March 14, 2025

EES Case Management Unit
Environment and Natural Resources Division
United States Department of Justice
P.O. Box 7611
Washington, D.C. 20044-7611

Re: DOJ # 90-5-2-1-11114
Updated Corrective Action Plan for Benzene Fenceline Air Monitoring
Flare Consent Decree 2:21-00114-MLCF-JVM
Dow Inc. - Orange, TX Site

CERTIFIED MAIL/RETURN RECEIPT REQUESTED 9589 0710 5270 1693 3500 42

Dear Sir/Madam:

In accordance with Paragraph 3.g. of Appendix 2.2 of the subject Flare Consent Decree, Dow Inc. (Dow) is submitting an update to our Corrective Action Plan for our site in Orange, Texas.

The benzene fenceline air monitoring results for this site exceeded the action level for benzene of a Δc value of 9 micrograms per cubic meter (ug/m^3) on an annual average basis. The site has conducted a root cause analysis and implemented corrective actions. The site has taken and is taking additional corrective actions to reduce the annual average concentration of benzene measured at the monitoring perimeter.

This attached updated Corrective Action Plan describes the corrective actions completed in 2024, and additional measures that the site plans to take to reduce benzene concentrations below the action level, along with a schedule for completion of these actions.

Please contact David Constant at 409-886-6580 or david.constant@dow.com if you have any questions regarding this submittal.

Sincerely,

Cara Leigh Wright
Responsible Care Director
Sabine River Operations
Dow Inc.

Attachment

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Update to Corrective Action Plan
Orange, TX Site
Benzene Fenceline Air Monitoring
Appendix 2.2 - Consent Decree 2:21-00114-MLCF-JVM

Background

Dow Inc. (Dow) and Union Carbide Corporation became subject to a Consent Decree (Civil Action 2:21-cv-114) on June 10, 2021. The Consent Decree covers flaring operations and emissions of volatile organic compounds (VOCs), hazardous air pollutants, and other pollutants at four chemical manufacturing facilities located in Texas and Louisiana. Compliance requirements within the Consent Decree include fenceline air monitoring for benzene in accordance with U.S. Environmental Protection Agency (EPA) Methods 325A and 325B of Appendix A to 40 Code of Federal Regulations (CFR) Part 63 (Test Methods – Pollutant Measurement Methods from Various Waste Media).

For the Orange, TX site, Dow implemented a Fenceline Monitoring program for benzene per Appendix 2.2 of the Consent Decree. The program consists of 18 sampling locations along the perimeter of the facility property in accordance with EPA Test Methods 325A and 325B of Appendix A to 40 CFR Part 63.

As part of the Consent Decree, Dow is required to calculate an annual average Δc based on the average of the 26 most recent 14-Day sampling periods and compare it to an action level of 9.0 micrograms per cubic meter ($\mu g/m^3$) for benzene.

As required by Appendix 2.2 Paragraph 3.g, Dow commenced a Root Cause Analysis (RCA) within five days of determining that the action level had been exceeded for the annual average Δc. RCAs and initial corrective action analyses were completed, and initial corrective actions were taken within 45 days of determining the exceedance.

After completing the corrective action analysis and corrective actions, corrective action measures were identified that require more than 45 days to implement. This required a Corrective Action Plan (CAP) to be prepared that describes the corrective action(s) completed to date, additional proposed measures to employ to reduce benzene concentrations below the action level, and the schedule for completion of these measures.

This document makes further updates to the first Corrective Action Plan (CAP) and includes additional actions and a schedule for completing those actions.

This updated CAP includes updates to the following information:

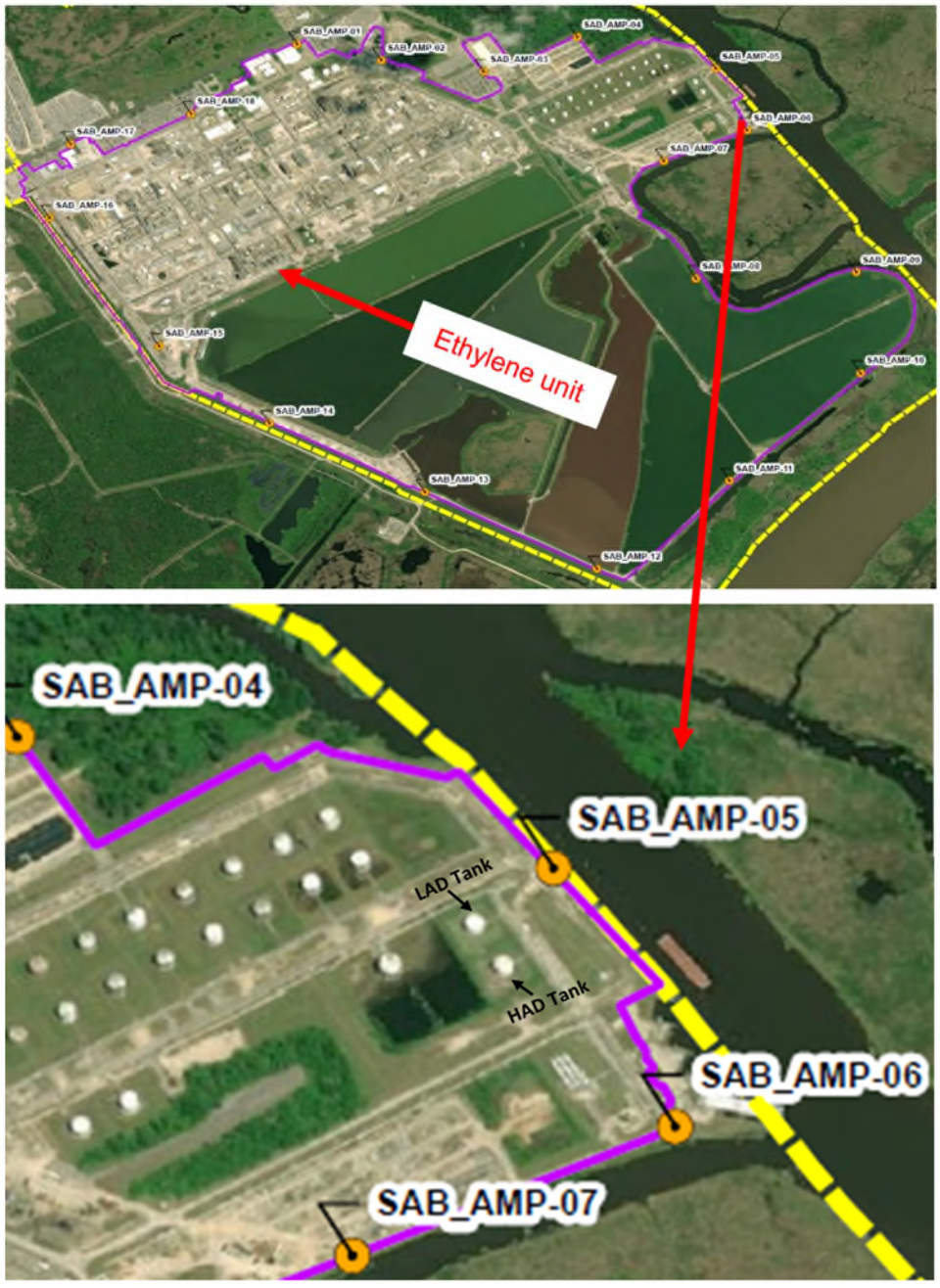
- Monitoring results and timeline – Updated through February 13, 2025
- Root Cause Analysis
- Corrective Actions Completed Through 2023
- Update to Corrective Action Measures Completed in 2024 and Corrective Actions Planned in 2025

Monitoring Results and Timeline

The first samples for the Orange site's Fenceline Monitoring program were collected on June 21, 2022. Results for that initial 14-Day sampling period showed a Δc of 40.14 µg/m^3 due to a sample result of 40.8 µg/m^3 at sampling point SAB_AMP-05 (known as Sample Spot #5).

Sample Spot #5 is located at the fenceline adjacent the 311 Hydrocarbons tank farm. See Figure 1 for the location of this sampling point in reference to the Ethylene production plant and tanks.

Figure 1 - Sample Point SAB_AMP-05



Analysis work began in July 2022 upon receipt of these first sampling results. See the next section for further details. The Light Aromatic Distillate (LAD) tank was removed from service in October 2022 based on the results from the initial analysis and sampling results improved.

In February 2023 and intermittently through summer 2023, additional elevated results were detected at sample spot #5.

