

C-67 Event Investigation Reports (Redacted) EIR-2023-063 C-67 (08/18/2023)

(Settlement Agreement Deliverable)

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC27-08RV14800



**P.O. Box 850
Richland, Washington 99352**

C-67 Event Investigation Reports (Redacted) EIR-2023-063 C-67 (08/18/2023)

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Washington River Protection Solutions

Date Published

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APPROVED
By Lynn M Ayers at 7:57 am, Jan 23, 2024

Release Approval

Date

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Washington River Protection Solutions
EVENT SUMMARY

Check PART 1 box to hide that section of the form. Check PART 2 box it will show that section.

PART 1 (hide)* **PART 2 (show)***

NOTE: This form provides timely notification to management and documents preliminary information of an event that may require a more formal investigation. Details may change upon further examination and analysis. The following is a current status of available information:

Project: Production Operations/242A Evaporator

Date: 8/18/2023

Area/Building/Location: 200 East/242A Evaporator Parking Lot

Approximate Time of Event: 1930 hours

AR Number: WRPS-AR-2023-2205

Responsible Manager: [REDACTED]

EIR Number: EIR-2023-063

Event Investigator: [REDACTED]

EVENT SUMMARY PART 1

Activity in Progress (What activity was under way, include procedures and work order numbers, as applicable):

One employee was walking from 272AW through the 242A parking lot to enter the 242A Evaporator facility.

Personnel Involved (Job positions, number of personnel, identify any support organizations or subcontractors directly involved):

One WRPS Nuclear Chemical Operator (NCO).

What Happened (Provide a short discussion of what happened):

On 8/18/2023 at approximately 1930 hours, one NCO was walking through the parking lot outside of the 242A Evaporator facility when they smelled a sulfur odor. The employee was crossing the parking lot area to enter the 242A facility. The employee was not in an area that required the use of respiratory protection. The NCO didn't report any symptoms and declined medical evaluation.

Industrial Hygiene Technicians (IHTs) responded and took direct reading instrument (DRI) readings in the location around the 242A parking lot. All monitoring results were at or below background (no elevated readings). Access to the 242A parking lot was restored.

Where Did It Happen (Description of work area and working conditions. Include information on weather conditions, PPE, Postings, etc.):

The sulfur odor was detected on the east side of the 242A Evaporator facility outside in the parking lot.

The Hanford site Meteorological Station reported the following weather conditions (200 East, station 06) at the approximate time of the event (1930 hours) as:

Wind Speed: 17 miles mph

Wind Direction: From the Northwest

Temperature: 86 degrees

Barometric Pressure: 29.06 Hg rising

Humidity: 9%

Mixing Height was reported at 1200 feet.

Impact to Facility (Caused by the event or a description of known consequences):

Access was restricted to the 242A parking lot. No operational impacts, impacts to facility safety status, or additional impacts to scheduled 08/18/2023 work evolutions occurred.

Immediate Actions Taken (List immediate actions taken to stabilize the scene or respond to the event):

- Central Shift Manager (CSM) initiated TFC-OPS-OPER-C-67 and restricted access to the 242A parking lot.

- CSM made required TFC-OPS-OPER-C-67 notifications.

- Production Operations shift Industrial Hygiene Technician (IHT) initiated TFC-OPS-OPER-C-67 response actions and monitoring per IHSP-POE-MULTI-TFCOPSOPERC67, Rev.2 and TFC-OPS-OPER-C-67 Attachment A- "Response Plan."

- Event Investigation EIR-2023-063, "TFC-OPS-OPER-C-67 Odor Response at 242-A Parking Lot," was initiated.

Washington River Protection Solutions
EVENT SUMMARY (Continued)

Project: Production Operations/242 A Evaporator

Date: 8/18/2023

Area/Building/Location: 200 East/242A Evaporator Parking Lot

Approximate Time of Event: 1930 hours

AR Number: WRPS-AR-2023-2205

Responsible Manager: [REDACTED]

EIR Number: EIR-2023-063

Event Investigator: [REDACTED]

Notifications Already Made (Time and personnel notified):

- [~1930 hours] The 242A Shift Operations Manager notified the CSM of the reported stronger than normal sulfur odor in the 242A parking lot.
- [1938 hours] Shift Operations Event Notification (SOEN) sent "Stronger than normal odors reported in the 242-A parking lot. Access to the 242-A parking lot is restricted. CSM."
- [1953 hours] The CSM notified the on-call Department of Energy (DOE) Facility Representative.
- [2311 hours] SOEN sent "IHT monitoring results are at or below background levels at all surveyed locations for the 242-A odor response. Normal access to the 242-A parking lot is restored. CSM"

This event does not merit an Event Investigation meeting

This event merits an Event Investigation meeting

Basis for Determination:

Information gathered from interview and documentation review have provided sufficient information regarding this event.

Responsible Manager:

[REDACTED]
Print First and Last Name

[REDACTED]
Signature / Date

CAS Manager:

[REDACTED]
Print First and Last Name

[REDACTED]
Signature / Date

EVENT SUMMARY PART 2

Key Elements of the Investigation (Key investigation points):

To summarize the conclusions of IHIR-00080, "TFC-OPS-OPER-C-67 Response 242A Parking Lot," investigation and direct reading instrument (DRI) monitoring could not readily identify a source. The odor descriptor provided by the affected worker is consistent with sewer odors or stagnant water observed in the area.

Direct reading instrumentation monitoring performed during TFC-OPS-OPER-C-67 response actions did not indicate further action was necessary with regard to a worker safety and health occupational exposure standpoint. As a result, the area was released from restricted access.

The following considerations support the IHIR-00080 conclusion:

- (1) At the time the odor was smelled, 242A was in a planned electrical outage with temporary power supplied by a portable generator located in the 242A parking lot. Based on this information and the odor descriptor "sulfur dioxide," monitoring for sulfur dioxide and hydrogen sulfide was performed.
- The American Industrial Hygiene Association (AIHA) Odor Threshold for Chemicals with Established Health Standards, 2nd Edition, lists hydrogen sulfide with the odor character "rotten eggs".
 - The AIHA Odor Threshold for Chemicals with Established Health Standards, 2nd Edition, lists sulfur dioxide with the odor character as "pungent, sour".
 - When monitoring for combustion engine vapors, DRI equipped with a carbon monoxide, nitric oxide, nitrogen dioxide, and sulfur dioxide electrochemical sensors, and a 10.6 eV photoionization detector (PID) for VOCs is typically utilized.

The Affected Area has a long history of similar odors or odors that have been found to be associated with sources other than Tank Farm vapor source emissions, such as septic tank gaseous emissions (which are known to change odor profile across a gradient when diluted by ambient atmosphere with distance from a point source) or anaerobic macrobiotic metabolic oxidation of

Washington River Protection Solutions
EVENT SUMMARY (Continued)

Project: Production Operations/242 A Evaporator

Date: 8/18/2023

Area/Building/Location: 200 East/242A Evaporator Parking Lot

Approximate Time of Event: 1930 hours

AR Number: WRPS-AR-2023-2205

Responsible Manager: [REDACTED]

EIR Number: EIR-2023-063

Event Investigator: [REDACTED]

Key Elements of the Investigation (Key Investigation points):

sulfur in stagnant water sources. Additionally, sulfur dioxide odors can be produced by combustion of sulfur containing fuels such as diesel powered internal combustion engines used to power electrical generators or air compressors. The initiating event was a stronger than normal "sulfur dioxide" odor. Sulfur odors are indicative of nearby septic related equipment, diesel powered internal combustion engines, or stagnant water sources.

