 2023, at 09:13.

- **An estimate of the emissions associated with the malfunction**

Pollutant	Emissions (tons)
CO2e	9896.026
CO	13.266
NOx	5.749
PM (filt)	0.157
PM 10	0.630
PM 2.5	0.630
VOC	20.786
HAP (total)	1.126
1, 3 Butadiene	0.899
Benzene	0.209

- **The calculations that were used to determine that quantity**
  Estimated emissions from the flaring vent gas combustion were based on measured flow rates, measured vent gas compositions, and application of accepted hydrocarbon destruction efficiencies, and the application of emission factors for products of combustion. See attached gas chromatograph (GC) and flow data used for these calculations.

  Note that the ECU recovery flaring ceased on July 11, 2023, at ~18:00, and this contributed to the majority of the excess emissions reported. Flaring from the PE units extended until July 13 at 13:30 due to restart attempts, and this contributed to the minority of the excess emissions reported.

  Summary of Visible Emissions (VE) elapsed time in the High Pressure (HP) Elevated Flare as determined by review of camera footage is captured below. Note- there was no VE from the HP Ground Flares, which was confirmed following review of the footage. Method 22 observations were performed and are attached to this malfunction report. Field operators were responding to investigate and correct the steam system and observations were not able to be initiated until after smoking had ceased.

  - 4 minutes and 56 seconds of VE observed between 08:56:59 and 09:01:55
  - 6 minutes and 8 seconds of VE observed between 09:06:42 and 09:12:50

- **The steps, if any, that the facility took to limit the duration and/or quantity of emissions associated with the malfunction**
  The ECU was stabilized as quickly as possible and ethane feed reduced. The flaring extended over a day due to the initial venting following the trip and then flaring related to unit recovery efforts. Similarly, the PE units were stabilized, and feed was completely removed. PE flaring extended until July 13, 2023, due to unit recovery efforts and some startup setbacks.

  Steam was lined up to the HP Elevated Flare to eliminate/minimize the smoking, but there was an issue with the lineup, which is detailed below.

- **A detailed analysis that sets forth the Root Cause of the malfunction, to the extent determinable**
  The cause of the initiating trip was identified to be the result of a loose wire.

Shutdown of the PE units was determined to be related to an existing issue that was unidentified until the time of the event. After the loss of ethylene production from the ECU, the PE units' feed source transitions to 100% from the refrigerated ethylene storage tank. Ethylene is stored as a cooled liquid in the tank and needs to be vaporized prior to feeding the PE units. Not long after the initiating ECU trip, one of heat exchangers that vaporizes the tank ethylene (via steam) was shut down due to the inability to remove condensate from the shell of the heat exchanger. Through investigation, it was determined that there was a plugged condensate strainer in the utilities area of the plant that limited the condensate outlet flow from the vaporizer.

The smoking of the HP Elevated Flare was also investigated further. During the event, field troubleshooting identified that the flare steam control valve's upstream and downstream manual isolation valves were closed. The lineup issue was quickly corrected, additional steam added to the HP Elevated Flare, and no further flare smoking occurred. It was later determined that the valve had remained isolated from the April through May outage when repairs were being performed on the HP Elevated Flare liquid seal drum.

- **An analysis of the measures, if any, that are available to reduce the likelihood of a recurrence of a malfunction resulting from the same Root Cause or contributing causes in the future**
  The following corrective actions will/have been implemented to prevent future spurious trips due to bad wiring:
  1. Complete-All remaining EIS/EDS switches in the ECU area were bypassed and the wires were checked for incomplete connections. Any loose wires that were found were properly secured.
  2. Pending- Do the same exercise described above for the Utilities and General Facilities area of the plant.

  The following corrective action has been implemented to prevent future, near-term failures of the ethylene feed vaporizer due to inadequate condensate removal:
  1. Complete- Flow has been bypassed around the condensate strainer until a longer term solution can be determined.

  The following corrective action has been implemented to prevent future HP Elevated Flare steam valve lineup issues:
  1. Complete-Car seal open the inlet and outlet isolation valves around the steam control valves.

