



Shell Chemical Appalachia LLC
300 Frankfort Rd
Monaca, PA 15061

February 06, 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 Ethylene Cracking Unit (Source ID 201) Demethanizer Flaring Event and High-Pressure (HP) Header System (Source ID 205) Excess Emission 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 process gas to stabilize unit operations to prevent an entire unit shutdown.

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

On January 20th, the Ethane Cracking Unit (ECU) was operating with 4 of its 7 cracking furnaces online. Early in the morning while in the process of bringing its fifth furnace online, production rates were increased from approximately 248 TPH to 280 TPH over a period of two hours. Unexpectedly, the temperature in the demethanizer tower decreased dramatically (-35°C to -41°C) and the reboiling ability of the demethanizer was lost. As a result, methane concentrations increased in the bottom of the demethanizer tower for a period of approximately 3.5 hours while operators worked to troubleshoot the system.

At 7:16 am that morning to recover the unit, operations removed feed from Furnace No.5 and decreased pressure in the demethanizer tower so that condensed methane at the bottom of the tower could vaporize to flow out of the top of the tower. Also, the Ethylene Collection Drum IV (V-14131) was vented to High Pressure Header System and Totally Enclosed Ground Flares in order to prevent the unit’s ethylene product from going off-spec, which would have exacerbated the upset conditions across all unit equipment.

After investigation of the incident, it was discovered that the operator's programed rate for bringing the fifth furnace online was too rapid (30+ TPH in 2 hours) causing a significant temperature swing in the demethanizer tower. The temperature drop caused methane and other non-condensable material to accumulate, exit the bottom of the tower, and migrate into the vapor space of the Ethylene Collection Drum IV (V-14131) causing the tower's reboiler to fail. To prevent re-occurrence of an identical incident in the future, Shell will do the following:

- Add a task to the field operator's rounds to vent the Ethylene Collection Drum IV (V-14131) to remove non-condensables from the vapor space of the drum. Initially the drum will be vented weekly for 1 hour with the frequency being adjusted as additional data is collected relative to the performance of V-14131. This will proactively prevent a buildup of non-condensable material in the drum vapor space, ensure ethylene can be condensed in the drum, and the reboiler system operates properly.
- Revise furnace procedures to ensure ECU Console Operators introduce feed slowly when starting up a furnace. The rate of feed will be based on communication between the Hot Side Console Operator (front-end of the unit) and the Cold-side Console and Field Operators (back-end of unit). This will allow for process swings during startup to gradually work through downstream equipment, giving operators on the back end of the unit time to adjust to unit to feed changes and prevent a unit upset. The following procedures will be revised: F10x01(x= 1-7) – Furnace Hot Steam Standby Quench Tower to Feed In.
- **Time when the incident was first observed, and duration of excess emissions**
Excess emission from routing process gas from the ECU to the HPGFs occurred from approximately 07:17 on January 20, 2023 and ended at 11:28 on January 20, 2023 when function of the demethanizer tower was stabilized. No visible emissions or smoke was observed from the HEGFs during this event. There was no use of the elevated flare.

Excess emissions were reduced by quickly addressing the process upset to prevent ECU's ethylene product from becoming out-of-spec which would have impacted additional equipment within the unit and resulted additional flaring.

- **Estimated excess emissions**

Based on the flow meter readings, the estimated excess emissions for this flaring event have been calculated using the gas composition, performance testing¹, and emission factors as:

CO₂e: 376.54 tons

CO: 0.84 tons

NO_x: 0.21 tons

SO₂: 0.00 tons

PM(filt): 0.01 tons

PM₁₀: 0.02

PM_{2.5}: 0.02

VOC: 0.34 tons

HAP: 0.00 tons

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

Sincerely,

Kimberly Kaal

Kimberly Kaal
Environmental Manager, Attorney-in-Fact

CC:
Anna Hensel, District Supervisor
Scott Beaudway, Air Quality Specialist

¹ In January 2023 Shell's flare vendor conducted a performance test of the HPGFs using Flare Guardian technology to establish the flare destruction efficiency, which was measured to be an average of 99.5% with a standard deviation of 0.34. Included in the test were three discoloration events during which a destruction efficiency of 99.5% was recorded. Detailed information associated with the performance testing was communicated to PADEP from Shell on January 23, 2023, via the Emission Exceedance Report and Mitigation Plan for Shell Chemical Appalachia LLC.