(2) Potential odor sources:

- Sanitary sewage sources -
 - o Portable Toilets are ubiquitous throughout the A-Complex Tank farm facilities due to the large number of Tank Farm personnel and deficiencies in permanent bathroom facilities and related sanitary sewer system capacity. Multiple portable toilets are located adjacent to the 242A Evaporator facility; on the North side of the parking lot, to the Southwest at MO2251, and to the East at the western extent of the 241-A Farm change trailer lot.
 - o The 2607-E12 Sanitary Sewer Lift Station is located to the Southwest of the odor location and has historically been associated with similar odors, especially before the lift station was upgraded from a septic waste storage tank system in 2019. Although the legacy tank system was pumped to the extent possible before conversion, the tanks were abandoned in place and may be subject to meteoric or ground water intrusion.
- Internal Combustion Engines -
 - o An Allmand MAXI-POWER 25 diesel electrical generator is located immediately adjacent to the reported odor location. This diesel generator was in operation at the time of the odor event to supply temporary electrical power to the 242A Facility during an ongoing planned electrical outage. MAXI-POWER 25 consumes approximately 1.6 U.S. Gallons of diesel per hour of operation.
 - o A SULLAIR 185 diesel air compressor is located nearby to the Southeast of the reported odor location.
- Potential stagnant water sources -
 - o The 243-G82 Pressure Reducing Valve Pit is a 8 feet diameter 10.5 feet deep corrugated culvert pipe with a compacted gravel floor located to the South-Southwest of the reported odor location. The pit contains service water piping which may be a source of standing or interstitial (within the gravel and soil) water source if the water service piping/fittings are leaking.
 - o The 120R/994S vent station culvert is a corrugated steel culvert containing vents for the 120R and 994S Effluent Treatment Facility (ETF) influent water lines located immediately South of the reported odor location. The water lines could contain large quantities of standing water which are vented to atmosphere at this location.

At the approximate time of the event, the Barometric Pressure was increasing. When the outside air pressure changes, there is a small pressure imbalance between the headspace of a passively ventilated tank and the outside air. This imbalance pushes air into the tank or draws it out (barometric breathing). As the outside air pressure was increasing at the time of the event, passively ventilated tanks, such as septic tanks or water system vents, sucks air into the tank ("breathing-in"). Therefore, it is unlikely the cause of the odors may be contributed to venting of stagnant water or septic tank sources through barometric breathing. High wind conditions did exist at the time of the initiating event leading to possible "venturi effect" at certain locations. As per Bernoulli's Principle "an increase in the speed of a fluid occurs simultaneously with a decrease in static pressure or the fluid." In this case, the fluid is the atmosphere; lower pressure of high velocity atmosphere relative to the gaseous contents of tanks or other vented volumes (water line vents, septic tanks, portable toilets) could cause "breathing-out" of those systems.

Although known nearby sources exist, monitoring performed to support response actions did not readily identify a source. The event response DRI results were less than detectable in the Affected Area for ammonia, sulfur dioxide, hydrogen sulfide, nitric oxide, nitrogen dioxide, carbon monoxide, and VOCs.

Washington River Protection Solutions
EVENT SUMMARY (Continued)

Project: Production Operations/242 A Evaporator

Date: 8/18/2023

Area/Building/Location: 200 East/242A Evaporator Parking Lot

Approximate Time of Event: 1930 hours

AR Number: WRPS-AR-2023-2205

Responsible Manager: [REDACTED]

EIR Number: EIR-2023-063

Event Investigator: [REDACTED]

(3) Evaluation of the weather details determined the cause of the odor source was unlikely to be resultant of Tank Farms exhauster emissions based on the wind direction, wind speed, mixing height, and stability class at the reported time of event.

(4) While the reported odor location and odor descriptions are inconsistent with Tank Waste Chemical Vapors, due to the proximity of 242A Evaporator to the Tank Farms, monitoring for Tank Waste Chemical Vapors was still conducted during the TFC-OPS-OPER-C-67 response.

Because nitric acid was utilized in nearly all production processes that generated tank waste, and the most common byproduct of those processes was reduction of nitrate ion to ammonia during the dissolution (oxidation) of irradiated fuel, ammonia is the most prevalent chemical of potential concern (COPC) found in all tanks. Therefore, ammonia is utilized as a sentinel indicator for Tank Waste Chemical Vapor COPCs, thus DRIs equipped with an ammonia sensor are utilized at a minimum when monitoring for tank waste chemical vapors/COPCs. Monitoring for VOCs utilizing a DRI equipped 10.6 eV PID provides further indication for Tank Waste Chemical Vapors/COPCs.

Investigative TFC-OPS-OPER-C-67 Direct Reading Instrument (DRI) monitoring indicated less than detectable concentrations for ammonia (< 1 ppm) and Volatile Organic Compounds (VOCs) (\leq 0.01 ppm) utilizing a DRI equipped 10.6 eV PID. Providing further indication the cause of the reported odor was unlikely to be resultant of Tank Farms exhauster emissions.

(5) Memo WRPS-1904672.1, "TANK FARM EXHAUST STACK CONCENTRATION ALARM/ACTION LEVELS FOR AMMONIA" establishes ammonia concentration stack alarm/action set points for tank farm exhausters based on the predicated ammonia concentration at unspecified ground receptors utilizing the Quantitative Risk Assessment (QRA) model. The exhauster high level alarm was established at concentrations where the predicted ground receptor ammonia concentration of 2.5 ppm (or 10% of the established Occupational Exposure Limit for ammonia) could be observed. The exhauster high level alarm conservatively established for A Complex (excluding A farm) is 460 ppm. According to the Vapor Monitoring and Detection System (VMDS), the ammonia concentration observed at the time of event occurrence was 15.868 ppm at the 702-AZ exhauster, 0.00 ppm at the POR-126 exhauster, 5.338 ppm at the POR-127 exhauster, and 30.533 ppm at the AN exhauster. The AP exhauster is not currently connected to VMDS, issues have been identified with the AW exhauster VMDS; therefore, readings are acquired once per calendar day in accordance with TF-OPS-IHT-037 when ammonia stack monitoring via VMDS is unavailable. The highest ammonia concentrations observed between 08/11/2023 and 08/18/2023 was 10.0 ppm at the AP Exhauster and 6 ppm at the AW exhauster. Conservatively utilizing the higher ammonia concentration observed in the AN exhauster, a predicted ground receptor ammonia concentration of 0.165 ppm (or 0.60% of the established Occupational Exposure Limit for ammonia) would be expected if AN, AY/AZ, AX, AP, or AW farm exhauster emissions were present.

The exhauster high level alarm conservatively established for A farm is 160 ppm. According to the VMDS, the ammonia concentration observed at the time of event occurrence was 3.107 ppm at the POR-518 exhauster and 1.232 ppm at the POR-519 exhauster. Conservatively utilizing the higher ammonia concentration observed in the POR-518 exhauster, a predicted ground receptor ammonia concentration of 0.019 ppm (or 0.10% of the established Occupational Exposure Limit for ammonia) would be expected if A tank farm exhauster emissions were present.

Additional Compensatory/Remedial Measures (any additional measures taken if different from immediate actions):

None.

Lessons Learned or Information That the Work Force Needs Immediately:

Washington River Protection Solutions
EVENT SUMMARY (Continued)

Project: Production Operations/242A Evaporator

Date: 8/18/2023

Area/Building/Location: 200 East/242A Evaporator Parking Lot

Approximate Time of Event: 1930 hours

AR Number: WRPS-AR-2023-2205

Responsible Manager: [REDACTED]

EIR Number: EIR-2023-063

Event Investigator: [REDACTED]

Lessons Learned or Information That the Work Force Needs Immediately:

None. Per TFC-OPS-OPER-C-28, "Operating Experience/Lessons Learned," this event did not meet the criteria requiring generation of a Lessons Learned.

- An Event Investigation will be completed per [TFC-OPS-OPER-C-14](#)
- This event will be managed by another process, i.e., Operability Evaluation, Engineering Technical Evaluation, etc.
- This event does not require continuation of the Event Investigation process

Basis for Determination:

This event does not require continuation of the event investigation process under TFC-OPS-OPER-C-14, "Event Investigation Process." The facts, findings, and comprehensive account captured under this Event Summary and the Industrial Hygiene Event Investigation Report, IHIR-00080, "TFC-OPS-OPER-C-67 Response 242A Parking Lot," form the basis that further investigation will provide no additional information or operational benefit.