The annual average Δc was calculated using the sample collected on June 22, 2023, after 26 sampling periods were available and the exceedance of the action level for benzene of 9.0 µg/m^3 was confirmed. This value was confirmed via a lab report available to Dow on July 6, 2023.

As required by Paragraph 3.g. of Appendix 2.2 of the Dow Flare Consent Decree, Dow commenced a formal Root Cause Analysis, utilizing Dow's Root Cause Investigation process, within five days of determining that the annual average had exceeded the action level. Corrective actions were identified that require more than 45 days to implement.

A timeline of sample results is available in Table 1 **- Timeline of Results from SAB_AMP-05** below.

Table 1 - Timeline of Results from SAB_AMP-05 (Sample Spot #5)

Sampling Event	Date of Retrieval	SAB_AMP-05 Benzene Sample Results (µg/m^3)	Delta-C (Δc) for period (ug/m^3)	Annual Average Δc (ug/m^3)	Comments
1	6/21/2022	40.8	40.14	NC	
	7/5/2022	M	NA	NC	Samples were not analyzed due to lab issue.
2	7/20/2022	69	68.53	NC	
3	8/4/2022	36.3	35.95	NC	
4	8/17/2022	13.2	12.69	NC	
5	8/31/2022	18.1	17.61	NC	
6	9/13/2022	11.3	10.14	NC	
7	9/28/2022	15.1	14.41	NC	
8	10/13/2022	7.27	8.89	NC	Δc calculated from Sample Point SAB-AMP-07 (9.52 ug/m^3)
9	10/28/2022	8.51	7.88	NC	
10	11/10/2022	3.41	3.30	NC	
11	11/22/2022	2.08	2.01	NC	
12	12/7/2022	8.31	7.59	NC	
13	12/21/2022	4.98	4.32	NC	
14	1/4/2023	4.24	3.58	NC	
15	1/17/2023	6.26	5.61	NC	
16	2/1/2023	1.66	2.58	NC	
17	2/15/2023	20.1	19.50	NC	
18	3/1/2023	38.7	38.11	NC	
19	3/15/2023	22.4	21.94	NC	

Sampling Event	Date of Retrieval	SAB_AMP-05 Benzene Sample Results (µg/m³)	Delta-C (Δc) for period (ug/m³)	Annual Average Δc (ug/m³)	Comments
20	3/29/2023	5.7	5.14	NC	
21	4/13/2023	7.61	7.12	NC	
22	4/27/2023	6.79	6.19	NC	
23	5/11/2023	9.46	9.03	NC	
24	5/25/2023	10.4	9.78	NC	
25	6/8/2023	9.08	8.43	NC	
26	6/22/2023	44.1	43.61	15.9	26th sampling round
27	7/5/2023	42.2	41.8	16.0	
28	7/19/2023	41.2	40.8	14.9	
29	8/2/2023	27.6	27.0	14.6	
30	8/17/2023	53.6	53.2	16.2	
31	8/31/2023	15.2	14.6	16.0	
32	9/14/2023	16.9	16.2	16.25	
33	9/28/2023	12.1	11.5	16.1	
34	10/12/2023	2.07	1.7	15.9	Updated Sampling Results Provided from this Date Forward
35	10/26/2023	11.4	10.4	15.9	
36	11/9/2023	9.52	8.9	16.2	
37	11/22/2023	3.31	3.7	16.2	
38	12/7/2023	3.65	3.4	16.1	
39	12/21/2023	2.35	1.7	15.9	
40	1/3/2024	2.92	2.4	15.9	
41	1/18/2024	2.66	2.0	15.8	
42	2/1/2024	5.21	4.4	15.9	
43	2/14/2024	6.9	6.3	15.4	
44	2/29/2024	15.2	14.7	14.4	
45	3/14/2024	8.16	7.5	13.9	
46	3/28/2024	3.04	3.34	13.8	
47	4/10/2024	8.5	8.0	13.9	
48	4/24/2024	13.3	12.89	14.1	
49	5/9/2024	7.15	6.87	14.0	
50	5/23/2024	72.3	71.6	16.4	
51	6/6/2024	99.1	98.5	19.9	
52	6/20/2024	9.5	8.99	18.6	
53	7/3/2024	22.7	22.2	17.8	
54	7/18/2024	23.9	23.32	17.1	
55	8/1/2024	30.4	29.8	17.2	
56	8/15/2024	23	22.37	16.0	
57	8/29/2024	21	20.13	16.3	
58	9/12/2024	0.5	7.62	15.9	

