



October 17, 2023

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  
Submittal of Corrective Action Plan for Benzene Fenceline Air Monitoring  
Flare Consent Decree 2:21-00114-MLCF-JVM  
The Dow Chemical Company  
Orange, TX Site

CERTIFIED MAIL/RETURN RECEIPT REQUESTED

7022 3330 0001 1611 5148

Dear Sir/Madam:

In accordance with Paragraph 3.g. of Appendix 2.2 of the subject Flare Consent Decree, The Dow Chemical Company (Dow) is submitting the attached 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  $\Delta c$  value of 9 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) on an annual average basis. The site has conducted a root cause analysis and implemented corrective actions.

This attached Corrective Action Plan describes the corrective actions completed to date, 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](mailto:david.constant@dow.com) if you have any questions regarding this submittal.

Sincerely,

A handwritten signature in black ink, appearing to read "Dustin Hedges", with a horizontal line underneath.

Dustin Hedges  
Responsible Care Director  
Sabine River Operations  
The Dow Chemical Company

Attachment

cc: e-mail: parrish.robert@epa.gov foley.patrick@epa.gov and stucky.marie@epa.gov

Cover Letter Only

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First-Class Mail - Cover Letter and Attachments

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Office of Civil Enforcement  
United States Environmental Protection Agency  
Mail Code 2242-A  
1200 Pennsylvania Ave, N.W.  
William Jefferson Clinton Building  
Room 1119  
Washington, DC 20460-0001  
Note: If using express mail – Change zip code to 20004

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

Annual Average  $\Delta c$  for Sampling Period ending June 22, 2023

# Background

On June 10, 2021, The Dow Chemical Company (Dow) and Union Carbide Corporation became subject to a Consent Decree (Civil Action 2:21-cv-114). 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  $\Delta c$  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 ( $\mu\text{g}/\text{m}^3$ ) 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  $\Delta c$ . 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 have been identified that require more than 45 days to implement. This triggers a Corrective Action Plan (CAP) 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 CAP includes the following:

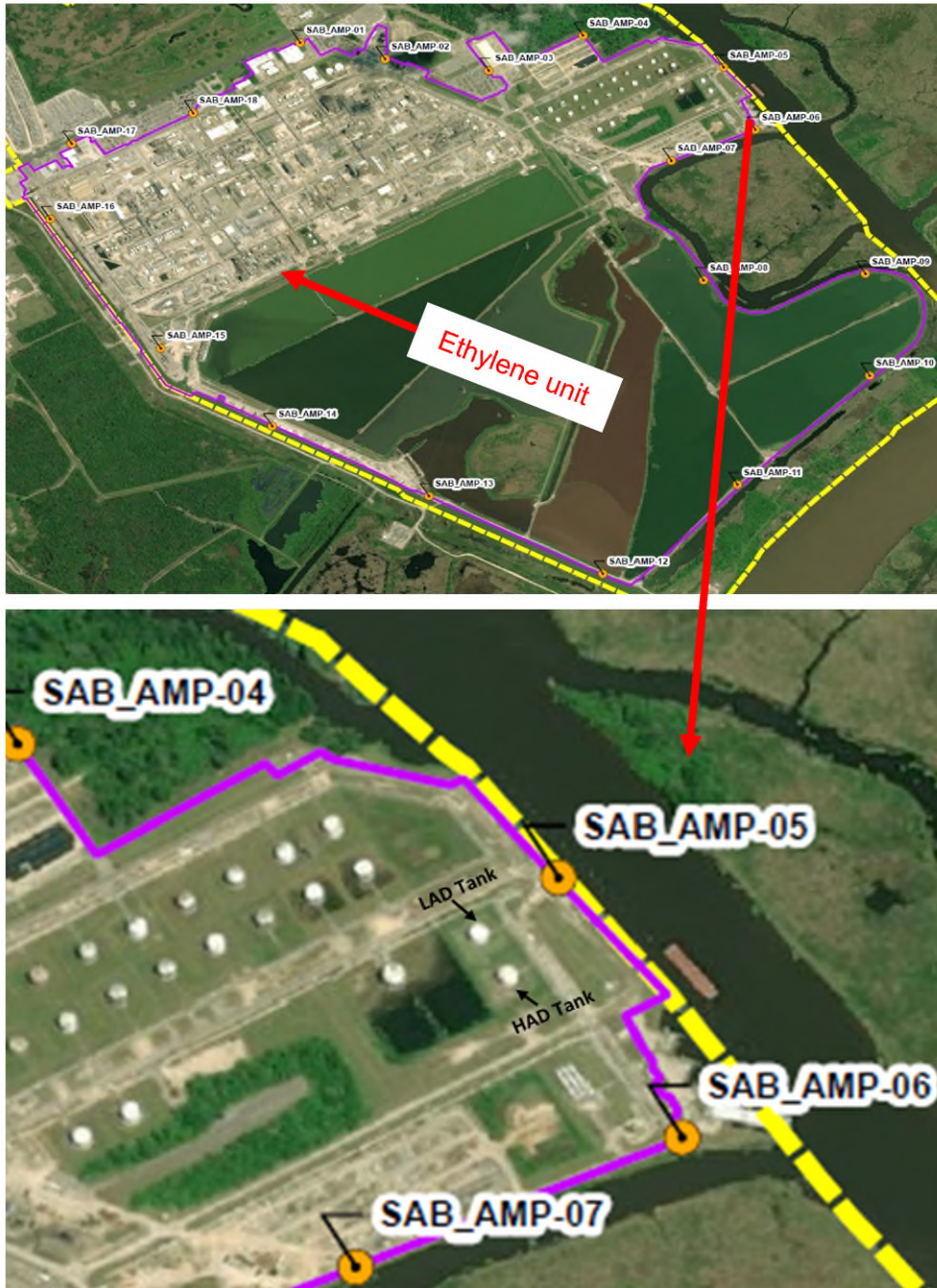
- Monitoring results and timeline
- Root Cause Analysis
- Corrective Actions Completed to Date
- Additional Measures & Schedule for Completion