Responsible Manager:

[REDACTED]

Print First and Last Name

Digitally signed by [REDACTED]

Date: 2023.08.24 17:23:26 -07'00'
Signature / Date

CAS Manager:

[REDACTED]

Print First and Last Name

Digitally signed by [REDACTED]

Date: 2023.08.24 17:42:35 -07'00'
Signature / Date

Washington River Protection Solutions
INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT

Event Title: <p style="text-align: center;">TFC-OPS-OPER-C-67 Response 242-A Parking Lot</p>	PER Number: <p style="text-align: center;">N/A</p>
IHIR Number: <p style="text-align: center;">IHIR-00080</p>	

Date: 08/18/2023	Time: 1930	Location: 242-A Parking Lot (South East of 242-A Evaporator)
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Event Summary and Timeline:

Event Summary:
 "On 08/18/2023 at approximately 1930 hours, 1 [Nuclear Chemical Operator (NCO)] reported sulfur odors in the 242-A Evaporator parking lot. The NCO was crossing the parking lot to enter the building when he detected the odor. There were no reported symptoms and the individual declined medical evaluation. 242-A is in a planned electrical outage with temporary power supplied by a portable generator located in the 242-A parking lot."

Field Response Timeline:

- 1938 Shift Office Event Notification (SOEN): "Stronger than normal odors reported in the 242-A parking lot. Access to the 242-A parking lot is restricted. CSM"
- 1945 Central Shift Manager (CSM) contacts Production Operations East (POE) Level 3 Safety & Health (S&H) Manager:
 - 1 employee reported "stronger than normal" sulfur odor in 242-A Parking Lot
 - After discussions with CSM and POE Shift Industrial Hygiene Technician (IHT) 1, POE Level 3 S&H Manager verbally directed POE Shift IHT-1 to sweep parking lot with direct reading instrumentation (DRI):
 - Ammonia- Action Limit 12 ppm
 - Volatile Organic Compounds (VOC) 10.6 eV photoionization detector (PID) - Action Limit 2 ppm
 - Hydrogen Sulfide- 0.5 ppm
 - Due to strong wind from west POE Level 3 S&H Manager requests:
 - Sweep begin at railroad tracks West of 242-A facility, move East to the 242-A Boiler Annex building, then the parking lot area
 - Emphasized extensive monitoring around generator
 - Voluntary Respiratory Protection Equipment (RPE) offered to POE Shift IHT-1, but declined.
- 2001 POE Level 3 S&H Manager contacts POE Industrial Hygienist (IH) to confirm DRI monitoring requirements
 - POE IH recommends additional monitoring requirements:
 - Nitrogen Dioxide- Action Limit 0.1 ppm
 - Sulfur Dioxide- Action Limit 0.1 ppm
 - Carbon Monoxide - Action Limit 12 ppm
- 2003 POE Level 3 S&H Manager contacts CSM to confirm POE Shift IHT-1 name
- 2007 POE Level 3 S&H Manager contacts POE Shift IHT Supervisor to ensure instrumentation was available to support field response actions
- 2010 POE Level 3 S&H Manager attempts to contact POE Shift IHT-1 via cellular telephone
- 2012 POE Level 3 S&H Manager contacts POE Shift IHT-2 to ensure that POE Shift IHT-1 is updated on additional monitoring requirements
- 2014 POE Shift IHT-1 contacts POE Level 3 S&H Manager to communicate that additional monitoring requirements were conveyed by POE Shift IHT-2 and were being prepped for field response actions
 - POE Shift IHT-2 noted that wind was "very strong"
- 2018 POE Shift IHT-1 contacts POE Level 3 S&H Manager to inform that one instrument failed pre-use-function-check
 - POE Level 3 S&H Manager communicates "take adequate time while prepping instruments to ensure that all the required sensors prescribed were ready for use and that is more important than rushing the response"

NOTE: Field Response Timeline continued on next page.

Washington River Protection Solutions
INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT(Continued)

Event Summary and Timeline:

Field Response Timeline continued:

- 2024 Initiated Event Investigation Report (EIR) #2023-063, "TFC-OPS-OPER-C-67", Odor Response at 242-A Parking Lot
- Performance Assurance (PA) Technical Specialist point-of-contact assigned
- 2039 POE Level 3 S&H Manager contacts PA Technical Specialist to inquire about needed material for event summary
- 2056 PA Technical Specialist requests to receive Odor/Vapor Response Card(s), Shift Office electronic logs and notifications, and TFC-OPS-OPER-C-67 attachments
- 2117 POE Shift IHT contacts POE Level 3 S&H Manager to provide results of field response actions:
- Extensive survey performed in area around generator
 - All readings less than background
 - Wind still very strong
 - No odors matching odor descriptor were perceptible during field response actions
 - No portable toilets were blown over in area near 242-A, no anomalous conditions around 242-A Boiler annex
- 2123 POE Level 3 S&H Manager contacts Level 1 Environmental Safety Health & Quality (ESH&Q) Manager and Level 2 IH Manager to provide briefing of field response actions and results
- Discussed weather conditions and possible sewer related odor sources
 - Discussed completion of Industrial Hygiene Event Investigation Report (IHIR) and related data reporting on following Monday (08/21/2023)
- 2130 POE Shift IHT-1 contacts POE Level 3 S&H Manager to confirm correct Industrial Hygiene Sample Plan (IHSP) for entry into Site Wide Industrial Hygiene Database (SWIHD) survey
- 2140 POE Level 3 S&H Manager provides email with PDF of IHSP-POE-MULTI-TFCOPSOPERC67 to POE Shift IHT-1 and CSM
- 2141 CSM contacts POE Level 3 S&H Manager to request notification of DRI instrumentation post-use-function-test, and per telecom approval of TFC-OPS-OPER-C-67 Attachment A "Response Plan"
- 2145 POE Level 3 S&H Manager provides contacts CSM to provide approval of TFC-OPS-OPER-C-67 Attachment A "Response Plan"
- POE Level 3 S&H Manager requests electronic copy of Odor/Vapor Response Card and TFC-OPS-OPER-C-67 Attachment A "Response Plan"
 - POE Level 3 S&H Manager confirms that affected employee declined precautionary medical surveillance

Field Response Timeline Acronyms:

CSM	Central Shift Manager	PA	performance assurance
EIR	Event Investigation Report	PID	photo-ionization detector
ESH&Q	Environmental, Safety, Health, & Quality	POE	Production Operations East
eV	electron-volts	ppm	parts per million
IHIR	Industrial Hygiene Event Investigation Report	RPE	respiratory protection equipment
IHSP	Industrial Hygiene Sample Plan	S&H	Safety & Health
IHT	Industrial Hygiene Technician	SOEN	Shift Office Event Notification
IHT	Industrial Hygienist	SWIHD	Site Wide Industrial Hygiene Database
NCO	Nuclear Chemical Operator	VOC	Volatile Organic Compound

Washington River Protection Solutions
INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT(Continued)

Sampling/Monitoring Results:

Direct Reading Instrument Monitoring Results:

- Monitoring performed in and around Affected Area
 - o Comments by Responding IHT- "IHT did monitoring for [hydrogen sulfide, nitrogen dioxide, sulfur dioxide, carbon monoxide, ammonia,] and VOCs this evening in around the 242A parking lot. IHT also did a thorough sweep around the generator that the evaporator is using for power during there electrical outage. Since there is such a strong wind tonight IHT also sweep from the railroad tracks in a easterly directions to see if they can pick anything up. All readings were below action limits."
- Peak readings during response at or below background.