Sampling Event	Date of Retrieval	SAB_AMP-05 Benzene Sample Results (µg/m³)	Delta-C (Δc) for period (ug/m³)	Annual Average Δc (ug/m³)	Comments
59	9/26/2024	17.8	17.2	16.1	
60	10/10/2024	4.03	6.2	16.3	
61	10/24/2024	7.95	7.25	16.2	
62	11/8/2024	2.07	1.79	15.9	
63	11/21/2024	0.65	9.28	16.1	
64	12/6/2024	4.62	3.75	16.1	
65	12/19/2024	2.61	1.88	16.1	
66	1/2/2025	3.43	2.75	16.1	
67	1/17/2025	1.75	1.62	16.1	
68	1/30/2025	1.8	1.5	16.03	
69	2/13/2025	7.61	7.0	16.06	
70	2/27/2025	2.4	1.71	15.58	

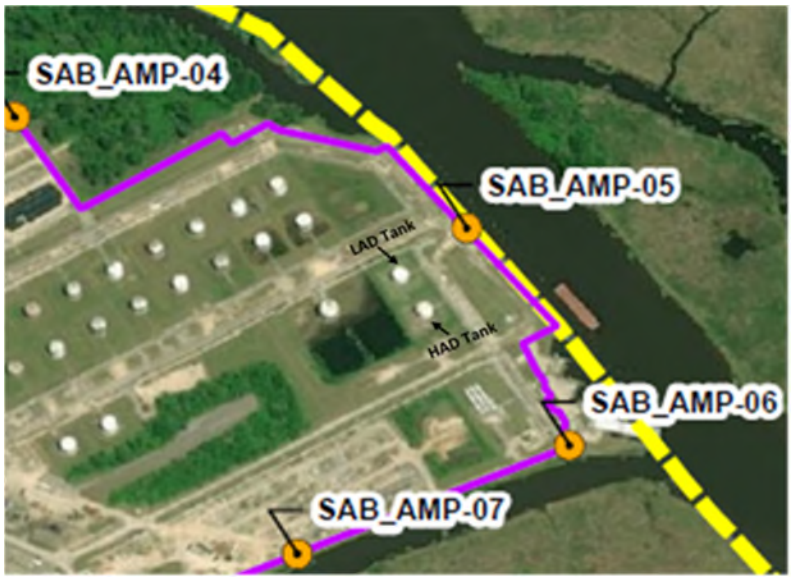
M: Results are not available due to a laboratory error.
NC: Not calculated

Root Cause Analysis

The first phase of the analysis of root causes was initiated in July 2022 upon receipt of the first round of sampling data from June 2022. After additional elevated results were received in the 2nd quarter of 2023, a second phase was initiated.

Reviews focused on emission sources near Sampling Point SAB_AMP-05. Sampling point SAB_AMP-05 is located near the site tank farm and barge loading facilities.

