Shell Chemical Appalachia LLC
300 Frankfort Rd
Monaca, PA 15061

December 5, 2024

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 Pyrolysis Fuel Oil Storage Tanks (Source ID 207) Offsite Malodor Malfunction Report

Dear Mr. Gorog,

Shell Chemical Appalachia LLC ("Shell") is submitting this malfunction report to the Pennsylvania Department of Environmental Protection (PADEP) for an offsite malodor traced back to the site on November 6, 2024.

This malfunction did not pose an imminent and substantial danger to 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 November 6, 2024, starting at approximately 4:00 AM, an offsite malodor was detected by the site's Emergency Response Team (ERT). The source of the malodor was determined to be the Pyrolysis Fuel Oil (PFO) tanks' vents. Note that there are two PFO tanks- tank A and tank B.

- **Time when the malfunction or breakdown was first observed**
  The offsite malodor was detected at approximately 4:00 AM on November 6, 2024.

- **The date and time that the malfunction started and ended**
  The offsite malodor was detected on November 6, 2024, at approximately 4:00 AM and ended at approximately 4:05 AM on the same day. The maintenance work that the odor was traced back to started at 2:49 AM on November 6, 2024, and ended at 4:05 AM on the same day.

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

Pollutant	PFO Tank A/B Emissions (lbs)
Total VOC	1.16
Total HAP	0.25
1,3-Butadiene	0.01
Benzene	0.12
Toluene	0.07

- **The calculations that were used to determine that quantity**
  The PFO storage tank emissions were modeled using ProMax modeling software to calculate tank flashing, breathing, and working losses. Inputs into the model include the storage tank physical characteristics, tank operating temperature, and tank fill rates. Reference Appendix A.

  Excess emissions were calculated for the duration of the maintenance work that the odor was ultimately traced back to versus just the duration that the offsite odor was detected. Working and breathing loss emissions were conservatively included for both tanks although only PFO Tank B was being filled during this maintenance work.

- **The steps, if any, that the facility took to limit the duration and/or quantity of emissions associated with the malfunction**
  Not long after the offsite malodor was discovered, the source of the malodor was identified and mitigated. See details below.

- **A detailed analysis that sets forth the Root Cause of the malfunction, to the extent determinable**
  At 2:49 AM on November 6, 2024, the blower that routes the PFO tanks' vapors to the Continuous Vent Thermal Oxidizer (CVTO- source ID C204A) was taken out of service in preparation for maintenance activities.

  When the blower is out of service, intermittent venting from the PFO tank relief devices is expected due to normal tank working and breathing losses. Due to this and because PFO has an extremely low odor threshold, the Emergency Response Team (ERT) was engaged to conduct extra onsite and offsite odor rounds. At approximately 4:00 AM on November 6, 2024, the ERT reported a PFO odor on the 376 Bridge and also on Grove Way in Vanport to the operations team. The decision was made to cease the maintenance preparation activities, and the PFO blower was returned to service at 4:05 AM.

  Further investigation of the offsite malodor occurred over the following week. The process data from the event suggested that the PFO tanks breathed more than expected, yielding more venting from the tank relief devices. Through field troubleshooting, it was concluded that both PFO tank nitrogen regulators were not functioning correctly. Note that the regulators act on tank vapor space pressure control and should close off in response to an increase in tank pressure, which is expected when the blower is out of service. However, it was determined that the regulators were not able to fully close and were leaking excess nitrogen into the tanks' vapor space. This caused the tanks' pressure to increase and, thus, the relief devices to open more frequently.

- **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 PFO tanks' nitrogen regulators are going to be maintained and/or repaired prior to attempting to take the PFO blower out of service for the planned maintenance. This is expected to occur before the end of Q1 2025.

- **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 action is expected to be complete by the end of Q1 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
Valerie Shaffer, Air Quality District Supervisor

Appendix A- ProMax Inputs and Outputs

PFO ProMax Input Assumptions
Shell Polymers Monaca

Tank Data/Sample Data

Tank Name	Tank ID	Contents	Length/ Height (m)	Diameter (m)	Temp (C)	Pressure (barg)	Flow Rate (kg/hr)
Pyrolysis Fuel Oil Storage Tank (PFO)	T-64204 A/B	Pyrolysis Fuel Oil	7.316	9.14	45.50	0.0057	615