Location	Ammonia	VOCs	Hydrogen Sulfide	Carbon Dioxide
242A Parking Lot	< 1 ppm	< 0.010 ppm	< 0.1 ppm	< 1 ppm
242A parking lot (Generator)	< 1 ppm	< 0.010 ppm	< 0.1 ppm	< 1 ppm
242A parking lot along A farm fence	< 1 ppm	< 0.010 ppm	< 0.1 ppm	< 1 ppm
242A parking lot to fourth & buffalo	< 1 ppm	< 0.010 ppm	< 0.1 ppm	< 1 ppm

Location	Nitric Oxide	Nitrogen Dioxide	Sulfur Dioxide
242A Parking Lot	< 1 ppm	< 0.1 ppm	< 0.1 ppm
242A parking lot (Generator)	< 1 ppm	< 0.1 ppm	< 0.1 ppm
242A parking lot along A farm fence	< 1 ppm	< 0.1 ppm	< 0.1 ppm
242A parking lot to fourth & buffalo	< 1 ppm	< 0.1 ppm	< 0.1 ppm

Refer to IHIR-00080 Attachment A for SmartSite™ Summary and Response Map.

SWIHD References:

- Event Response Site Wide Industrial Hygiene Database Direct Reading Instrumentation (DRI) Survey:
- # 23-05625 "TFC-OPS-OPER-C-67 242-A Parking Lot"

Additional Information:

Respiratory Protection Equipment was not prescribed for the Initiating Event. Accordingly, at the time of the Initiating Event, the Affected Workers were not wearing Respiratory Protection Equipment. Respiratory Protection Equipment was not required, nor worn, for Response Actions.

While the odor description is inconsistent with Tank Waste Chemical Vapors, due to the proximity to the Tank Farms, monitoring for Tank Waste Chemical Vapors was performed:

Ammonia is used as a sentinel Tank Waste Chemical Vapor for chemicals of potential concern (COPC). Each Hanford production process had different feedstock chemicals and generated different waste streams. Hanford production processes were also separated temporally, with different processes being performed at different times in the history of Hanford production (1943 - 1986). Some chemicals are common to all processes/waste streams (e.g., nitric acid), while others are specific to particular processes/waste streams. Some in-tank waste treatment processes (e.g., neutralization and de-nitrification) used the same chemical feed stocks (e.g., sodium hydroxide solution) in most, if not all Tank Farms. The chemistry and radiochemistry of these compounds result in waste stream similarities across all tank farms. Because nitric acid was common to nearly all processes that generated tank waste, and the most common result of those processes was reduction of nitrate ion to ammonia during the dissolution (oxidation) of irradiated fuel, ammonia is the most common COPC and is found in all tanks. It is logical to choose ammonia for the sentinel as it is a byproduct of all production processes and found in all tanks.

NOTE: Additional Information continued on next page.

Washington River Protection Solutions
INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT(Continued)

Additional Information:

Additional Information continued:

Therefore, when monitoring for Tank Waste Chemical Vapors/COPCs, DRI equipped with an ammonia sensor is utilized at a minimum. Additional COPC monitoring was conducted concurrently with ammonia during the event response. The COPC with DRI monitoring capabilities readily available at the Tank Farms includes VOCs. As individual agents are not identified when monitoring for VOCs, an Action Limit was developed as an indicator of Tank Farm emissions (mixture of organic vapors) that could impact workers' health and conservatively set at 2 ppm. When monitoring for Tank Waste VOC vapors, DRI equipped with a 10.6 eV PID is utilized to detect multiple VOC COPCs simultaneously. NOTE: The 2 ppm Action Limit is not applicable to chemical use.

Review of the Data Fusion & Advisory System (DFAS) application, powered by SmartSite™, Weather Details dashboard for the approximate time of the Event:

08/18/2023 @ 1930 (approximate time of initiating event):

- Wind Speed: 19 mph (15 minute average)
- Wind Direction: 315.80° (out of Northwest)
- Mixing Height: 1200 feet above grade
- Stability Class: E (slightly stable conditions)

Meteorological information from the Hanford Weather Station for Station #6 on 08/18/2023 @ 1925:

- Temperature: 90°F
- Relative Humidity: 15.0%
- Wind Speed: 16 mph
- Wind Direction: from 315° (out of Northwest)
- Barometric Pressure: 29.01 inches of mercury and increasing

Vapor Monitoring Detection System (VMDS) exhauster ammonia readings on 08/18/2023 @ 1930:

- POR518 (241-A): 3.107 ppm
- POR519 (241-A): 0 ppm
- 241-AN: 30.480 ppm
- 241-AW: 0 ppm
- POR126 (241-AX): 0 ppm
- POR127 (241-AX): 5.338 ppm
- 702AZ (241-AY/AZ): 15.757 ppm
- 241-AP: N/A

Memo WRPS-1904672.1, TANK FARM EXHAUST ~ CK CONCENTRATION ALARM/ ACTION LEVELS FOR AMMONIA establishes stack alarm/action set points for Tank Farm Exhausters. The alarm/action set points are based on a linear extrapolation of the Quantitative Risk Assessment (QRA) model prediction; conservatively established at the ammonia stack concentration that could result in various ammonia concentrations at an unspecified ground receptor:

- High Alarm → ammonia concentration of 2.5 ppm at an unspecified ground receptor
- High High Alarm → ammonia concentration of 5 ppm at an unspecified ground receptor

Memo WRPS-1904672.1, TANK FARM EXHAUST ~ CK CONCENTRATION ALARM/ ACTION LEVELS FOR AMMONIA:

Tank Farm	Exhauster	High Alarm	High High Alarm
241-A	POR518/POR519	160 ppm	320 ppm
241-AN	Primary		
241-AP	Primary		
241-AW	Primary	460 ppm	920 ppm
241-AX	POR126/POR127		
241-AY/AZ	702AZ		

NOTE: Additional Information continued on next page.

Washington River Protection Solutions
INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT(Continued)

Additional Information continued:

Vapor Monitoring Detection System (VMDS) 08/17/2023 @ 1930 to 08/18/2023 @ 1930:

Tank Farm	Exhauster	Minimum*A	Maximum*A
241-A	POR518/POR519	0 ppm	3.268 ppm
241-AN	Primary	27.210 ppm	30.559 ppm
241-AW	Primary	0 ppm	0 ppm
241-AX	POR126/POR127	0 ppm	4.854 ppm
241-AY/AZ	702AZ	15.225 ppm	15.673 ppm

*A VMDS Alternate Real Time Monitoring performed 08/17/2023 to 08/18/2023 for 241-AP and 241-AW.

The 241-AP Primary Exhauster is not currently connected to the VMDS software. When stack monitoring via the VMDS is unavailable, and ventilation is operating, IH will conduct alternate monitoring for ammonia. Report TOC-IH-RPT-50042, Ammonia Monitoring- Rate of Change of Tank Vapor Source Concentration and Monitoring Frequency, recommends measuring the exhaust ventilation systems once every 4 days. Conservatively, stack readings are required once per calendar day, in accordance with ARP-T-041-00002 and are acquired in accordance with TF-OPS-IHT-037.

Vapor Monitoring Detection System (VMDS) Alternate Monitoring 08/11/2023 to 08/18/2023:

Tank Farm	Exhauster	Minimum	Maximum
241-AP	Primary	4 ppm	10 ppm
241-AW	Primary	5 ppm	6 ppm

Based on the odor descriptor "sulfur dioxide" and the anecdotal reference to diesel generator use in the affected area, monitoring for sulfur dioxide and hydrogen sulfide vapors was performed:

- The American Industrial Hygiene Association (AIHA) Odor Threshold for Chemicals with Established Health Standards, 2nd Edition, lists hydrogen sulfide with the odor character "rotten eggs".
- The AIHA Odor Threshold for Chemicals with Established Health Standards, 2nd Edition, lists sulfur dioxide with the odor character as "pungent, sour".
- When monitoring for combustion engine vapors, DRI equipped with a carbon monoxide, nitric oxide, nitrogen dioxide, and sulfur dioxide electrochemical sensors, and a 10.6 eV PID for VOCs is typically utilized.
- Refer to TOC-IH-58956 for more detail on the monitoring strategy for response to odors.

