



Shell Chemical Appalachia LLC
300 Frankfort Rd
Monaca, PA 15061

March 6, 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) C Process Dilution Steam Generator 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.

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

At approximately 1:45AM on 2/3/2023, the C Dilution Steam Generator (E-13011C) was returned to service after completion of maintenance work. Shortly after coming online, the CO concentration of furnace cracked gas increased drastically, reaching up to 1,077ppm CO at the downstream Acetylene (AC) reactor around 2:00AM. The CO concentrations in the cracked gas (as evidenced by online analyzers) were sufficient to reduce the acetylene (AC) reactor catalyst activity, and subsequently caused the AC breakthrough. As a result, the AC reactor product went off -spec. Due to the production of off spec material, operations began routing off-spec material to the off-spec sphere, continued sending small amounts of liquid ethylene to the on-spec tank, and flared the remainder of off-spec material to begin the process of stabilizing unit operations. The AC reactor stopped making off-spec material at 3:30 AM and flaring ceased at 5:45AM when all unit equipment was stabilized. At approximately 7:00AM, the ECU ethylene product was fully back on-spec.

After investigation of the incident, evidence based on the process data indicates that the incident was likely caused by some amount of air (i.e., oxygen) remaining in either the Dilution Steam Generator (E-13011C) or the Process Steam Separator (V-13031) after “air freeing” the equipment and associated systems. Operations air-frees equipment prior to being returned to service by pressure purging the equipment with nitrogen. The air freeing process was conducted on the Dilution Steam Generator tube side by pressure purging up to 6 bar and down to 0 bar with nitrogen a total of 6 times. Pressure purging of the shell side was conducted 3 times. Purging of the shell side of system was proactively done in the case any tube would leak allowing air to enter the tube side from the shell side upon start up. Upon completing the purges of the Dilution Steam Generator, the tube side of the generator was lined-up to the Process Steam Separator and an additional 4 nitrogen purges were conducted on the combined system.

Although the exact cause of the incident could not be specifically identified, an assessment of process data up to and during the incident lead Shell to believe that some small amount of air remained in the Dilution Steam Generator and Process Steam Separator system at startup. And although Shell expected that no significant quantities of air could have remained in the system after its thorough air-freeing process, Shell did not conduct a test with an instrument to prove no residual air (i.e., oxygen) existed in the system prior to returning the equipment to service. To prevent re-occurrence of an identical incident in the future, Shell will do the following:

1. Update steam generator start up procedures ECU-130-0002/3/4/5-SU (Start up of Process Steam Generators E-13011A-D) to ensure testing for oxygen content is conducted prior to placing Dilution Steam Generators and any associated systems in service.
- **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 02:17 on February 3, 2023 and ended at 06:55 on February 3, 2023 when function of the ECU was stabilized and producing on-spec product. No visible emissions or smoke was observed from the HEGFs during this event. There was no use of the elevated flare.
 - **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: 537.53 tons

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.

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CO: 1.10 tons
NOx: 0.27 tons
SO2: 0.00 tons
PM(filt): 0.01tons
PM10: 0.03
PM2.5: 0.03
VOC: 0.55 tons
HAP: 0.00 tons

The incident referenced above did not pose an imminent and substantial danger to the public health and safety or the environment. There were no injuries, fatalities, or road closures associated with this incident. Off-site air quality monitoring was performed throughout the duration of the event and no detections of hazardous constituents were detected above the OSHA permissible exposure limits. 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:
Anna Hensel, District Supervisor
Scott Beaudway, Air Quality Specialist