- **To the extent that investigations of the causes and/or possible corrective action(s) still are underway on the due date of the report, a statement of the anticipated date by which a follow-up report will be submitted**
  A follow-up report will be submitted on or by October 30, 2023.

- **Corrective action is final or timeline for implementation**
  Utilities and General Facilities panel wiring checks- October 1, 2023

If you have any questions regarding this matter, please contact me at (724) 709-2467 or kimberly.kaal@shell.com.

Sincerely,

Kimberly Kaal

Digitally signed by Kimberly Kaal
DN: cn=Kimberly Kaal
Date: 2023.08.09 15:28:58 -04'00'

Kimberly Kaal
Environmental Manager, Attorney-in-Fact

CC:
Scott Beaudway, Air Quality Specialist
Beth Speicher, Environmental Group Manager

Attachment A

HP Flare GC and Flow Data

Attachment B
Method 22 Form

HP Flare System GC Hourly Average Mol% Compositions, Wt % Compositions, Flow, and NHV

Date and Time	Elemental Hydrogen % mol	Nitrogen % mol	Methane % mol	Ethane % mol	Acetylene % mol	Ethylene % mol	C3 % mol	C4 % mol	C4 Olefins % mol	C5 % mol	C6+ % mol	Total % mol	Elemental Hydrogen % wt	Nitrogen % wt	Methane % wt	Ethane % wt	Acetylene % wt	Ethylene % wt	C3 % wt	C4 % wt	C4 Olefins % wt	C5 % wt	C6+ % wt	Total % wt	Actual Flow Rate m3/hr	Flow Density kg/m3	Mass Rate ton/hr	NHVcz Btu/scf
10-Jul-23 08:00:00	29.41	9.11	47.91	2.33	0.00	10.05	0.08	0.04	0.00	0.63	0.45	100.00	3.90	16.78	50.51	4.60	0.00	18.52	0.22	0.13	0.02	2.98	2.33	100.00	29,107	0.70	20.44	1,022.48
10-Jul-23 09:00:00	32.55	1.72	12.77	17.58	0.25	34.21	0.35	0.05	0.31	0.13	0.08	100.00	3.53	2.58	10.99	28.36	0.35	51.47	0.84	0.14	0.91	0.49	0.34	100.00	200,983	1.02	204.38	1,328.90
10-Jul-23 10:00:00	32.19	0.64	5.81	27.50	0.20	32.90	0.49	0.04	0.21	0.00	0.02	100.00	3.30	0.91	4.74	42.03	0.27	46.89	1.09	0.11	0.58	0.00	0.07	100.00	193,081	1.00	193.82	1,392.29
10-Jul-23 11:00:00	33.89	0.61	5.39	26.31	0.11	32.84	0.45	0.06	0.33	0.00	0.02	100.00	3.55	0.89	4.48	41.00	0.15	47.74	1.02	0.18	0.92	0.00	0.08	100.00	194,382	0.98	189.61	1,391.01
10-Jul-23 12:00:00	32.32	1.38	5.50	24.57	0.00	35.15	0.44	0.05	0.32	0.15	0.11	100.00	3.30	1.96	4.47	37.38	0.00	49.87	0.97	0.16	0.87	0.56	0.45	100.00	190,283	1.01	191.75	1,387.29
10-Jul-23 13:00:00	32.36	4.56	5.46	23.28	0.00	32.60	0.47	0.04	0.24	0.69	0.30	100.00	3.26	6.37	4.37	34.93	0.00	45.63	1.03	0.12	0.64	2.50	1.16	100.00	190,863	1.01	193.17	1,355.94