Figure 2 - Location of Sample Point SAB_AMP-05

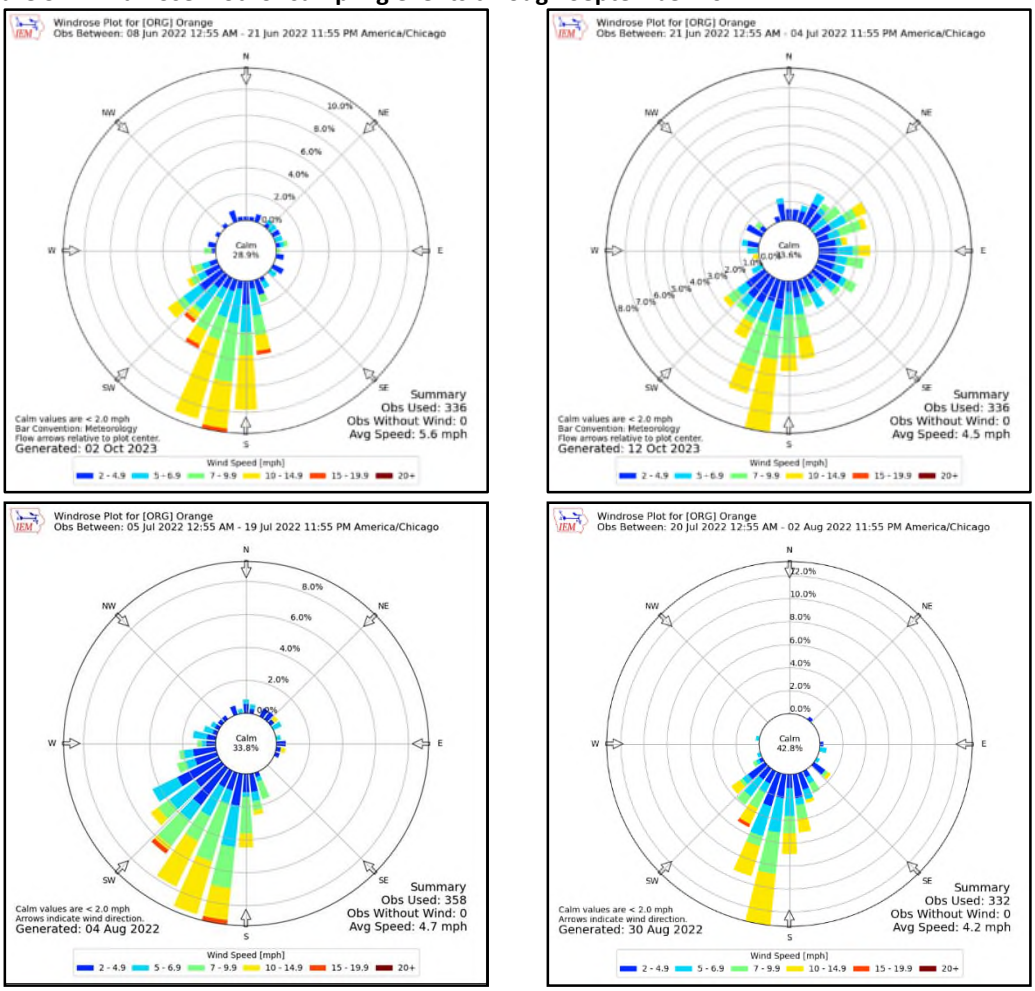


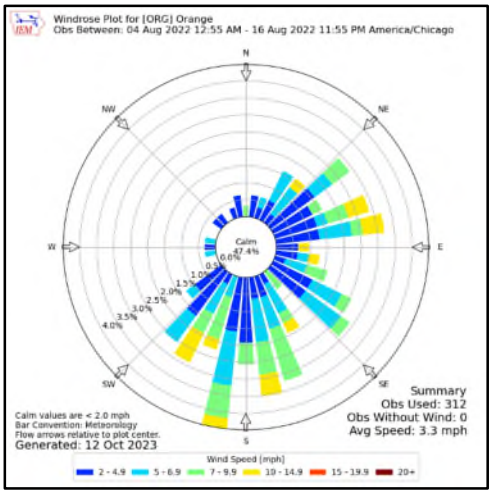
The first phase of the analysis addressed the results received in 2022 after the monitoring program was first implemented. A second phase of the analysis began in the 2nd quarter of 2023 after additional elevated sample results were obtained.

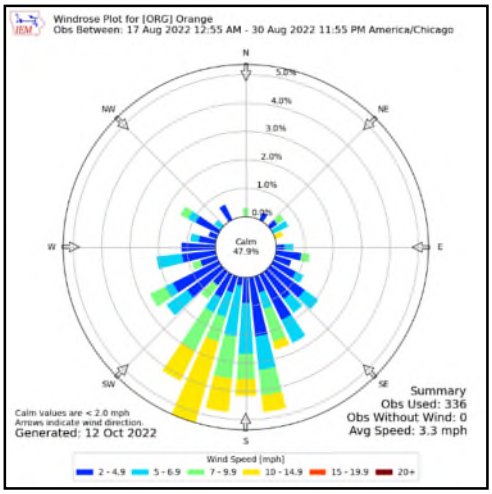
1. Phase 1

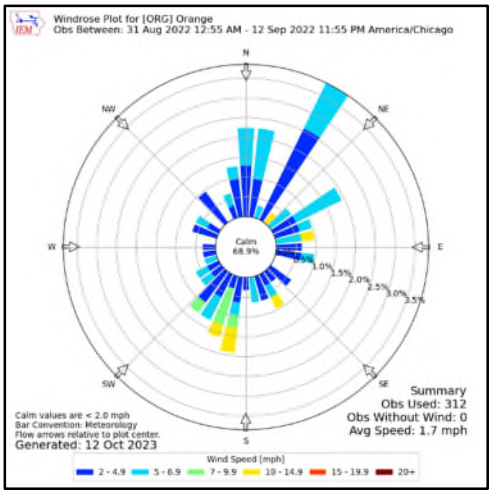
A wind rose for the 14-Day sampling periods between June 8, 2022, and September 28, 2022, is included in **Figure 3**.