Sample Data

	PFO
Constituent	% by weight
1,3-Butadiene	0.010
Benzene	1.680
n-Hexane	0.007
Toluene	3.909
Ethylbenzene	1.530
Styrene	10.110
m-Xylene	0.501
o-Xylene	0.644
p-Xylene	0.501
Naphthalene	1.013
n-Butane	0.007
Isoprene	0.001
n-Pentane	0.001
Cyclopentene	0.002
Cyclopentane	0.001
2-Methyl-2-Butene	0.001
cis-1,3-Pentadiene	0.007
trans-1,3-Pentadiene	0.006
Cyclopentadiene	3.605
Dicyclopentadiene	0.845
Curve Oil (balance)	75.619

Curve Oil inputs

PFO Distillation Curve

Component % mass	Temperature Results (°C)
0	153.78
5	170.02
10	182.82
15	196.89
20	211.03
25	226.49
30	241.77
35	257.51
40	271.40
45	284.48
50	305.89
55	329.67
60	350.96
65	370.26
70	392.82
75	414.56
80	431.55
85	450.14
90	470.79
95	501.87
98	536.33
100	545.00

MW:	133	g/mol Heat and Material Balance
Specific Gravity:	0.79	from *PFO_Composition*
Promax calculated VP	0.110532	bar at 100 F

PFO ProMax Output

Shell Polymers Monaca

Process Streams		Breathing	Flashing	Working
Composition	Status:	Solved	Solved	Solved
Phase: Total	From Block:	PFO Fixed Roof Tank	PFO Fixed Roof Tank	PFO Fixed Roof Tank
	To Block:	--	--	--
Mass Flow		lb/h	lb/hr	lb/h
1,3-Butadiene		0.000761703	0	0.00204450
Benzene		0.0123374	0	0.0331151
n-Hexane		2.91154E-05	0	7.81493E-05
Toluene		0.00737958	0	0.0198077
Ethylbenzene		0.000827405	0	0.00222086
Styrene		0.00476117	0	0.0127795
m-Xylene		0.000241615	0	0.000648523
o-Xylene		0.000288662	0	0.000774803
p-Xylene		0.000249842	0	0.000670606
Naphthalene		4.39700E-05	0	0.000118021
n-Butane		0.000423998	0	0.00113806
Isoprene		1.82120E-05	0	4.88831E-05
n-Pentane		1.55105E-05	0	4.16321E-05
Cyclopentene		4.10866E-05	0	0.000110282
Cyclopentane		1.58322E-05	0	4.24956E-05
2-Methyl-2-Butene		1.42316E-05	0	3.81995E-05
cis-1,3-Pentadiene		8.91890E-05	0	0.000239394
trans-1,3-Pentadiene		8.13018E-05	0	0.000218224
Cyclopentadiene		0.0968951	0	0.260078
Dicyclopentadiene		0.000136420	0	0.000366168
PFO @224.7 °C		7.25234E-06	0	1.94662E-05
PFO @237.5 °C		2.98664E-06	0	8.01649E-06
PFO @250.7 °C		1.19422E-06	0	3.20542E-06
PFO @263.7 °C		5.40289E-07	0	1.45020E-06
PFO @276.3 °C		2.34829E-07	0	6.30310E-07
PFO @289.5 °C		5.42255E-08	0	1.45548E-07
PFO @302.6 °C		1.83427E-08	0	4.92340E-08
PFO @315.9 °C		5.57330E-09	0	1.49594E-08
PFO @328.9 °C		1.96975E-09	0	5.28706E-09
PFO @342.0 °C		6.81595E-10	0	1.82948E-09
PFO @355.0 °C		2.43952E-10	0	6.54798E-10
PFO @367.8 °C		6.96380E-11	0	1.86917E-10
PFO @381.0 °C		1.91760E-11	0	5.14708E-11
PFO @394.0 °C		5.64695E-12	0	1.51571E-11
PFO @407.3 °C		1.77555E-12	0	4.76579E-12
PFO @420.1 °C		6.50357E-13	0	1.74564E-12
PFO @436.3 °C		1.92797E-13	0	5.17491E-13
PFO @455.8 °C		2.67089E-14	0	7.16900E-14
PFO @475.4 °C		3.09592E-15	0	8.30983E-15
PFO @494.4 °C		2.72015E-16	0	7.30122E-16
PFO @516.2 °C		2.26479E-17	0	6.07897E-17
PFO @537.3 °C		7.42210E-18	0	1.99218E-17
PFO (Unidentified)		0	0	0