10-Jul-23 14:00:00	33.03	4.18	5.58	22.76	0.00	32.61	0.57	0.04	0.23	0.73	0.27	100.00	3.36	5.90	4.50	34.47	0.00	46.07	1.27	0.11	0.62	2.66	1.05	100.00	187,576	0.98	183.39	1,358.54
10-Jul-23 15:00:00	32.44	5.08	5.79	22.34	0.00	32.43	0.46	0.04	0.22	0.89	0.33	100.00	3.27	7.09	4.63	33.48	0.00	45.35	1.01	0.11	0.59	3.19	1.28	100.00	169,889	0.93	158.43	1,349.83
10-Jul-23 16:00:00	42.69	4.36	7.10	15.95	0.00	28.84	0.23	0.02	0.11	0.58	0.13	100.00	5.13	7.27	6.78	28.55	0.00	48.15	0.59	0.08	0.34	2.49	0.61	100.00	156,611	0.77	121.23	1,301.60
10-Jul-23 17:00:00	45.44	5.77	8.34	12.80	0.00	26.57	0.30	0.03	0.16	0.43	0.16	100.00	5.79	10.21	8.45	24.28	0.00	47.05	0.82	0.11	0.53	1.96	0.79	100.00	160,369	0.73	117.70	1,262.38
10-Jul-23 18:00:00	49.91	6.89	8.27	9.78	0.00	22.20	1.12	0.19	1.08	0.38	0.18	100.00	6.71	12.83	8.83	19.56	0.00	41.42	3.27	0.74	3.88	1.82	0.94	100.00	136,166	0.68	93.17	1,247.94
10-Jul-23 19:00:00	10.12	82.16	1.84	1.42	0.00	3.72	0.24	0.06	0.35	0.06	0.02	100.00	0.81	90.67	1.16	1.68	0.00	4.11	0.42	0.14	0.76	0.18	0.07	100.00	125,514	1.19	148.88	250.98
10-Jul-23 20:00:00	55.60	7.66	9.97	6.67	0.00	17.59	0.63	0.23	1.28	0.27	0.12	100.00	8.51	16.26	12.12	15.21	0.00	37.39	2.11	1.00	5.24	1.46	0.71	100.00	128,390	0.61	78.78	1,206.51
10-Jul-23 21:00:00	52.40	6.57	9.41	5.94	0.00	24.25	0.40	0.12	0.70	0.15	0.07	100.00	7.68	13.34	10.95	12.95	0.00	49.35	1.28	0.50	2.76	0.77	0.42	100.00	143,407	0.66	94.53	1,217.35
10-Jul-23 22:00:00	31.58	4.62	6.50	15.57	0.00	40.65	0.33	0.08	0.46	0.12	0.09	100.00	3.25	6.59	5.30	23.82	0.00	58.01	0.74	0.24	1.28	0.43	0.36	100.00	219,480	1.00	219.63	1,325.15
10-Jul-23 23:00:00	33.89	4.97	5.67	14.35	0.00	40.06	0.33	0.07	0.45	0.11	0.10	100.00	3.58	7.28	4.75	22.55	0.00	58.74	0.76	0.22	1.28	0.41	0.42	100.00	205,810	0.93	191.57	1,317.01
11-Jul-23 00:00:00	36.47	4.85	6.94	12.76	0.00	37.87	0.34	0.09	0.52	0.09	0.08	100.00	4.03	7.44	6.10	20.99	0.00	58.14	0.81	0.28	1.54	0.34	0.32	100.00	202,690	0.91	184.74	1,302.52
11-Jul-23 01:00:00	37.63	5.28	7.02	13.92	0.00	35.43	0.20	0.06	0.36	0.06	0.06	100.00	4.25	8.26	6.29	23.39	0.00	55.54	0.50	0.19	1.09	0.23	0.27	100.00	188,313	0.88	164.87	1,289.64
11-Jul-23 02:00:00	42.39	5.98	7.54	11.22	0.00	31.63	0.36	0.10	0.67	0.06	0.05	100.00	5.14	10.06	7.26	20.26	0.00	53.28	0.95	0.35	2.19	0.25	0.26	100.00	168,290	0.80	135.31	1,266.21
11-Jul-23 03:00:00	41.86	5.48	7.78	10.93	0.00	32.79	0.34	0.09	0.65	0.04	0.04	100.00	5.05	9.17	7.46	19.65	0.00	54.98	0.90	0.32	2.11	0.18	0.18	100.00	176,056	0.81	142.97	1,272.13
11-Jul-23 04:00:00	66.12	3.69	12.04	4.24	0.00	13.72	0.04	0.02	0.12	0.00	0.02	100.00	14.02	10.83	20.27	13.37	0.00	40.40	0.19	0.13	0.65	0.00	0.14	100.00	111,296	0.45	49.55	1,189.31
