Shell Chemical Appalachia LLC
300 Frankfort Rd
Monaca, PA 15061

May 23, 2025

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 HP Ground Flares #1 and #2 (Source IDs C205A and B) Visible Emissions Malfunction Report

Dear Mr. Gorog,

Shell Chemical Appalachia LLC ("Shell"), located in Beaver County, PA is submitting this Malfunction Report to the Pennsylvania Department of Environmental Protection (PADEP) for visible emissions from HP Ground Flares #1 (Source ID C205A) and #2 (Source ID C205B) on April 25, 2025.

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

For clarity, please see Attachment A for a table summary of TEGF visible emissions malfunctions that have occurred year to date.

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

- **Nature and cause of the incident**
  On April 25, 2025, during planned Ethane Cracking Unit (ECU) startup activities that required venting to the HP flare system, visible emissions (VE) were observed at HP Ground Flares #1 and #2 (Totally Enclosed Ground Flares A and B/TEGF A and B) starting at 9:42. The VE were intermittent and exceeded 5 minutes over multiple consecutive 2-hour periods.

- **Time when the malfunction or breakdown was first observed**
  TEGF A VE: 4/25/25 9:42
  TEGF B VE: 4/25/25 10:00

- **The date and time that the malfunction started and ended**
  TEGF A VE: 4/25/25 9:42-15:52
  TEGF B VE: 4/25/25 10:00-15:49

- **An estimate of the emissions associated with the malfunction**
  No excess emissions. Malfunction is visible emissions only.

- **The calculations that were used to determine that quantity**
  Summary of VE elapsed time from TEGF A/B as determined by review of flare camera footage and the Method 22 observations is captured below. The Method 22 observation forms are included as Attachment B.

  - TEGF A: 2 hours 9 minutes and 26 seconds of intermittent VE observed between 9:42:27 and 15:52:00
  - TEGF B: 34 minutes and 55 seconds of intermittent VE observed between 10:00:25 and 15:49:33

- **The steps, if any, that the facility took to limit the duration and/or quantity of emissions associated with the malfunction**
  Once the VE were observed, immediate troubleshooting by the technical and operations teams commenced. This included reviewing process data and performing a drone inspection of the TEGFs while VE were present.

  Once the cause was understood, interim mitigation plans were put into place which resulted in the termination of the VE, while a longer-term plan was developed.

- **A detailed analysis that sets forth the Root Cause of the malfunction, to the extent determinable**
  <u>4/25/25 ECU Startup</u>
  During ECU startup after planned maintenance, visible emissions were observed from the TEGFs. Process data was reviewed and confirmed to be within the design parameters for the online stages. For further investigation, a drone was deployed to provide visual evidence of the burners and staging in the TEGFs during the period of VE. The drone footage identified that some burners tips on stages 8 and 9 did not have flames anchored to the burners. Stage 10 eventually had all burner flames anchored (within a minute) but did have similar issues when the stage came online. When the flame does not anchor to the burner, vent gas combusts higher in the chamber, but VOC is still combusted as intended because the temperatures inside the flares were above vent gas auto-ignition during this event (as confirmed by temperature instruments). Combustion higher in the chamber can yield VE due to improper mixing. Once the issue with these stages was identified, the stages were manually closed such that they could not be used during the rest of the flaring duration. After implementation, visible emissions did not occur again during the ECU startup event.

  After further investigation by the site's flare subject matter experts, it was determined that the burner flame anchoring issue was likely due to lack of adequate combustion air to stages 8 and 9 for the vent gas to ignite on the impacted burners. This is influenced by the impacted burners' locations relative to the combustion chamber's ambient air intake as well as any other stages also in service consuming available air.
- **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**
  <u>4/25/25 Initial Observations of VE during ECU startup</u>
  The following mitigations were put into place within hours of the initiating VE event based on learnings from the drone inspection:

- Take stages out of service
  - Stages 8 and 9 were taken out of service.
  - Stage 10 was conservatively taken out of service based on its burner flame anchoring response (upon stage opening) with the understanding that all burners do have flames anchored within a minute.
  - Stages 1-7 were in service during the drone inspection and demonstrated no issues and remained in service.

4/26/25 ECU Startup Paused

ECU startup activities were temporarily paused to address hydrate accumulation in process equipment identified as the unit progressed through startup procedures. During this time, furnace rate was reduced to minimum to minimize flaring.

5/8/25 ECU Startup Resumed

Once the ECU startup resumed, to recover TEGF capacity and minimize the likelihood of using the HP elevated flare while still eliminating any burner tip flame anchoring concerns, the following mitigations were implemented:

- Take stages out of service
  - Stages 8 and 9 remained out of service.
- Increase staging pressure setpoint
  - The staging pressure was increased to ensure quick burner flame anchoring of stage 10, which was then put back into service.
- Console operator guidance
  - Updated operator instructions were created and distributed, which included additional directions on what to do if smoking was observed during the ECU startup activities.

Note that during the startup, a drone was deployed again to confirm the stages and burners were all operating as intended.

Post 5/8/25 ECU Startup

Once ECU was out of startup mode and operating normally, the TEGFs were returned to the normal configuration with stages 8 through 10 in service and staging pressure returned to the original setpoint. This was done to ensure the TEGF capacity is fully available in the event of an unplanned ECU trip or other emergency conditions that may cause substantial flaring. Note that stages 8-10 are not expected to be in service during steady-state plant operations when there are normal baseline flaring rates.

With the TEGFs back to the normal configuration, the following temporary mitigations were implemented to mitigate any burner flame anchoring issues:

- Stage alarms
  - Alarms were created to notify the console operators if stages 8-10 open to drive immediate awareness and, if needed, intervention.
- Console operator guidance
  - Updated operator instructions were created and distributed, which include directions on what to do if smoking is observed from stages 8-10.

