



Shell Chemical Appalachia LLC
300 Frankfort Rd
Monaca, PA 15061

April 25, 2023

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

RE: PA-04-00740C Source ID 205 High Pressure 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 excess emissions from flaring Ethane Cracking Unit (ECU) process gas to stabilize unit operations.

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 (SPM)
300 Frankfort Road, Monaca PA, 15061
- **Nature and cause of the incident**

At approximately 14:00 on 3/25/23, a caustic circulation pipe in the ECU developed a pinhole leak. As there are no valves to isolate the section of pipe containing the leak, to repair the leak, SPM commenced an unplanned, controlled shutdown of ECU. Shutdown of ECU required off-gases to be routed to the High Pressure (HP) Flare system. During the process of shutting down, visible emissions exceeding 5 minutes in a 2 hour period were observed from both HP Ground Flares (A&B).

- **Time when the malfunction or breakdown was first observed**
March 25, 2023 at 14:00
- **The date and time that the malfunction started and ended**
March 25, 2023 at 14:00 and ending on March 26, 2023 at 02:00
- **An estimate of the emissions associated with the malfunction**

Pollutant	Emission Rate (tons)
NOx	0.369
CO	1.505
PM (filt)	0.010
PM10	0.040
PM2.5	0.040
CO2e	729.265

VOC	0.693
HAP (Total)	0.063

Summary of Visible Emissions (VE) elapsed time in each HP Ground Flare as determined by review of camera footage:

- 27 minutes and 15 seconds of VE observed from TEGF A between 15:39 and 18:43
- 40 minutes and 10 seconds of VE observed from TEGF B between 15:33 and 18:44

- **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 engineering material balance, and application of expected or tested hydrocarbon destruction efficiencies, and the application of emission factors for products of combustion. See attached representative gas chromatograph (GC) analysis used for the these calculations.

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

Furnace feed was immediately reduced by closing ethane feed to the 7 ECU furnaces.

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

SPM conducted an investigation and the following factors were determined to contribute to the malfunction incident:

- Caustic pipe leak: corrosion rates in existing CS (Carbon Steel) piping within the caustic scrubber unit caused the leak because the pipe material was incompatible with the polymer inhibitor that is injected into the caustic stream. This lead to ECU shutdown due to the lack of isolation valves to stop the leak.
- TEGF Floor: Shell has performed a root cause analysis, and it revealed that the TEGF floors, as built, deviate 2-4 inches in places compared to specification and is the primary root cause of the VE. This floor to tip deviation impacts the fuel air mixing and has contributed to VE, and resulted in tip fouling and failure.
- Stages 1, 2, 3, and 4 Temporarily Removed from Service: Stages 1 through 4 on HP Ground Flare A and 1 through 3 on HP Ground Flare B have been temporarily removed from service due to tip fouling and failure noted from the primary root cause above. This action was taken under consultation with the flare manufacturer's confirmation that removing Stages 1-3 does not affect manufacturer's rated destruction and removal efficiency, and Stage 4 is base loaded at a reasonable minimum rate to ensure adequate draft air and flame stability. This is a secondary root cause of VE as it limited the ability to establish a proper draft when opening a new stage in the flare.
- Excessive Wind Speeds: During the flaring event, specifically at the time when VE were observed, wind speed gust were recorded in the area of up to 46 mph. Per reference, the design case for the TEGF performance guarantees is wind speed of 20.5 mph. This is a secondary root cause of VE and specifically during this event.

- **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 operational changes have been utilized to minimize visible emissions and repair caustic leak:

To prevent re-occurrence of an identical incident in the future, Shell will implement the following:

- 1) Leak repair in ECU caustic scrubber system – maintenance team scoped an execution work package to replace a section of line, that can be isolated, with a more compatible metallurgy (304SS) and add an injection quill such that the inhibitor does not come in direct contact CS piping.
 - 2) Short term corrective actions for HP Ground Flare B:
 - Repair Hotspot
 - Replace Refractory
 - Perform Laser Scans of interior (data collection)
 - Replace 5 of 5 tips on HP Ground Flare B, Stage B2
 - 3) Further corrective actions as detailed below:
 - Replacement of additional burner tips in TEGF A and B which may be degraded
 - Repair of refractory floor in in HP Ground Flare A and B
- **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 is anticipated to be submitted by June 30 2023, following an outage to perform repairs to HP Ground Flare B and the HP Flare System.
- **Corrective action is final or timeline for implementation**
 - Corrective action #1 and 2 - expected to be completed by 05/31/2023
 - Corrective action #3 – will be performed during future opportunity outages or scheduled outages, which are to be determined

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 Analysis

GC Analysis During Malfunction												
Date/Starttime	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
25-Mar-23 14:00:00	40.408	12.047	17.718	8.715	0.000	18.698	1.792	0.090	0.493	0.031	0.009	100.000
25-Mar-23 15:00:00	38.534	13.925	12.056	7.079	0.071	22.939	1.368	0.121	2.011	1.889	0.007	100.000
25-Mar-23 16:00:00	21.074	16.466	7.124	17.104	0.247	30.201	1.982	0.097	2.718	2.969	0.019	100.000
25-Mar-23 17:00:00	11.745	22.442	9.980	33.352	0.295	15.639	0.788	0.107	2.539	3.049	0.064	100.000
25-Mar-23 18:00:00	11.989	23.495	11.139	12.081	0.259	35.729	0.638	0.116	2.092	2.364	0.098	100.000
25-Mar-23 19:00:00	20.325	29.225	14.604	8.532	0.341	22.167	0.489	0.125	1.920	2.176	0.095	100.000
25-Mar-23 20:00:00	15.037	32.796	29.613	5.774	0.238	13.232	0.290	0.134	1.244	1.551	0.091	100.000
25-Mar-23 21:00:00	17.847	29.344	27.313	6.288	0.301	16.050	0.376	0.292	1.017	1.087	0.086	100.000
25-Mar-23 22:00:00	13.071	34.291	31.819	5.526	0.234	12.609	0.472	0.123	0.852	0.922	0.082	100.000
25-Mar-23 23:00:00	4.411	35.059	52.035	3.099	0.048	3.784	0.284	0.100	0.414	0.688	0.077	100.000
26-Mar-23 00:00:00	3.524	30.487	41.450	2.563	0.048	19.964	0.210	0.104	0.200	1.377	0.073	100.000
26-Mar-23 01:00:00	1.435	34.635	45.220	2.878	0.012	14.065	0.294	0.108	0.129	1.155	0.068	100.000