11-Jul-23 05:00:00	69.03	6.43	12.47	1.45	0.00	10.52	0.02	0.01	0.05	0.00	0.02	100.00	16.14	20.86	23.16	5.05	0.00	34.16	0.08	0.09	0.29	0.00	0.17	100.00	111,810	0.40	45.25	1,134.17
11-Jul-23 06:00:00	72.84	4.83	12.77	0.86	0.00	8.53	0.02	0.02	0.12	0.00	0.01	100.00	19.31	17.76	26.88	3.40	0.00	31.41	0.09	0.15	0.84	0.00	0.15	100.00	110,720	0.35	38.60	1,146.20
11-Jul-23 07:00:00	70.78	5.01	12.74	0.75	0.00	10.61	0.01	0.01	0.07	0.00	0.02	100.00	17.56	17.23	25.10	2.78	0.00	36.57	0.04	0.10	0.48	0.00	0.15	100.00	111,790	0.38	42.48	1,147.31
11-Jul-23 08:00:00	40.68	41.24	7.51	0.53	0.00	10.00	0.00	0.01	0.02	0.00	0.01	100.00	4.96	69.74	7.28	0.97	0.00	16.94	0.01	0.02	0.06	0.00	0.03	100.00	117,344	0.78	92.08	794.19
11-Jul-23 09:00:00	31.45	53.47	6.89	0.51	0.00	7.62	0.03	0.01	0.01	0.00	0.00	100.00	3.34	78.67	5.80	0.81	0.00	11.23	0.08	0.02	0.03	0.00	0.01	100.00	117,403	0.90	106.01	484.34
11-Jul-23 10:00:00	61.34	6.10	14.91	0.88	0.00	16.38	0.25	0.03	0.11	0.00	0.01	100.00	11.93	16.46	23.03	2.54	0.00	44.22	1.05	0.14	0.57	0.00	0.07	100.00	95,989	0.48	45.76	1,146.88
11-Jul-23 11:00:00	53.96	7.15	17.05	0.87	0.00	20.20	0.54	0.03	0.19	0.00	0.01	100.00	8.99	16.53	22.57	2.16	0.00	46.75	1.96	0.14	0.84	0.00	0.05	100.00	61,575	0.56	34.32	1,141.47
11-Jul-23 12:00:00	54.12	8.29	16.66	1.38	0.00	19.50	0.02	0.01	0.01	0.00	0.01	100.00	9.11	19.35	22.27	3.46	0.00	45.58	0.09	0.06	0.03	0.00	0.06	100.00	57,639	0.54	30.90	1,120.91
11-Jul-23 13:00:00	63.47	6.02	19.11	1.36	0.00	9.99	0.02	0.01	0.02	0.00	0.01	100.00	13.82	18.17	33.04	4.40	0.00	30.21	0.11	0.08	0.10	0.00	0.06	100.00	48,803	0.39	18.97	1,115.38
11-Jul-23 14:00:00	63.94	7.59	20.64	1.03	0.00	6.76	0.03	0.01	0.00	0.00	0.01	100.00	14.42	23.73	36.95	3.44	0.00	21.16	0.13	0.08	0.02	0.00	0.06	100.00	38,341	0.37	14.24	1,081.43
11-Jul-23 15:00:00	7.66	29.26	47.52	4.08	0.00	11.24	0.16	0.04	0.01	0.00	0.02	100.00	0.76	40.03	37.24	6.00	0.00	15.40	0.35	0.12	0.02	0.00	0.09	100.00	10,261	0.85	8.71	759.68
11-Jul-23 16:00:00	16.25	24.08	40.84	5.77	0.00	12.70	0.29	0.04	0.01	0.00	0.02	100.00	1.72	35.33	34.31	9.09	0.00	18.65	0.66	0.12	0.03	0.00	0.08	100.00	13,418	0.81	10.93	856.05
11-Jul-23 17:00:00	19.64	23.67	41.43	4.14	0.00	10.82	0.22	0.04	0.01	0.01	0.02	100.00	2.19	36.62	36.71	6.88	0.00	16.76	0.54	0.14	0.02	0.03	0.11	100.00	14,453	0.79	11.39	846.78
11-Jul-23 18:00:00	17.07	30.23	29.05	2.36	0.00	17.46	0.12	0.03	0.03	2.92	0.74	100.00	1.58	38.75	21.32	3.24	0.00	22.42	0.23	0.07	0.07	9.64	2.66	100.00	23,751	0.93	22.18	913.41