Additional information about odor conditions around Tank Farm facilities-

The Hanford Site Tank Operations Contractor, Washington River Protections Solutions, LLC (WRPS), Chemical Vapor Solutions Team (CVST) chartered a Fugitive Emissions (FE) sub-team. The primary focus of the FE workscope was to identify odor sources around the Tank Farms work areas, characterizing the type and concentration of the odor constituents. The FE sub-team's investigations included characterizing how septic/sewer odors change odor profile across a gradient when diluted by ambient atmosphere with distance from a point source. The major components of sewer gases can include: Hydrogen Sulfide, Carbon Dioxide, Methane, and Ammonia. The FE sub-team's investigations found that close to the septic system (within approximately 20') the odor was described as sewer. Further away from septic system (within approximately 100') the odor was described as skunk. Even further away from septic system (within approximately 200') the odor was described as body odor. It should be noted that odors are a perception and can be vary between individuals.

NOTE: Additional Information continued on next page.

Washington River Protection Solutions
INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT(Continued)

Additional Information continued:

The Affected Area has a long history of similar odors or odors that have been found to be associated with sources other than Tank Farm vapor source emissions, such as septic tank gaseous emissions (which are known to change odor profile across a gradient when diluted by ambient atmosphere with distance from a point source) or anaerobic macrobiotic metabolic oxidation of sulfur in stagnant water sources. Additionally, sulfur dioxide odors can be produced by combustion of sulfur containing fuels such as diesel powered internal combustion engines used to power electrical generators or air compressors. The initiating event was a stronger than normal "sulfur dioxide" odor. Sulfur odors are indicative of nearby septic related equipment, diesel powered internal combustion engines, or stagnant water sources.

Hydrogen sulfide gas has an offensive distinct rotten egg odor that is detectable at very low concentrations. The lower range of odor values for hydrogen sulfide as 40 ppt (or 0.04 ppb or 0.00004 ppm). Sulfur Dioxide has a pungent, sour odor that is detectable at concentrations as low as 0.47 ppm. Ammonia gas has an offensive pungent, irritating odor that is detectable at very low concentrations. The lower range of odor values for ammonia as 43 ppb (or 0.043 ppm) (AIHA, 2013). While odors may be readily perceived, concentrations are still well below levels of worker exposure concern. Hydrogen sulfide, ammonia, and VOC gas production rate is a function of bacteria/organics concentrations, temperature, and dissolved oxygen.

The resolution of DRI equipped with hydrogen sulfide (0.1 ppm), sulfur dioxide (0.1 ppm), and ammonia (1 ppm) sensors are comparatively inadequate as a detection tool at the concentrations perceived by the human olfactory sense. While the resolution of the DRI equipped with these sensors are insufficient to detect concentrations at the lower range of odor threshold values, they are sufficient to detect hydrogen sulfide and ammonia at concentrations that approach their established occupational exposure limits (OELs).

Limit Type	Concentrations			
	Hydrogen Sulfide	Sulfur dioxide	Ammonia	VOCs
Odor Response Action Limit	0.5 ppm	0.1 ppm	12 ppm	2 ppm
ACGIH 8-hour TWA-TLV	1 ppm	--	25 ppm	--
ACGIH 15-minute STEL-TLV	5 ppm	0.25 ppm	35 ppm	--
OSHA 8-hour TWA-PEL	--	5 ppm	50 ppm	--
OSHA Ceiling-PEL	20 ppm	--	--	--
OSHA 10-minute Peak-PEL*	50 ppm	--	--	--
NIOSH IDLH	100 ppm	100 ppm	300 ppm	--

*Allowed for 10-mintues if there is no other exposure to hydrogen sulfide during the shift

References

American Conference of Governmental Industrial Hygienists (2016). TLVs® and BEIs® Based on the Documentation of the Threshold Limit Values for Chemicals Substances and Physical Agents & Biological Exposure Indices. Cincinnati, OH: Signature Publications.

American Industrial Hygiene Association (2013). Odor Thresholds for Chemicals with Established Health Standards, 2nd Edition.

Silva, D.P. (2002). The chemical logic behind... Fermentation and Respiration. Retrieved from <https://aggie-horticulture.tamu.edu/earthkind/landscape/dont-bag-it/chapter-1-the-decomposition-process/>

Texas A&M (2009). Earth-Kind Landscaping: Chapter 1, The Decomposition Process. Retrieved from <https://web.archive.org/web/20080917123419/http://www2.ufp.pt/~pedros/bq/respi.htm>

The event response DRI results were less than detectable in the Affected Area for ammonia, sulfur dioxide, hydrogen sulfide, nitric oxide, nitrogen dioxide, carbon monoxide, and VOCs. These results along with the review of the atmospheric conditions (DFAS application, powered by SmartSite™, and those provided by On-Duty Forecaster) outside of Affected Area around the reported time of the event indicate the cause of the odor is unlikely to be from Tank Farm emissions. The Atmospheric Stability Class at 1930 was slightly stable conditions. The Atmospheric Mixing Height was steady at 1200 feet above grade.

NOTE: Additional Information continued on next page.

Washington River Protection Solutions
INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT(Continued)

Additional Information continued:

Potential odor sources:

- Sanitary sewage sources -
 - o Portable Toilets are ubiquitous throughout the A-Complex Tank farm facilities due to the large number of Tank Farm personnel and deficiencies in permanent bathroom facilities and related sanitary sewer system capacity. Multiple portable toilets are located adjacent to the 242-A Evaporator facility; on the North side of the parking lot, to the Southwest at M02251, and to the East at the western extent of the 241-A Farm change trailer lot.
 - o The 2607-E12 Sanitary Sewer Lift Station is located to the Southwest of the odor location and has historically been associated with similar odors (septic/sewer odors change odor profile across a gradient when diluted by ambient atmosphere with distance from a point source) especially before the lift station was upgraded from a septic waste storage tank system in 2019. Although the legacy tank system was pumped to the extent possible before conversion, the tanks were abandoned in place and may be subject to meteoric or ground water intrusion.
- Internal Combustion Engines -
 - o An Allmand MAXI-POWER 25 diesel electrical generator is located immediately adjacent to the reported odor location. This diesel generator was in operation at the time of the odor event to supply temporary electrical power to the 242-A Facility during an ongoing planned electrical outage. The MAXI-POWER 25 has a diesel powered 2.2L 4-cylinder turbocharged Isuzu 4LE2T 33.3 horsepower engine equipped with Diesel Oxidation Catalyst emission reduction system. The MAXI-POWER 25 consumes approximately 1.6 U.S. Gallons of diesel per hour of operation.
 - o A SULLAIR 185 diesel air compressor is located nearby to the Southeast of the reported odor location. It is not known if the air compressor was in operation during the time of the odor event. The SULLAIR 185 has a diesel powered 2.2L 4-cylinder turbocharged KUBOTA KUB1803 28 horsepower engine equipped with Diesel Oxidation Catalyst emission reduction system. The SULLAIR 185 consumes approximately 2.7 U.S. Gallons of diesel per hour of operation.
- Potential stagnant water sources -
 - o The 243-G82 Pressure Reducing Valve Pit is a 8 feet diameter 10.5 feet deep corrugated culvert pipe with a compacted gravel floor located to the South-Southwest of the reported odor location. The pit contains service water piping which may be a source of standing or interstitial (within the gravel and soil) water source if the water service piping/fittings are leaking.
 - o The 120R/994S vent station culvert is a corrugated steel culvert containing vents for the 120R and 994S Effluent Treatment Facility (ETF) influent water lines located immediately South of the reported odor location. The water lines could contain large quantities of standing water which are vented to atmosphere at this location.

At the approximate time of the event, the Barometric Pressure was increasing. When the outside air pressure changes, there is a small pressure imbalance between the headspace of a passively ventilated tank and the outside air. This imbalance pushes air into the tank or draws it out (barometric breathing). As the outside air pressure was increasing at the time of the event, passively ventilated tanks, such as septic tanks or water system vents, sucks air into the tank ("breathing-in"). Therefore, it is unlikely the cause of the odors may be contributed to venting of stagnant water or septic tank sources through barometric breathing. High wind conditions did exist at the time of the initiating event leading to possible "venturi effect" at certain locations. As per Bernoulli's Principle "an increase in the speed of a fluid occurs simultaneously with a decrease in static pressure or the fluid". In this case, the fluid is the atmosphere; lower pressure of high velocity atmosphere relative to the gaseous contents of tanks or other vented volumes (water line vents, septic tanks, portable toilets) could cause "breathing-out" of those systems. Although known nearby sources exist, monitoring performed to support response actions did not readily identify a source.