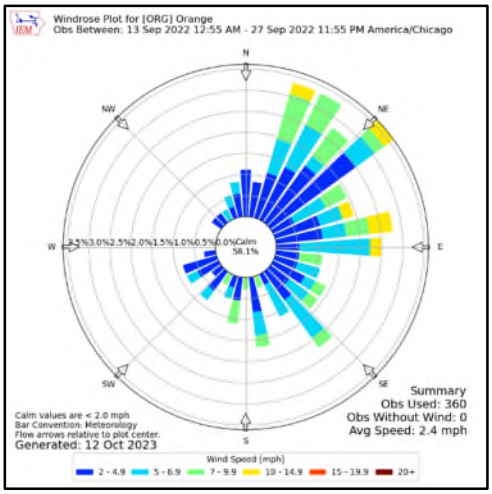
Figure 3 - Wind Rose Plot for sampling events through September 2022




Windrose Plot for [ORG] Orange
Obs Between: 04 Aug 2022 12:55 AM - 16 Aug 2022 11:55 PM America/Chicago
Calm
47.4%
Summary
Obs Used: 312
Obs Without Wind: 0
Avg Speed: 3.3 mph
Calm values are < 2.0 mph
Bar Convention: Meteorology
Flow arrows relative to plot center.
Generated: 12 Oct 2023
Wind Speed [mph]
2 - 4.9
5 - 6.9
7 - 9.9
10 - 14.9
15 - 19.9
20+

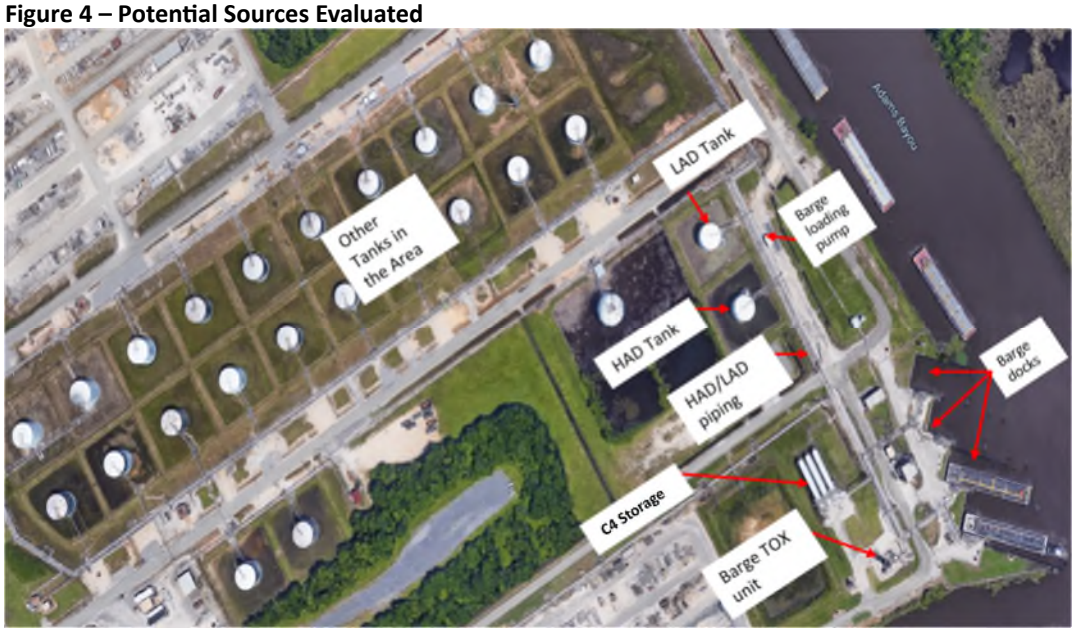

Windrose Plot for [ORG] Orange
Obs Between: 17 Aug 2022 12:55 AM - 30 Aug 2022 11:55 PM America/Chicago
Calm
47.9%
Summary
Obs Used: 336
Obs Without Wind: 0
Avg Speed: 3.3 mph
Calm values are < 2.0 mph
Arrows indicate wind direction.
Generated: 12 Oct 2022
Wind Speed [mph]
2 - 4.9
5 - 6.9
7 - 9.9
10 - 14.9
15 - 19.9
20+