11-Jul-23 19:00:00	16.58	32.30	28.63	1.98	0.00	16.40	0.05	0.02	0.02	3.10	0.91	100.00	1.51	40.82	20.72	2.69	0.00	20.75	0.10	0.06	0.05	10.10	3.20	100.00	21,932	0.95	20.81	894.39
11-Jul-23 20:00:00	33.73	24.72	22.88	1.47	0.00	14.18	0.76	0.05	0.23	1.50	0.49	100.00	3.86	39.24	20.80	2.50	0.00	22.55	1.91	0.15	0.71	6.12	2.15	100.00	30,342	0.82	24.90	953.27
11-Jul-23 21:00:00	32.54	25.86	22.07	1.59	0.00	11.88	3.48	0.15	1.14	0.96	0.33	100.00	3.56	39.27	19.20	2.59	0.00	18.06	8.32	0.47	3.33	3.77	1.42	100.00	29,818	0.87	26.02	960.76
11-Jul-23 22:00:00	28.55	30.02	22.15	1.61	0.00	10.68	4.49	0.19	1.42	0.63	0.25	100.00	2.95	43.05	18.19	2.48	0.00	15.34	10.14	0.56	3.95	2.32	1.02	100.00	28,279	0.93	26.38	909.62
11-Jul-23 23:00:00	26.48	32.14	23.48	1.62	0.00	9.70	4.34	0.18	1.41	0.45	0.20	100.00	2.71	45.53	19.05	2.47	0.00	13.77	9.67	0.53	3.85	1.64	0.79	100.00	26,137	0.92	24.08	871.35
12-Jul-23 00:00:00	27.62	34.75	25.49	1.52	0.00	10.09	0.05	0.02	0.01	0.29	0.16	100.00	3.09	53.94	22.66	2.54	0.00	15.69	0.11	0.06	0.02	1.18	0.71	100.00	25,496	0.83	21.14	760.49
12-Jul-23 01:00:00	26.57	34.65	27.51	1.54	0.00	9.38	0.03	0.01	0.00	0.19	0.12	100.00	2.98	53.91	24.51	2.57	0.00	14.61	0.08	0.05	0.01	0.75	0.53	100.00	24,904	0.83	20.56	749.40
12-Jul-23 02:00:00	25.55	34.82	28.99	1.51	0.00	8.87	0.03	0.01	0.00	0.12	0.09	100.00	2.86	54.04	25.77	2.52	0.00	13.79	0.07	0.05	0.01	0.49	0.40	100.00	24,507	0.83	20.30	738.55
12-Jul-23 03:00:00	24.45	35.75	29.75	1.53	0.00	8.32	0.03	0.01	0.00	0.08	0.07	100.00	2.71	54.99	26.21	2.52	0.00	12.82	0.07	0.05	0.01	0.31	0.31	100.00	23,685	0.83	19.73	721.61
12-Jul-23 04:00:00	24.39	35.80	30.18	1.52	0.00	7.97	0.03	0.01	0.00	0.05	0.05	100.00	2.71	55.24	26.67	2.52	0.00	12.31	0.07	0.05	0.00	0.19	0.24	100.00	24,744	0.84	20.71	717.29
12-Jul-23 05:00:00	29.46	31.50	29.81	1.46	0.00	7.68	0.03	0.01	0.00	0.00	0.04	100.00	3.53	52.38	28.39	2.61	0.00	12.80	0.07	0.04	0.00	0.00	0.17	100.00	26,698	0.79	21.00	767.59
12-Jul-23 06:00:00	29.27	31.63	29.81	1.54	0.00	7.68	0.03	0.01	0.00	0.00	0.03	100.00	3.50	52.45	28.30	2.74	0.00	12.75	0.08	0.04	0.00	0.00	0.13	100.00	26,602	0.79	20.98	766.04
12-Jul-23 07:00:00	29.03	31.89	29.83	1.62	0.00	7.57	0.03	0.01	0.00	0.00	0.02	100.00	3.46	52.70	28.23	2.87	0.00	12.52	0.08	0.04	0.00	0.00	0.11	100.00	26,574	0.79	20.96	762.66
12-Jul-23 08:00:00	29.34	31.87	30.03	1.58	0.00	7.13	0.03	0.01	0.00	0.00	0.02	100.00	3.52	52.99	28.60	2.81	0.00	11.87	0.08	0.04	0.00	0.00	0.09	100.00	26,964	0.78	20.91	760.59