Refer to IHIR-00080 Attachment A for SmartSite™ Summary, Response Map, and Response Pictures.

NOTE: Additional Information continued on next page.

Washington River Protection Solutions
INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT(Continued)

Additional Information Acronyms:

ACGIH	American Conference of Governmental Industrial Hygienists		
NIOSH	National Institute of Occupational Safety & Health		
AIHA	American Industrial Hygiene Association	PEL	Permissible Exposure Limit
COPC	chemical of potential concern	PID	photoionization detector
CVST	Chemical Vapors Solutions Team	ppb	parts per billion
DFAS	Data Fusion & Advisory System	ppm	parts per million
DRI	direct reading instrument	ppt	parts per trillion
ETF	Effluent Treatment Facility	STEL	short-term exposure limit
eV	electron-volts	TLV	Threshold Limit Value
FE	fugitive emissions	TWA	time-weighted average
IDLH	Immediately Dangerous to Life or Health	VMSD	Vapor Monitoring Detection System
mph	miles per hour	VOC	Volatile Organic Compound
OEL	occupational exposure limit	WRPS	Washington River Protection Solutions

Recommendations/Conclusions:

Recommendations:

N/A

Conclusions:

Direct Reading Instrumentation monitoring performed during response actions did not indicate further action was necessary to protect worker safety and health. As a result the area was released from restricted access and work was allowed to continue. Odor descriptors provided by Affected Workers are consistent with sewer odors or stagnant water sources observed in the area. Although known nearby sources exist, monitoring performed to support response actions did not readily identify a source, as readings indicated that further response action was not necessary.

Other:

- No symptoms were reported, Affected employee declined precautionary medical evaluation.
- Event Investigation Report (EIR) #2023-063.

Industrial Hygienist:

Print First and Last Name

Digitally signed by _____

Signature / Date

Industrial Hygiene Level 2 Manager:

Print First and Last Name

Signature / Date

IHIR-00080 Attachment A: SmartSite™ Summary, Response Map, and Pictures



Figure 1. 200-East Area (with 241-AW, 241-AP, 241-AN, 241-AY/AZ, 241-AX, 241-A Farm projected plume models) at 1930 08/18/2023 from Data Fusion and Advisory System (DFAS) application, powered by SmartSite™

NOTE: 241-AN, 241-A, 241-AW Farm Exhausters are not connected to the DFAS; however, an approximate exhauster plume was added for each based on other modeled plumes.

IHIR-00080 Attachment A: SmartSite™ Summary, Response Map, and Pictures

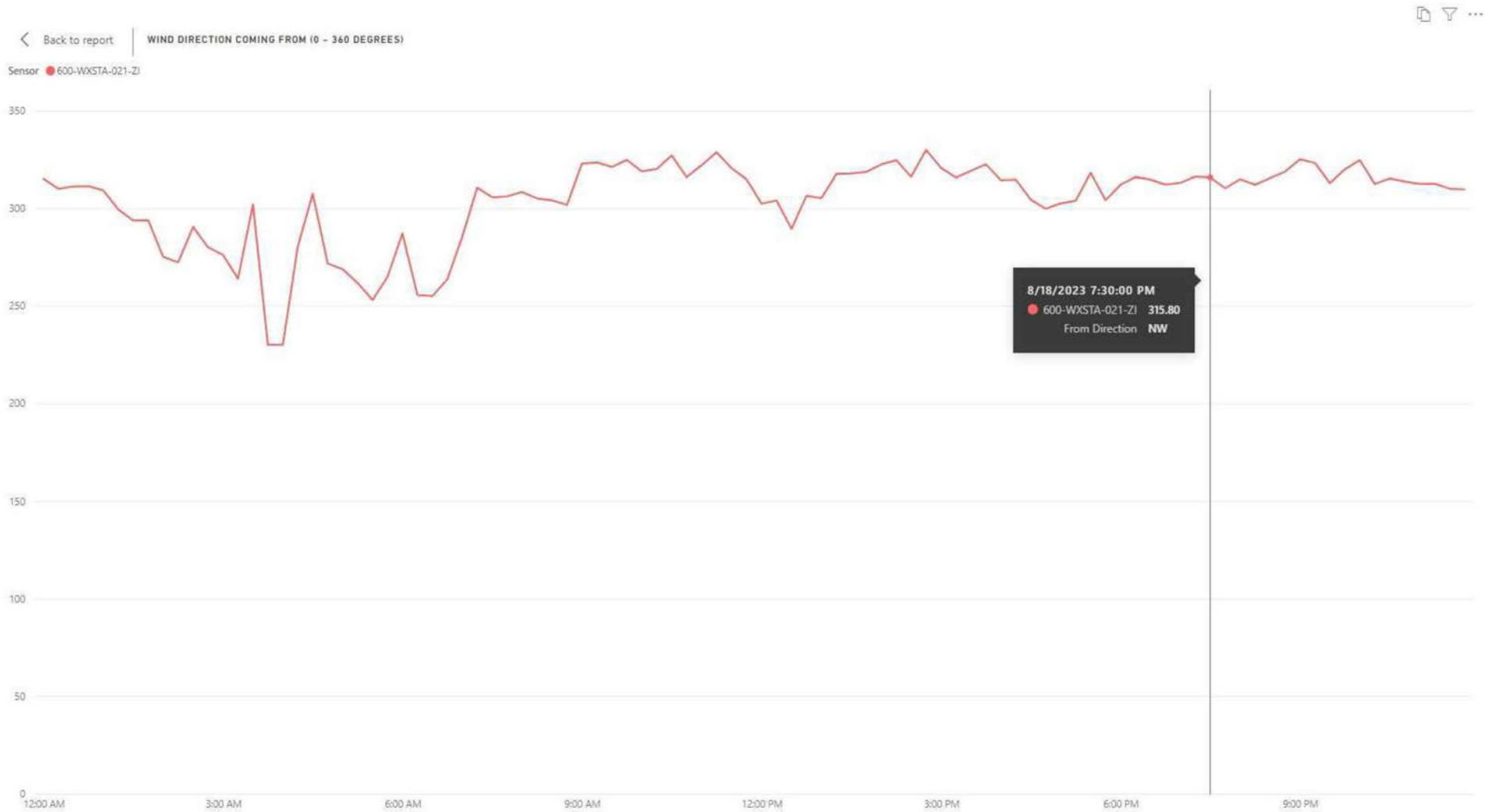


Figure 2. DFAS application, powered by SmartSite™ Weather Data (Wind Direction) from 1930 08/18/2023