# 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  $\Delta c$  of  $40.14 \mu\text{g}/\text{m}^3$  due to a sample result of  $40.8 \mu\text{g}/\text{m}^3$  at sampling point SAB\_AMP-05.

Sampling point SAB\_AMP-05 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 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 sampling point SAB\_AMP-05.

The annual average  $\Delta c$  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  $9.0 \mu\text{g}/\text{m}^3$  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 have been 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**

Sampling Event	Date of Retrieval	SAB_AMP-05 Benzene Sample Results ( $\mu\text{g}/\text{m}^3$ )	Delta-C ( $\Delta c$ ) for period ( $\mu\text{g}/\text{m}^3$ )	Annual Average $\Delta c$ ( $\mu\text{g}/\text{m}^3$ )	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	$\Delta c$ calculated from Sample Point SAB-AMP-07 ( $9.52 \mu\text{g}/\text{m}^3$ )
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	
20	3/29/2023	5.7	5.14	NC	
21	4/13/2023	7.61	7.12	NC	

Sampling Event	Date of Retrieval	SAB_AMP-05 Benzene Sample Results ( $\mu\text{g}/\text{m}^3$ )	Delta-C ( $\Delta\text{c}$ ) for period ( $\text{ug}/\text{m}^3$ )	Annual Average $\Delta\text{c}$ ( $\text{ug}/\text{m}^3$ )	Comments
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	26 <sup>th</sup> 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	

*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 2<sup>nd</sup> 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