12-Jul-23 09:00:00	30.18	31.15	29.81	1.46	0.00	7.33	0.03	0.01	0.00	0.00	0.01	100.00	3.66	52.42	28.73	2.64	0.00	12.36	0.07	0.05	0.00	0.00	0.06	100.00	27,105	0.75	20.40	770.12
12-Jul-23 10:00:00	29.49	31.13	28.97	1.53	0.00	7.69	0.86	0.05	0.26	0.01	0.01	100.00	3.48	50.86	27.11	2.68	0.00	12.59	2.21	0.15	0.82	0.04	0.06	100.00	27,655	0.77	21.18	787.25
12-Jul-23 11:00:00	28.44	30.66	27.29	1.62	0.00	7.43	3.32	0.16	1.05	0.01	0.01	100.00	3.15	47.04	23.98	2.67	0.00	11.41	8.03	0.51	3.11	0.06	0.04	100.00	28,514	0.83	23.59	836.45
12-Jul-23 12:00:00	27.78	29.43	25.99	1.71	0.00	7.23	5.72	0.24	1.82	0.07	0.01	100.00	2.92	42.89	21.69	2.67	0.00	10.55	13.12	0.73	5.13	0.25	0.04	100.00	28,351	0.87	24.57	894.40
12-Jul-23 13:00:00	28.14	27.34	26.30	1.70	0.00	14.82	1.19	0.07	0.38	0.06	0.01	100.00	3.17	42.70	23.52	2.84	0.00	23.18	2.92	0.23	1.16	0.24	0.03	100.00	28,360	0.80	22.66	867.76
12-Jul-23 14:00:00	31.36	23.19	30.22	1.87	0.00	11.82	0.10	1.39	0.01	0.03	0.00	100.00	3.78	38.81	28.96	3.36	0.00	19.81	0.26	4.81	0.04	0.15	0.02	100.00	25,930	0.73	18.83	902.64
12-Jul-23 15:00:00	31.82	27.28	30.47	1.82	0.00	8.38	0.05	0.09	0.10	0.00	0.00	100.00	3.97	47.18	30.17	3.38	0.00	14.51	0.13	0.32	0.34	0.00	0.01	100.00	25,890	0.69	17.92	821.90
12-Jul-23 16:00:00	31.84	27.74	30.18	1.77	0.00	8.15	0.04	0.04	0.24	0.00	0.00	100.00	3.96	47.83	29.79	3.27	0.00	14.07	0.12	0.15	0.80	0.00	0.01	100.00	26,360	0.69	18.22	817.83
12-Jul-23 17:00:00	32.13	27.66	30.56	1.74	0.00	7.63	0.04	0.02	0.22	0.00	0.00	100.00	4.03	48.09	30.43	3.24	0.00	13.28	0.11	0.07	0.74	0.00	0.01	100.00	26,588	0.69	18.26	815.36
12-Jul-23 18:00:00	32.51	27.54	30.67	1.64	0.00	7.47	0.04	0.02	0.12	0.00	0.00	100.00	4.11	48.30	30.80	3.08	0.00	13.12	0.11	0.07	0.40	0.00	0.01	100.00	26,247	0.68	17.90	814.03
12-Jul-23 19:00:00	32.58	27.29	30.86	1.69	0.00	7.46	0.04	0.02	0.05	0.00	0.00	100.00	4.14	48.04	31.11	3.20	0.00	13.15	0.12	0.07	0.17	0.00	0.01	100.00	26,396	0.69	18.10	815.46
12-Jul-23 20:00:00	32.68	26.52	31.62	1.61	0.00	7.52	0.03	0.02	0.00	0.00	0.00	100.00	4.18	47.07	32.15	3.07	0.00	13.36	0.09	0.06	0.01	0.00	0.01	100.00	26,369	0.69	18.19	821.30
12-Jul-23 21:00:00	32.29	26.92	31.66	1.62	0.00	7.45	0.03	0.02	0.00	0.00	0.00	100.00	4.11	47.50	31.99	3.07	0.00	13.17	0.09	0.06	0.00	0.00	0.01	100.00	26,082	0.70	18.31	816.22
12-Jul-23 22:00:00	31.19	26.93	30.38	1.67	0.00	7.20	1.90	0.10	0.63	0.00	0.00	100.00	3.75	44.89	29.00	2.98	0.00	12.01	5.00	0.33	2.03	0.00	0.01	100.00	26,304	0.76	19.93	849.34
12-Jul-23 23:00:00	30.34	26.84	29.68	1.62	0.00	6.83	3.39	0.16	1.12	0.02	0.00	100.00	3.50	42.95	27.20	2.78	0.00	10.95	8.55	0.53	3.46	0.07	0.02	100.00	26,958	0.81	21.75	875.17
