



Shell Chemical Appalachia LLC  
300 Frankfort Rd  
Monaca, PA 15061

November 13, 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) 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 excess emissions from the HP Ground Flares #1 and #2 and the HP Elevated Flare stemming from an Ethane Cracking Unit<sup>1</sup> malfunction on October 08, 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 October 08, 2023, at approximately 02:31, the Ethane Cracking Unit (ECU) Ethylene Refrigerant Compressor (ERC) tripped, resulting in flaring to the High Pressure (HP) Flare system<sup>2</sup> including the HP Elevated Flare. In addition to excess emissions through the morning of October 12, 2023, the ERC trip also indirectly resulted in visible and excess emissions from the LP Multipoint Ground Flare on October 11, 2023 during the process of ECU start up, which is the subject of malfunction report RE: *PA-04-00740C LP Multipoint Ground Flare (C204B) Visible and Excess Emissions*.

The ERC was inspected after the trip and support personnel performed troubleshooting efforts and their data analysis identified issues with the turbine extraction valve actuator. A stroke test was performed and there were no issues found with the functionality of the valve actuator, so the compressor was turned over to operations for restart activities. During the process of bringing the compressor to slow roll mode, there were performance issues with the shuttle valve and the control oil system was not at the correct operating pressure and that kept the compressor system from restarting until the oil system problem was resolved and the compressor was back online on October 12, 2023.

<sup>1</sup> Identified as Ethylene Manufacturing Line (Source ID 201) PA-04-00740C

<sup>2</sup> Identified as High Pressure (HP) Header System (Source ID 205) PA-04-00740C

- **Time when the malfunction or breakdown was first observed**

The incident first occurred with an event logging at the control room related to ERC overspeed trip and flaring started at approximately 02:31 on October 08, 2023.

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

The ERC unit trip event resulted in flaring of ethylene gas at the two HP ground flares began at approximately 02:31 on October 08, 2023, through the daylight hours and reduced for the next two days while maintenance team conducted extraction valve functional test and executed repairs on the oil system shuttle valve deviation. The ECU unit initiated re start activities on the night of October 11, 2023, and flaring reduced to normal levels at approximately 01:24 on October 12, 2023. The HP elevated flare valve opened initially during the trip for approximately 3 minutes and no visible emissions were observed during the event from the HP flares, and there was under a total of 5 minutes of flaring total from the elevated flare.

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

<b>Pollutant</b>	<b>Emissions (tons)</b>
CO <sub>2</sub> e	21,142.841
CO	42.309
NO <sub>x</sub>	11.541
PM (filt)	0.316
PM 10	1.265
PM 2.5	1.265
VOC	36.159
HAP (total)	1.246
1, 3 Butadiene	1.054
Benzene	0.161

- **The calculations that were used to determine that quantity**

Estimated emissions from the flaring event were based on measured flow rates, measured and estimated vent gas compositions, application of accepted hydrocarbon destruction efficiencies, and the use of emission factors for products of combustion. See attached gas composition and flow data used for these calculations.

- **The steps, if any, that the facility took to limit the duration and/or quantity of emissions associated with the malfunction**

ECU Operations performed a diagnosis on the extraction valve, lube and shuttle valve and the control oil systems. After a detailed review it was concluded that the overall system conditions were not sufficient for reliable and proper operation of the ECU unit and because those system repairs were projected to delay the restart activities then ECU Ops removed ethane feed the furnaces to minimize flaring.

For the remaining ERC restart delays, lube and shuttle valve and the control oil systems, the shuttle valve was removed and during additional inspection varnish was found inside of the shuttle valve, which reduced clearance in the valve assembly and did not allow for proper operation and pressures. The valve was cleaned, and the system put back together and turned over to operations for startup.

- **A detailed analysis that sets forth the Root Cause of the malfunction, to the extent determinable**

For the initial cause of the ERC trip, the turbine extraction valve actuator failure, after the extraction valve stroke test and functional tests passed the investigation focused on the logic actuator and it is believed that ECU is experiencing a compressor trip without the Trip signal/status (the root cause of this deviation is still under investigation).

- **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 action will help prevent future similar incidents.

- Ongoing - Continue investigation into understanding the extraction valve trip. Bring vendor onsite to perform functionality testing on the extraction valves to understand the extraction valve trip cause.

- Ongoing - To address the shuttle valve malfunction, oil sampling and testing will be conducted to assess the condition of the lube/control oil. A plan for varnish mitigation will be developed to address current varnish levels as well as prevent further varnish from reaching troublesome levels. The testing will evaluate the oils remaining useable life and resistance to oxidation.