Windrose Plot for [ORG] Orange
Obs Between: 31 Aug 2022 12:55 AM - 12 Sep 2022 11:55 PM America/Chicago
Calm
68.9%
Summary
Obs Used: 312
Obs Without Wind: 0
Avg Speed: 1.7 mph
Calm values are < 2.0 mph
Bar Convention: Meteorology
Flow arrows relative to plot center.
Generated: 12 Oct 2023
Wind Speed [mph]
2 - 4.9
5 - 6.9
7 - 9.9
10 - 14.9
15 - 19.9
20+


Windrose Plot for [ORG] Orange
Obs Between: 13 Sep 2022 12:55 AM - 27 Sep 2022 11:55 PM America/Chicago
Calm
58.1%
Summary
Obs Used: 360
Obs Without Wind: 0
Avg Speed: 2.4 mph
Calm values are < 2.0 mph
Bar Convention: Meteorology
Flow arrows relative to plot center.
Generated: 12 Oct 2023
Wind Speed [mph]
2 - 4.9
5 - 6.9
7 - 9.9
10 - 14.9
15 - 19.9
20+

In July 2022, a list of potential emission sources was developed, as shown in Figure 4:

Figure 4 – Potential Sources Evaluated



Evaluation of these potential sources included the following techniques:

- Review of process design information and data related on equipment handling benzene-containing liquids.
- Gas detector and optical gas imaging camera (OGIC) readings (1) from piping to the Heavy Aromatic Distillate (HAD) and Light Aromatic Distillate (LAD) tanks, (2) from tanks to the barge terminal and terminal vapor recovery and (3) marine loading activities.
- Review of performance testing and compliance data for control devices associated with loading emissions.
- Interviews with third-party tenants and barge owners/operators.
- Visual inspections of the HAD tank and LAD tank floating roof.

Findings and Corrective Actions

Sample Point SAB_AMP-05 is located near two floating-roof tanks that store benzene-containing liquids. These tanks are known as the Light Aromatic Distillate (LAD) or Heavy Aromatic Distillate (HAD) tanks.

HAD Tank

The floating roof of the HAD Tank was visually inspected, and no issues were identified at the time.

LAD Tank

The floating roof the LAD Tank was visually inspected and there was indication of seal damage and liquid on the roof. Secondary inspections were performed at multiple liquid levels on the LAD tank to gain a better visual. Emissions from the LAD tank were identified as the root cause for the high sampling results in 2022.

The LAD tank was removed from service in October 2022 & has been upgraded to a double-seal roof.

2. Phase 2

Upon receipt of sampling results greater than 9.0 ug/m^3 for Sampling Point SAB_AMP-05 in March 2023, a new review was initiated.

Prevailing winds were similar to the previous wind rose in **Figure 3**. Phase 2 included the same techniques as Phase 1 but evaluated additional potential sources.

Findings and Corrective Actions:

The 405 Debutanizer Column has experienced fouling which was first identified in February 2023. Issues with this column have a potential to cause variations in the material C4 composition received at the HAD Tank in early 2023. This tank is a single-seal internal floating roof (IFR) tank. Inspections performed in 2022 did not indicate an issue with the floating roof.

Initial indication of an issue was noted when a barge sample was out of specification. The reboiler EA412 was fouled during a steam supply interruption and the facility was limited in control for the top or bottom outputs from the column. To limit potential for damage of the IFR roof on the HAD Tank, the reflux flow rate was lowered to maintain appropriate temperatures. The facility elected to remove the column from service to clean the reboiler and inspect the trays. A reflux line was also cleaned to eliminate plugging to improve reflux flow.

The Debutanizer Column was removed from service on August 29, 2023, for cleaning and repair. The Column was returned to service on September 13, 2023.