13-Jul-23 00:00:00	29.48	24.50	29.78	1.51	0.00	6.63	5.91	0.26	1.89	0.04	0.00	100.00	3.24	37.38	26.02	2.47	0.00	10.13	14.19	0.82	5.58	0.15	0.02	100.00	26,741	0.85	22.66	941.18
13-Jul-23 01:00:00	32.40	26.61	32.15	1.57	0.00	7.07	0.09	0.03	0.09	0.00	0.00	100.00	4.14	47.10	32.59	2.98	0.00	12.53	0.24	0.10	0.32	0.00	0.01	100.00	25,541	0.71	18.22	819.57
13-Jul-23 02:00:00	32.46	26.61	31.31	1.54	0.00	7.24	0.05	0.02	0.77	0.00	0.00	100.00	4.08	46.37	31.23	2.88	0.00	12.62	0.13	0.08	2.60	0.00	0.01	100.00	25,728	0.73	18.76	833.15
13-Jul-23 03:00:00	32.15	26.84	31.70	1.60	0.00	7.18	0.05	0.02	0.46	0.00	0.00	100.00	4.05	46.90	31.72	3.01	0.00	12.56	0.13	0.07	1.56	0.00	0.01	100.00	25,540	0.73	18.57	824.25
13-Jul-23 04:00:00	32.15	26.96	31.90	1.66	0.00	7.22	0.05	0.02	0.05	0.00	0.00	100.00	4.08	47.49	32.19	3.14	0.00	12.73	0.13	0.07	0.16	0.00	0.01	100.00	25,359	0.72	18.31	815.46
13-Jul-23 05:00:00	32.13	26.98	32.05	1.66	0.00	7.11	0.05	0.02	0.00	0.00	0.00	100.00	4.09	47.60	32.38	3.15	0.00	12.57	0.13	0.07	0.00	0.00	0.01	100.00	25,172	0.72	18.18	813.80
13-Jul-23 06:00:00	32.27	26.88	32.00	1.50	0.00	7.27	0.05	0.02	0.00	0.00	0.00	100.00	4.12	47.54	32.41	2.85	0.00	12.88	0.13	0.07	0.00	0.00	0.01	100.00	25,138	0.72	18.08	814.86
13-Jul-23 07:00:00	32.13	26.93	31.83	1.48	0.00	7.56	0.05	0.02	0.00	0.00	0.00	100.00	4.08	47.45	32.12	2.80	0.00	13.34	0.13	0.07	0.00	0.00	0.01	100.00	25,266	0.72	18.17	815.52
13-Jul-23 08:00:00	32.61	26.79	31.43	1.46	0.00	7.64	0.04	0.02	0.00	0.00	0.00	100.00	4.16	47.44	31.87	2.78	0.00	13.54	0.12	0.07	0.00	0.00	0.01	100.00	25,234	0.71	17.86	818.59
13-Jul-23 09:00:00	32.69	26.80	31.23	1.45	0.00	7.76	0.04	0.02	0.00	0.00	0.00	100.00	4.17	47.44	31.66	2.76	0.00	13.76	0.12	0.08	0.00	0.00	0.01	100.00	25,291	0.70	17.71	819.43
13-Jul-23 10:00:00	31.03	26.12	30.02	1.47	0.00	7.70	0.12	3.54	0.00	0.00	0.00	100.00	3.59	41.88	27.55	2.52	0.00	12.36	0.31	11.79	0.00	0.00	0.01	100.00	25,688	0.78	19.93	889.85
13-Jul-23 11:00:00	31.89	26.41	30.97	1.50	0.00	7.86	0.06	1.30	0.00	0.00	0.00	100.00	3.92	44.97	30.19	2.75	0.00	13.40	0.17	4.60	0.00	0.00	0.01	100.00	25,261	0.71	17.90	846.57
13-Jul-23 12:00:00	33.89	29.87	26.72	1.23	0.00	8.14	0.04	0.10	0.01	0.00	0.00	100.00	4.26	52.06	26.66	2.30	0.00	14.20	0.11	0.36	0.04	0.00	0.01	100.00	23,988	0.67	16.10	797.92
13-Jul-23 13:00:00	42.06	20.20	26.04	0.98	0.00	10.10	0.04	0.02	0.56	0.00	0.02	100.00	6.00	39.99	29.51	2.07	0.00	20.01	0.12	0.09	2.12	0.00	0.09	100.00	18,842	0.56	10.55	929.61