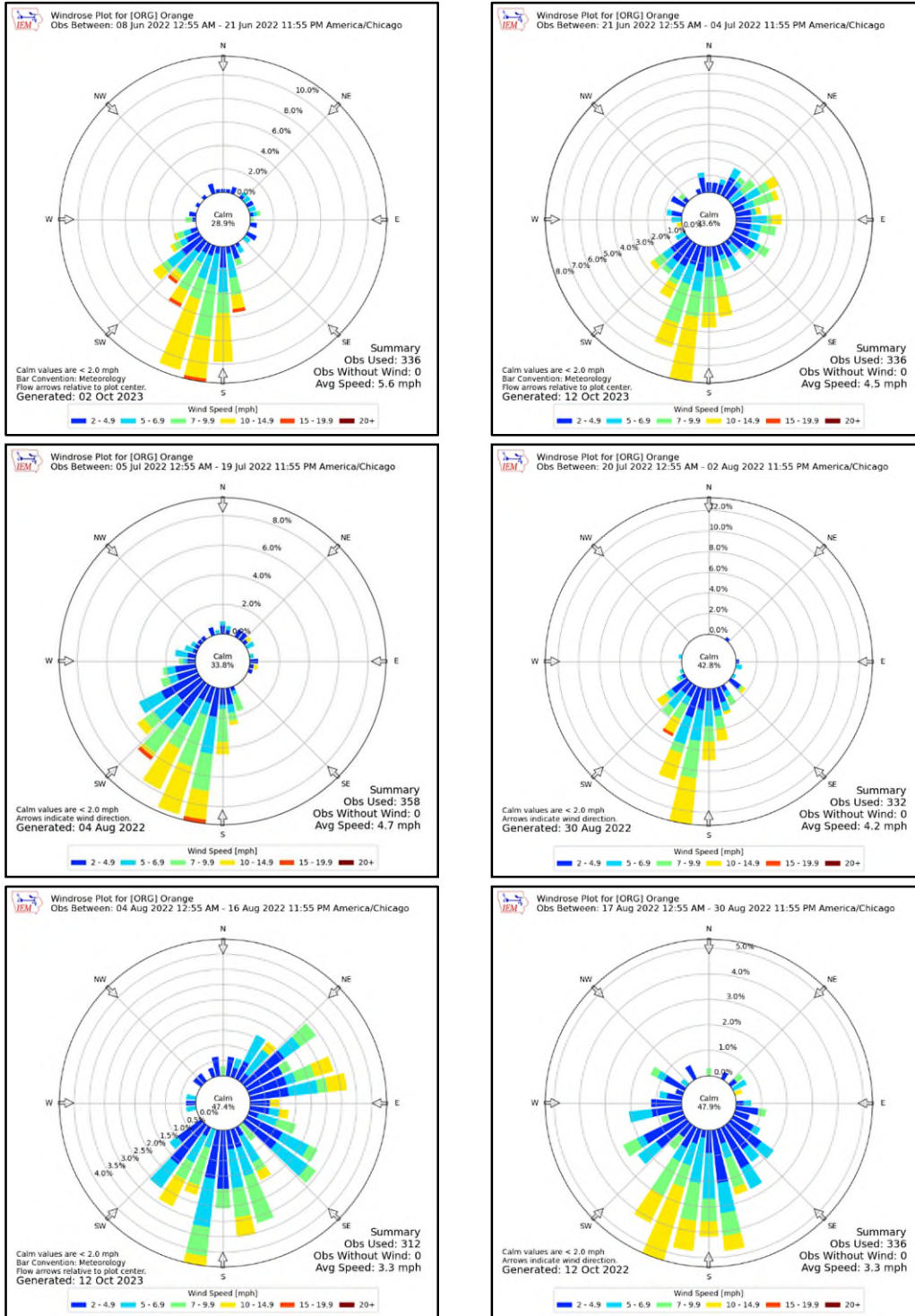
The first phase of the analysis addressed the results received in 2022 after the monitoring program was first implemented. A second phase of the analysis began in the 2<sup>nd</sup> quarter of 2023 after additional elevated sample results were obtained.

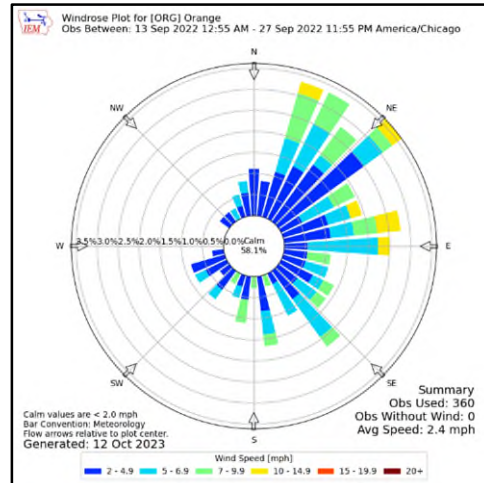
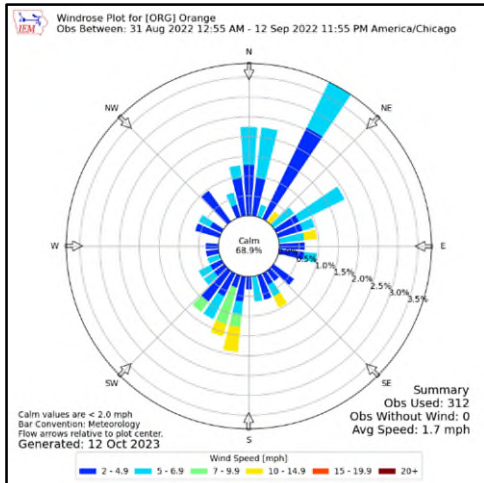