Initial Corrective Actions Completed

The below actions were performed prior to the completion of the corrective action analysis on August 20, 2023:

Corrective Actions	Completion Date	Comments
Commenced review team	June 2022	
Monitored barge Loading on June 26 with optical gas imaging (FLIR) camera	June 2022	No indication of issue during barge loading and line clearing.
Reviewed operation of Thermal Abator during loading of barges in June 2022	3rd Quarter 2022	Thermal Abator was working as designed.
Reviewed potential benzene sources from 3rd-party tanks	July 2022	Confirmed no benzene in process material in adjacent tank farm.
Collected data on recent maintenance activities on HAD/LAD tanks and most recent Mechanical Integrity records for these tanks.	August 2022	No maintenance activities occurred on the HAD or LAD tanks during the months of June or July 2022.
Reviewed LDAR monitoring results and any Delay of Repair (DOR) for the Ethylene Tank Farm area.	August 2022	There were no leaking components at the Tank farm during the month of June.
Inspected HAD Tank IFR	September 2022	No abnormal indications found on HAD tank IFR
Inspected LAD Tank IFR	September 2022	LAD tank IFR was found with rim seal defects, which could allow excess venting of Benzene
LAD Tank removed from service	October 2022	
Replace LAD Tank IFR with upgraded design.	June 2023	This tank has not yet been returned to service as of September 2023.

Corrective Action Measures Completed Between August 20, 2023 and December 31, 2023

Additional Corrective Actions	Completion Date
Completed visual inspections of Heavy Aromatic Distillate (HAD) Tank roof.	August 30, 2023
Take Column DA-405 out of service and clean and repair column to optimize the performance of the column, which in turn is expected to reduce the amount of benzene in the liquid flowing to the Heavy Aromatic Distillate (HAD) Tank after Return to Operation.	September 13, 2023
Placed the Light Aromatic Distillate (LAD) Tank back into service with the new internal floating roof design.	October 13, 2023

Update to Corrective Action Measures Completed in 2024 and Corrective Actions Planned in 2025

Additional Corrective Action Measures Completed in 2024

Additional Corrective Actions	Completion Date
Commenced using a portable gas chromatograph (GC) system called an E-GC. The E-GC is a field instrument that is able to make benzene concentration measurements in ambient air every 10-minutes.	February 16, 2024 – Started operation of the E-GC.
Minimized the use of the Heavy Aromatic Distillate (HAD) Tank during and after a planned turnaround of the Ethylene Plant in the second quarter of May 2024.	May 7, 2024
Made physical changes to the LAD tank by enclosing a number of vents and flowing nitrogen into the vapor space of the tank. Then, conducted emission testing on vapors emitted from the vapor space of the Light Aromatic Distillate (LAD) Tank.	August 6 – August 9, 2024 – Emission Testing Dates
Removed the HAD Tank from service to perform a scheduled inspection of and maintenance on the vessel. The tank remains out of service with no organic liquids currently being stored.	October 4, 2024

Summary of learnings from the actions in 2024:

1. The emission testing conducted in August 2024 confirmed that the LAD storage tank is a source of benzene air emissions that is likely contributing the most to the high concentration readings at Sample Spot #5, which is the sample location along the fenceline in close proximity to the LAD and HAD storage tanks.
2. The E-GC instrument measures higher concentrations of benzene when the wind direction is transporting the emissions from the storage tanks towards Sample Spot #5.
3. These learnings confirmed the need for an emission collection and reduction project to meet the action level for benzene. This project is discussed in more detail on the next page.

Proposed Corrective Action Measures & Schedule for Completion

The Dow Orange, TX site is implementing the following additional project to reduce the benzene concentration along the nearby fenceline. The site proposes the following schedule for completing the project.

Proposed Additional Corrective Actions	Proposed Schedule
Construct a project to capture the vapors emitted from the vapor space of the LAD tank and the HAD tank and then route the combined vent gas stream to a portable thermal oxidizer. The vent from the LAD tank will be connected to the portable thermal oxidizer first, and then the vent from HAD tank will be connected at a later time. The vent connection to the oxidizer will occur prior to the HAD tank returning to liquid hydrocarbon service. The proposed schedule is to have the LAD tank connected to the thermal oxidizer system in April 2025. The start-up date could be slightly impacted by construction conditions during winter and early spring months.	April 15, 2025, for connecting the LAD tank vent to the portable thermal oxidizer. The HAD tank vent will be connected at a later date.