Shell Chemical Appalachia LLC
300 Frankfort Rd
Monaca, PA 15061

June 22, 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 Source ID 205 High Pressure (HP) Header System Visible 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 visible emissions (VE) in excess of five minutes from flaring Polyethylene Unit 2 process gas as part of startup flaring activities.

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 May 24, 2023, beginning at approximately 13:00 and intermittently or at times continuously through May 24, 2023 at 21:36, Totally Enclosed Ground Flare A (TEGF A)[1] experienced smoking and VE to the atmosphere. Smoking was intermittent to continuous during periods of time at generally low levels of opacity. Smoke was greyish in coloration with a low level of loft and generally did not trail outside of the site boundary during the incident. Cause of the incident was determined to be too low combustion temperature to promote the required air and fuel mix to result in smokeless combustion.

- **Time when the malfunction or breakdown was first observed**
  May 24, 2023 at 14:00

- **The date and time that the malfunction started and ended**
  May 24, 2023 at ~13:00 and ending on May 24, 2023 at ~20:36

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

  Summary of VE elapsed time from TEGF A and TEGF B:

[1] TEGF A is the site name for Source ID C205A HP Ground Flare #1 in PA-04-00740C

- 4 hours 53 minutes and 20 seconds of VE observed from TEFG A between 13:00 and 20:37
- <30 seconds of VE observed from TEGF B at ~14:11

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

  The duration of VE was determined by combination of real time Method 22 readings and subsequent review of continuous video camera footage as supplemental information.

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

  Field observations and troubleshooting were conducted by Shell and the flare manufacturer personnel during the incident to observe flare flame and burner performance concurrently with VE observations and flare operating parameters. Flare flows were temporarily redirected to only TEGF B, but were routed back to TEGF A after observing VE from TEGF B under the same operating conditions. VE ended as flare vent gas flow increased, vent gas composition changed, and TEGF stages changed through the startup flaring activity. Startup steps were temporarily paused the following day while troubleshooting and corrective measures were developed in consultation with the flare manufacturer.

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

  Low flare vent gas flow rates (~11-14 tonnes/hr) coupled with high ethylene concentrations (~27%+ mol%) and the TEGF A staging configuration during peak VE periods resulted in flare combustion temperatures which were not high enough to promote the required air and fuel mix that would result in smokeless combustion.

  A previously identified long term potentially contributing cause to this malfunction includes TEGF mis-installed floors relative to burners.

- **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**

  Operator instructions have been created, distributed, and trained upon to mitigate and eliminate VE from future similar occurrences. These include instructions for manual switching of active TEGF stages and the introduction of supplemental gas in small increments to change overall vent gas composition, combustion temperatures and promote increased air/fuel mixing in the TEGFs. These also include subsequent monitoring of the overall vent gas composition to identify when to return to normal automatic staging of the TEGFs.

  A third party contractor was brought in to conduct more frequent Method 22 readings and provide feedback to Operations for flare VE mitigation during resumption of the startup steps.

  In addition to the Operational changes described above and to prevent re-occurrence of an identical incident in the future, Shell is planning long term TEGF repairs including:

  1) Replacing and adjusting floor heights relative to the burner tips
  2) Replacing flare burner tips in-kind as needed to address coking
  3) Upgrading refractory on the bottom third of the TEGFs
  4) Additional improvements as determined based on results of computational dynamic modeling.

- **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**

  No follow up report is anticipated

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

  Corrective actions are completed other than long term TEGF repairs which are subject to timelines determined by the May 24, 2023, Consent Order and Agreement