# 1. Phase 1

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

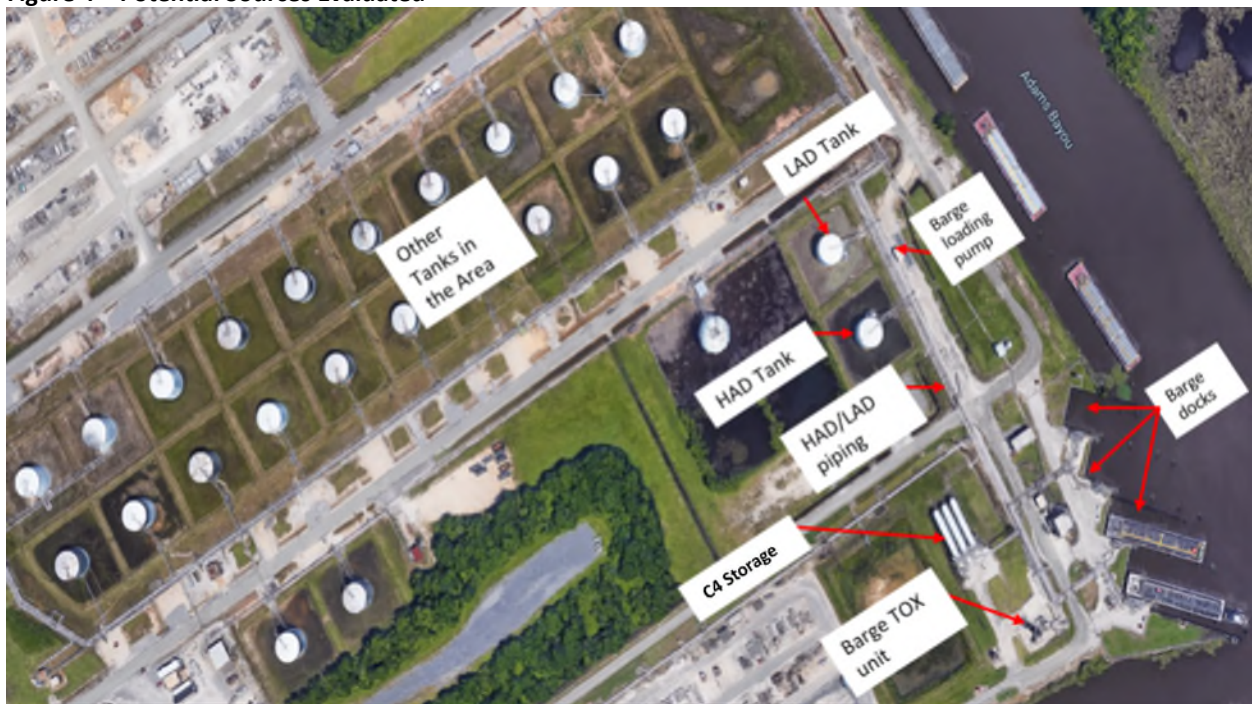
Figure 3 - Wind Rose Plot for sampling events through September 2022





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 ug/m<sup>3</sup> 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	3 <sup>rd</sup> Quarter 2022	Thermal Abator was working as designed.
Reviewed potential benzene sources from 3 <sup>rd</sup> -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.

## Additional Corrective Action Measures Completed

The below actions were completed after August 20, 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
Place the Light Aromatic Distillate (LAD) Tank back into service with the new internal floating roof design.	October 13, 2023

## Proposed Corrective Action Measures & Schedule for Completion

The Dow Orange, TX site proposes the following additional measures with the following proposed schedule:

<b>Proposed Additional Corrective Actions</b>	<b>Proposed Schedule</b>
Complete monitoring and inspections of the LAD Tank after it is returned to service to validate internal floating roof is operating correctly.	December 31, 2023
Evaluate fenceline monitoring data and trends to validate corrective actions.	Next 14-Day sampling period for which the sampling start time begins after the completion of the corrective actions.