- **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 following completion of vendor investigation into the extraction valve trip cause and completion of the varnish mitigation plan including oil sampling and analysis. This is anticipated by January 1, 2024.

- **Corrective action is final or timeline for implementation**

N/A.

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

Sincerely,

Kimberly Kaal  
Environmental Manager, Attorney-in-Fact

CC:  
Scott Beaudway, Air Quality Specialist  
Kristin Goddard, Air Quality District Supervisor  
Beth Speicher, Environmental Group Manager

**Attachment A**  
HP Flare GC and Flow Data

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

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
08-Oct-23 02:00:00	40.06	8.91	43.02	4.12	0.00	3.69	0.10	0.02	0.00	0.06	0.02	100.00	6.43	19.81	54.80	9.84	0.00	8.21	0.35	0.07	0.01	0.33	0.14	100.00	41,075	0.63	26.06	1,001.25
08-Oct-23 03:00:00	33.37	2.19	10.16	17.48	0.29	35.15	0.50	0.03	0.13	0.64	0.06	100.00	3.56	3.25	8.61	27.77	0.40	52.10	1.16	0.09	0.37	2.45	0.24	100.00	195,616	1.07	208.45	1,343.22
08-Oct-23 04:00:00	34.76	2.07	9.16	19.81	0.27	32.40	0.51	0.06	0.41	0.50	0.05	100.00	3.75	3.09	7.84	31.77	0.38	48.47	1.20	0.19	1.19	1.91	0.23	100.00	172,505	0.97	167.11	1,351.26
08-Oct-23 05:00:00	32.49	2.94	9.60	19.19	0.33	33.99	0.66	0.06	0.44	0.26	0.03	100.00	3.42	4.29	8.03	30.08	0.45	49.69	1.51	0.18	1.24	0.98	0.13	100.00	159,439	0.99	158.34	1,336.54
08-Oct-23 06:00:00	32.44	4.18	9.03	21.85	0.27	30.97	0.58	0.07	0.43	0.18	0.03	100.00	3.40	6.07	7.51	34.08	0.36	45.07	1.32	0.20	1.21	0.66	0.12	100.00	146,963	1.00	146.57	1,322.99
08-Oct-23 07:00:00	32.13	4.72	9.38	20.54	0.26	31.91	0.53	0.05	0.36	0.09	0.02	100.00	3.38	6.88	7.83	32.15	0.36	46.59	1.21	0.16	1.02	0.34	0.09	100.00	141,365	0.99	140.56	1,308.10
08-Oct-23 08:00:00	32.55	5.06	9.51	21.03	0.25	30.61	0.56	0.05	0.32	0.03	0.02	100.00	3.45	7.43	8.00	33.17	0.35	45.04	1.31	0.14	0.91	0.13	0.07	100.00	141,531	0.99	140.34	1,299.98
08-Oct-23 09:00:00	31.96	5.06	9.33	21.79	0.25	30.70	0.53	0.04	0.32	0.00	0.01	100.00	3.36	7.37	7.78	34.07	0.35	44.78	1.21	0.13	0.90	0.00	0.05	100.00	143,247	1.00	143.75	1,302.25
08-Oct-23 10:00:00	31.19	5.28	9.25	21.77	0.24	31.09	0.72	0.06	0.41	0.00	0.01	100.00	3.23	7.58	7.61	33.57	0.32	44.73	1.63	0.17	1.12	0.00	0.04	100.00	142,603	1.01	143.66	1,304.67
08-Oct-23 11:00:00	32.29	4.32	9.31	22.67	0.24	30.31	0.55	0.04	0.26	0.00	0.01	100.00	3.41	6.32	7.80	35.60	0.32	44.40	1.26	0.12	0.75	0.00	0.02	100.00	140,166	0.98	137.24	1,312.56
08-Oct-23 12:00:00	31.61	4.71	8.91	23.54	0.23	30.29	0.29	0.06	0.35	0.00	0.01	100.00	3.29	6.81	7.38	36.53	0.31	43.84	0.65	0.17	0.97	0.00	0.05	100.00	152,601	0.99	151.10	1,311.76
08-Oct-23 13:00:00	30.45	4.26	7.71	26.97	0.10	29.88	0.24	0.05	0.33	0.00	0.01	100.00	3.09	6.00	6.21	40.78	0.13	42.14	0.54	0.15	0.91	0.00	0.04	100.00	161,966	1.01	163.22	1,332.54
08-Oct-23 14:00:00	32.26	3.95	7.19	25.09	0.00	31.35	0.10	0.01	0.06	0.00	0.00	100.00	3.37	5.72	5.96	39.02	0.00	45.49	0.23	0.03	0.16	0.00	0.01	100.00	168,536	0.99	166.31	1,326.90
08-Oct-23 15:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	207,691	0.92	191.69	1,313.30
08-Oct-23 16:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	237,103	0.94	223.92	1,315.32