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

Sincerely,

Kimberly J. Kaal

Kimberly Kaal
Environmental Manager, Attorney-in-Fact

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

Attachment A
GC, Flow, and NHV Data

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

Date and Time	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	Flow Rate m3/hr	Flow Temp C	Flow Pres Barg	Flow Density kg/m3	Flow Rate ton/hr	NHVcz Btu/scf
24-May-23 12:00:00	0.01	23.27	24.34	1.84	0.01	50.05	0.25	0.04	0.20	0.00	0.01	100.00	9,232.08	0.07	40.80	1.02	10.36	969.10
24-May-23 13:00:00	0.01	19.52	20.86	1.59	0.01	57.52	0.31	0.03	0.15	0.00	0.00	100.00	11,221.02	0.13	45.36	1.08	13.34	1,036.68
24-May-23 14:00:00	0.01	22.85	16.18	1.24	0.01	59.23	0.31	0.05	0.14	0.00	0.00	100.00	11,413.69	0.13	45.75	1.12	14.08	1,015.16
24-May-23 15:00:00	0.01	42.63	23.86	1.77	0.01	31.20	0.26	0.04	0.20	0.00	0.00	100.00	9,364.37	0.07	45.15	0.99	10.26	730.17
24-May-23 16:00:00	0.01	23.51	51.44	3.87	0.01	20.25	0.50	0.09	0.31	0.00	0.00	100.00	11,974.85	0.10	45.88	0.86	11.37	854.03
24-May-23 17:00:00	0.01	24.87	34.46	2.60	0.01	37.25	0.50	0.11	0.19	0.00	0.00	100.00	12,544.81	0.13	43.62	0.98	13.59	905.22
24-May-23 18:00:00	0.01	35.01	27.68	2.04	0.01	34.44	0.56	0.11	0.15	0.00	0.00	100.00	13,206.26	0.14	39.92	1.05	15.31	812.26
24-May-23 19:00:00	0.01	34.67	27.74	2.01	0.00	34.48	0.76	0.11	0.23	0.00	0.00	100.00	13,481.26	0.14	33.17	1.07	15.95	815.94
24-May-23 20:00:00	0.00	37.14	25.36	1.87	0.00	34.44	0.84	0.07	0.26	0.02	0.01	100.00	13,962.84	0.16	26.61	1.13	17.46	795.35
24-May-23 21:00:00	0.01	47.57	24.51	1.78	0.00	25.30	0.60	0.05	0.17	0.00	0.01	100.00	21,242.64	0.14	21.77	1.13	26.45	670.21
24-May-23 22:00:00	0.00	33.30	40.10	2.89	0.00	23.02	0.48	0.05	0.12	0.00	0.02	100.00	22,089.11	0.09	18.36	1.00	24.30	786.14

Shell Polymers HP Flare System GC Hourly Average Mol % Compositions

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
24-May-23 12:00:00	0.09	20.27	37.03	1.73	0.01	40.62	0.14	0.02	0.09	0.00	0.00	100.00
24-May-23 13:00:00	0.08	17.49	32.63	1.53	0.01	48.00	0.17	0.01	0.07	0.00	0.00	100.00
24-May-23 14:00:00	0.08	21.16	26.16	1.23	0.01	51.09	0.18	0.02	0.07	0.00	0.00	100.00
24-May-23 15:00:00	0.14	36.83	36.01	1.65	0.01	25.11	0.14	0.02	0.09	0.00	0.00	100.00
24-May-23 16:00:00	0.12	17.15	65.54	3.04	0.01	13.76	0.23	0.03	0.12	0.00	0.00	100.00
24-May-23 17:00:00	0.09	20.19	48.88	2.27	0.01	28.18	0.26	0.04	0.08	0.00	0.00	100.00
24-May-23 18:00:00	0.07	29.62	40.89	1.86	0.00	27.14	0.30	0.05	0.07	0.00	0.00	100.00
24-May-23 19:00:00	0.06	29.36	41.01	1.83	0.00	27.19	0.41	0.04	0.10	0.00	0.00	100.00
24-May-23 20:00:00	0.05	31.94	38.08	1.73	0.00	27.59	0.46	0.03	0.11	0.01	0.00	100.00
24-May-23 21:00:00	0.07	40.86	36.76	1.64	0.00	20.24	0.33	0.02	0.08	0.00	0.00	100.00
24-May-23 22:00:00	0.05	25.95	54.56	2.43	0.00	16.71	0.24	0.02	0.05	0.00	0.00	100.00

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	26.04	28.05	30.07	44.10	58.12	54.09	72.15	78.11