To mitigate the burner flame anchoring issue, the following *permanent* corrective actions will be implemented:

- Stage sequencing change
  - The investigation identified that changing the TEGF stage sequence (order in which stages open) will mitigate the combustion air limitations of the stages with

anchoring issues. The stage sequence will be adjusted such that the stages will open from the center of the flares and then work evenly outwards to optimize available combustion air, which is pulled in from the outside perimeter of the flares.
  - This improvement is being progressed through the Management of Change (MOC) process and will be implemented by 5/31/25.

- **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**
  All temporary corrective actions are complete as detailed above. The permanent corrective action will be implemented by 5/31/25. See summary table below.

Event	**Root Cause**	**Corrective Action**	**Temporary or Permanent**	**Timing**
TEGF A/B VE during 4/25/25 ECU Startup (Malfunction)	Flames not anchored to all burner tips	Stages 8-10 taken out of service	Temporary	Complete
5/8/25 ECU Startup	NA	- Stages 8 and 9 remained out of service - Increased staging pressure setpoint - Console operator guidance	Temporary	Complete
Post 5/8/25 ECU Startup	NA	- Stage 8-10 alarms when stage(s) open - Console operator guidance	Temporary	Complete
Post 5/8/25 ECU Startup	NA	MOC to change staging sequence	Permanent	5/31/2025

If you have any questions regarding this matter, please don't hesitate to contact Kimberly Kaal at kimberly.kaal@shell.com or me at nathan.levin@shell.com.

Sincerely,
Nathan Levin
Operations Manager

CC:
Scott Beaudway, Air Quality Specialist

Attachment A- 2025 TEGF VE Malfunction Summary

Malfunction	Date	Root Cause	Impacted Stages	Corrective Actions	Date Malfunction Report Submitted to Dept.	Follow Up Report (Yes/No)	Date Follow Up Report sent to Dept.
TEGF A/B VE during ECU Maintanence Activities	3/13/2025	Low vent gas flow paired with high ethylene concentrations yielded stage burner velocities that were not high enough to induce the amount of air required for smokeless combustion	1	- Console operator guidance - Console alarm triggered on similar process conditions	4/10/2025	Yes	forthcoming (by 6/17/25)
TEGF A/B VE during ECU Startup (subject report)	4/25/2025	Flames not anchored to some burner tips due to lack of available combustion air	8, 9, 10	- Temporary mitigations referenced in subject report - MOC to change staging sequence	subject report	No	NA
TEGF A VE during PE3 Trip	5/12/2025	Low vent gas flow paired with high ethylene concentrations yielded stage burner velocities that were not high enough to induce the amount of air required for smokeless combustion	4	MOC to change staging sequence	forthcoming (by 6/11/25)	No	NA

Attachment B- Method 22 Forms

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):	4/25/25 9:58		
Sky Conditions:	Cloudy		
Precipitation:	Light Rain		
Wind Direction (direction from):		SN	155.35
Wind Speed (m/s):	0.8		
	Site MET Data (Wind Direction 500QT-060A and Speed 500QT-050A)		
Visible Emissions Source:	High Pressure Ground Flare A (A-59001A)		
Observation Location:	R (HPEF)		
Observation Picture:			

Observations

	Date (MM/DD/YY)	Clock Time (hh:mm)	Observation Period (accumulated time when you are looking at stack h:mm:ss, Example: 0:00:00-0:15:00 OR 0:15:00)	Emissions Observed (cumulative time you see smoke during observation period (mm:ss)
Begin	4/25/25	9:58	9:58:00	18:00:00
End	4/25/25	10:16	10:16:00	

Compliant? (Y/N): **N**

General Notes

Emission for the entire 18 min

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):	4/25/25 0:00		
Sky Conditions:	Cloudy		
Precipitation:	Light Rain		
Wind Direction (direction from):		SN	203.67
Wind Speed (m/s):	0.71		
	Site MET Data (Wind Direction 500QT-060A and Speed 500QT-050A)		
Visible Emissions Source:	HPGF A & B (A-59001A, A-59001B)		
Observation Location:	R (HPGF A/HPGF B)		
Observation Picture:			

Observations

	Date (MM/DD/YY)	Clock Time (hh:mm)	Observation Period (accumulated time when you are looking at stack h:mm:ss, Example: 0:00:00-0:15:00 OR 0:15:00)	Emissions Observed (cumulative time you see smoke during observation period (mm:ss)
Begin	4/25/25	11:57	11:57:00 AM- 12:08:00	11:00:00
End	4/25/25	12:08		

Compliant? (Y/N) **N**

General Notes

Emission for the entire 11 min

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):	4/25/25 15:52		
Sky Conditions:	Cloudy		
Precipitation:	None		
Wind Direction (direction from):		SN	122.64
Wind Speed (m/s):	0.5		
	Site MET Data (Wind Direction 500QT-060A and Speed 500QT-050A)		
Visible Emissions Source:	HPGF A & B (A-59001A, A-59001B)		
Observation Location:	R (HPGF A/HPGF B)		
Observation Picture:			

Observations

	Date (MM/DD/YY)	Clock Time (hh:mm)	Observation Period (accumulated time when you are looking at stack h:mm:ss, Example: 0:00:00-0:15:00 OR 0:15:00)	Emissions Observed (cumulative time you see smoke during observation period (mm:ss)
Begin	4/25/25	15:52	15:54:00 -15:54:05	5 SEC
			15:56:00	10 SEC
			15:58:00	30 SEC
			16:00:00	5 SEC
			16:02:00	5 SEC
			16:03:00	3 SEC
			16:04:00	3 SEC
			16:05:00	5 SEC
End	4/25/25	18:02		

Compliant? (Y/N) **Y**

General Notes