IHIR-00080 Attachment A: SmartSite™ Summary, Response Map, and Pictures

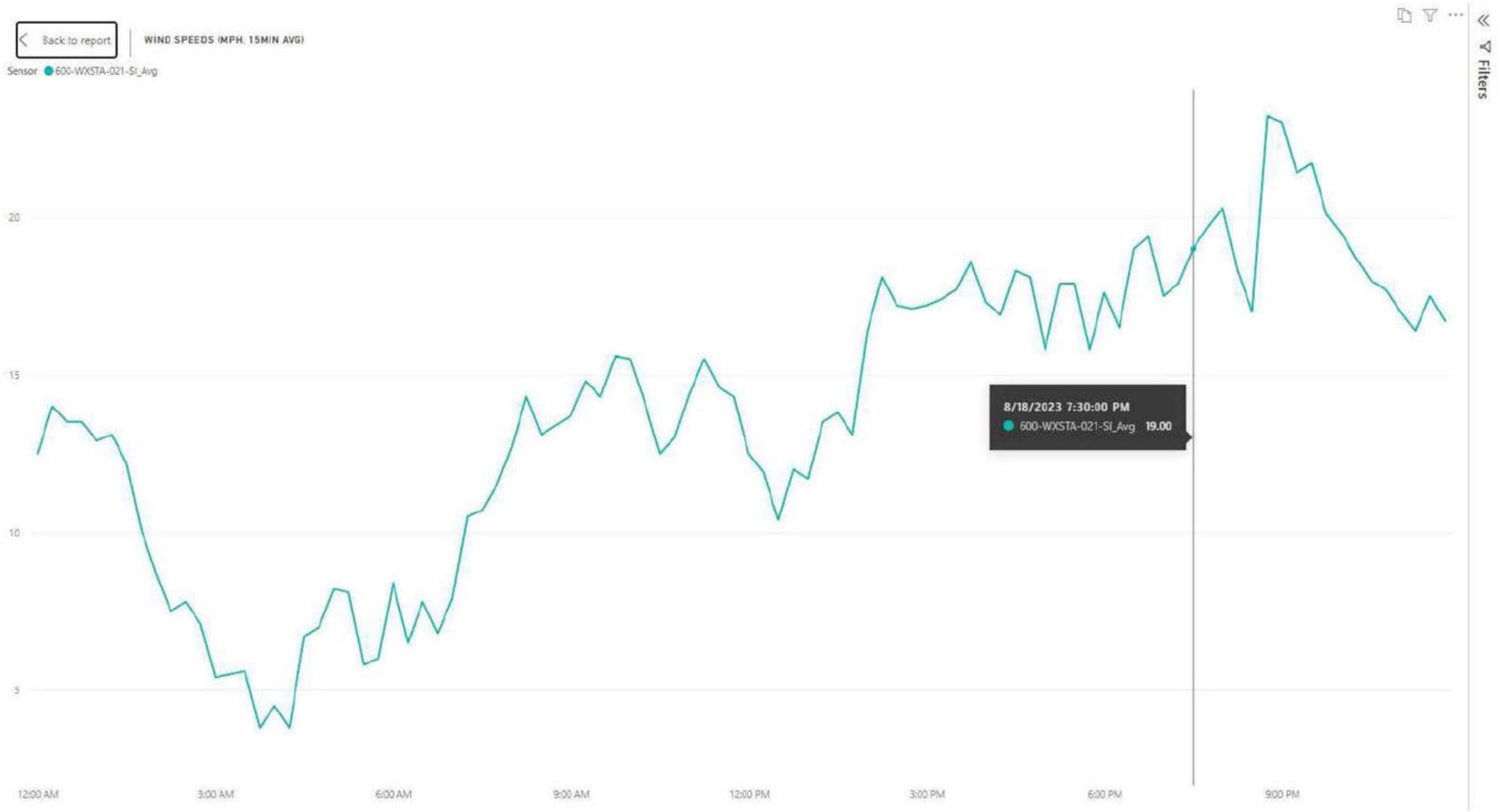


Figure 3. DFAS application, powered powered by SmartSite™ Weather Data (Wind Speed) from 1930 08/18/2023

IHIR-00080 Attachment A: SmartSite™ Summary, Response Map, and Pictures

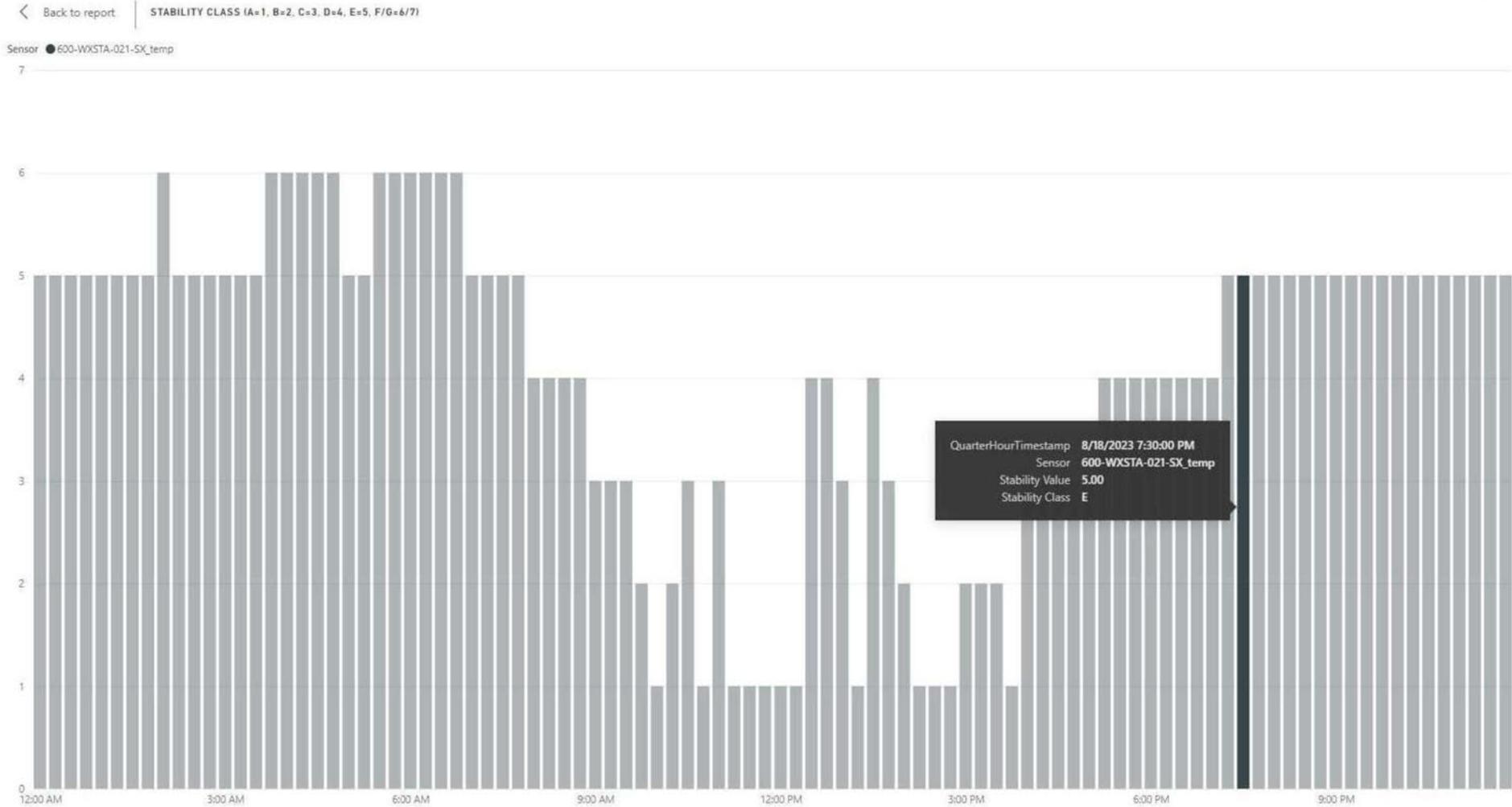


Figure 4. DFAS application, powered by SmartSite™ Weather Data (Stability Class) from 1930 08/18/2023