Constants

Property	Hydrogen (H2)	Nitrogen (N2)	Methane (CH4)	Ethane (C2H6)	Acetylene (C2H2)	Ethylene (C2H4)	C3	C4	C4 Olefins	C5	C6+
NHV (Btu/scf)	1,212	0	896	1,404	1,477	1,595	2,281	2,968	2,826	3,655	3,655
MW (lb/lb-mol)	2.02	28.01	16.04	30.07	26.04	28.05	44.1	58.12	54.09	72.15	78.11

Shell Polymers Monaca
Method 22 Visible Emissions Observation Form SPM-HSE-FO-0003

Observer Name:	[redacted]	
Observer Title:	Field Operator	
Date and Time (MM/DD/YY XX:XX):	7/10/23 13:00	
Sky Conditions:	Partly Cloudy	
Precipitation:	None	
Wind Direction (direction from):	SW	218
Wind Speed (m/s):	1.3	
	Site MET Data (Wind Direction 500QT-060A and Speed 500QT-050A)	
Visible Emissions Source:	High Pressure Elevated Flare (A-59002)	
Observation Location:	N (HPEF)	
Observation Picture:		

Observations

		Clock Time	Observation Period (when you are actually looking at stack)	Emissions Observed (when you actually see smoke)
Begin	7/10/2023 11:00	11:00		0:00:00
				0:00:00
				0:00:00
				0:00:00
			Every 5 Minutes	0:00:00
				0:00:00
				0:00:00
				0:00:00
				0:00:00
End	13:00	13:00		0:00:00
Compliant? (Y/N)		YES	**Y**	

General Notes

No Emission Observed between 7/10/2023 11:00 and 13:00. Per camera footage, the HP Elevated flare smoking ended at 9:12:50.