08-Oct-23 17:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	190,957	0.90	171.29	1,315.33
08-Oct-23 18:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	162,299	0.95	154.29	1,315.33
08-Oct-23 19:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	164,786	0.97	160.64	1,315.32
08-Oct-23 20:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	166,144	0.97	160.76	1,315.31
08-Oct-23 21:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	168,704	0.98	165.44	1,315.34
08-Oct-23 22:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	155,876	0.98	153.05	1,315.40
08-Oct-23 23:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	156,324	0.97	152.37	1,315.40
09-Oct-23 00:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	143,669	0.98	140.38	1,315.40
09-Oct-23 01:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	127,045	0.95	120.07	1,315.43
09-Oct-23 02:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	97,687	0.94	92.06	1,315.42
09-Oct-23 03:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	68,576	0.93	64.11	1,315.40
09-Oct-23 04:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	41,746	0.93	39.00	1,315.40
09-Oct-23 05:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	19,757	0.89	17.53	1,315.38
09-Oct-23 06:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	18,425	0.89	16.32	1,315.38
09-Oct-23 07:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	18,328	0.89	16.32	1,315.36
09-Oct-23 08:00:00	24.25	6.29	23.52	19.06	0.10	26.31	0.36	0.02	0.10	0.00	0.01	100.00	2.53	9.09	19.46	29.56	0.14	38.06	0.82	0.05	0.27	0.00	0.02	100.00	17,260	0.88	15.25	1,113.08
09-Oct-23 09:00:00	16.24	8.63	39.85	13.03	0.20	21.26	0.62	0.02	0.14	0.00	0.01	100.00	1.69	12.43	32.89	20.15	0.27	30.68	1.40	0.07	0.39	0.00	0.04	100.00	15,757	0.88	13.79	1,101.55
09-Oct-23 10:00:00	9.66	39.37	29.27	8.25	0.12	12.83	0.35	0.02	0.11	0.00	0.01	100.00	0.88	49.54	21.09	11.15	0.15	16.17	0.69	0.04	0.27	0.00	0.02	100.00	17,308	1.00	17.33	719.19
09-Oct-23 11:00:00	13.12	8.19	48.04	11.64	0.17	17.68	0.73	0.04	0.36	0.00	0.01	100.00	1.37	11.88	39.88	18.11	0.23	25.65	1.67	0.13	1.01	0.01	0.06	100.00	17,054	0.85	14.52	1,070.53
09-Oct-23 12:00:00	11.40	7.41	51.15	11.15	0.16	17.46	0.77	0.06	0.43	0.00	0.01	100.00	1.19	10.69	42.25	17.27	0.21	25.21	1.76	0.18	1.20	0.00	0.05	100.00	18,262	0.85	15.57	1,069.34
09-Oct-23 13:00:00	9.81	8.00	53.87	10.59	0.14	16.04	0.93	0.08	0.52	0.00	0.01	100.00	1.01	11.46	44.20	16.28	0.19	23.01	2.10	0.24	1.45	0.01	0.05	100.00	17,906	0.85	15.26	1,051.72
09-Oct-23 14:00:00	8.48	8.24	56.38	10.27	0.13	14.80	1.06	0.08	0.53	0.02	0.02	100.00	0.87	11.76	46.09	15.73	0.17	21.15	2.37	0.25	1.46	0.07	0.06	100.00	17,482	0.86	14.96	1,038.33
09-Oct-23 15:00:00	7.40	8.33	58.57	10.20	0.11	13.63	1.13	0.08	0.48	0.03	0.02	100.00	0.76	11.88	47.82	15.62	0.15	19.45	2.53	0.23	1.33	0.12	0.09	100.00	17,543	0.86	15.13	1,027.06
09-Oct-23 16:00:00	6.27	8.24	59.11	11.80	0.10	12.75	1.18	0.07	0.44	0.01	0.02	100.00	0.64	11.61	47.67	17.84	0.13	17.99	2.62	0.21	1.20	0.02	0.07	100.00	18,645	0.88	16.50	1,029.58
09-Oct-23 17:00:00	4.89	7.29	53.83	22.00	0.08	10.36	1.13	0.06	0.34	0.00	0.01	100.00	0.47	9.71	41.02	31.43	0.10	13.81	2.37	0.16	0.87	0.00	0.05	100.00	19,491	0.95	18.56	1,087.02
09-Oct-23 18:00:00	4.04	9.80	52.89	20.91	0.07	10.29	1.39	0.08	0.52	0.00	0.02	100.00	0.38	12.79														