IHIR-00080 Attachment A: SmartSite™ Summary, Response Map, and Pictures

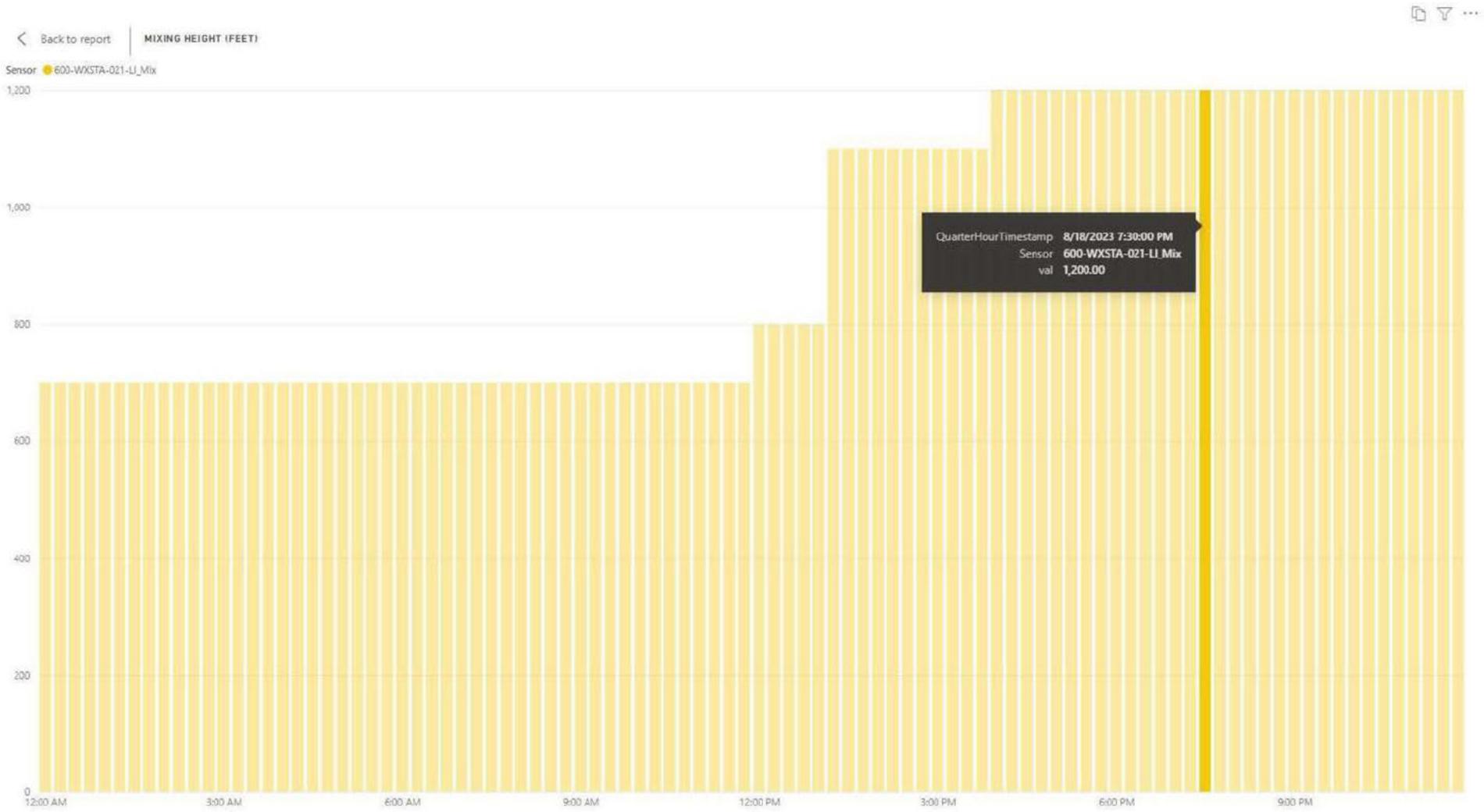


Figure 5. DFAS application, powered by SmartSite™ Weather Data (Mixing Height) from 1930 08/18/2023

IHIR-00080 Attachment A: SmartSite™ Summary, Response Map, and Pictures

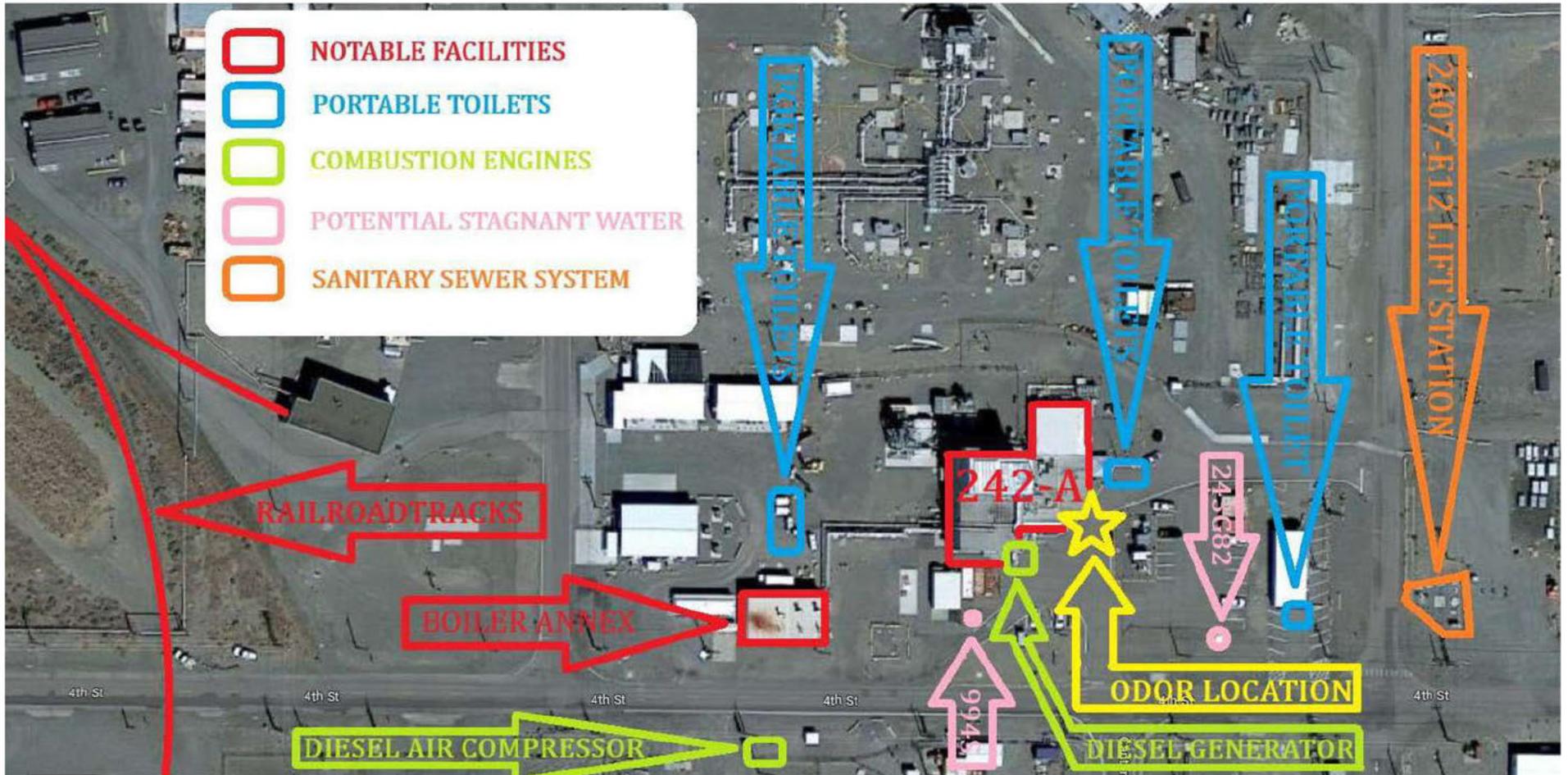


Figure 6. Event Location map showing notable facilities and potential odor locations consistent with odor descriptor.



Figure 7. Allmand MAXI-POWER 25 Diesel powered generator (located adjacent to reported odor location).



Figure 7. SULLAIR 185 Diesel powered air compressor (located East-Southeast of reported odor location).



Figure 8. Portable toilets in 242-A Parking Lot (located North of reported odor location).



Figure 9. Portable toilets adjacent to 242-A Facility (located East of reported odor location).



Figure 10. Portable toilet adjacent to 242-A Facility (located West-Southwest of reported odor location).



Figure 11. 2607-E12 Sewage lift station (located West-Southwest of reported odor location).



Figure 12. 243-G82 Service water pressure-reducing-valve encasement (located Southwest of reported odor location).



Figure 13. 120R/994S ETF influent vent station (located South of reported odor location).