

Washington River Protection Solutions
EVENT SUMMARY

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:

1. **Project:** Effluent Treatment Facility (ETF) 2. **Report Date:** 9/30/2024

3. **Investigation Title:** Response to Odors at ETF

4. **Investigation Report Number:** EIR-2024-073

5. **Responsible Manager:** [REDACTED]

6. **Event Investigator:** [REDACTED]

7. **Area / Building / Location:** 200 East Area/ETF/2025E/Room 131 (Process Floor)

8. **Date and Approximate Time of Event:** **Date:** 09/10/2024 **Time (military):** 1052 hours

9. **Associated Action Request (AR) Number:** WRPS-AR-2024-2822

10. **Associated Occurrence Report Number (if applicable):** N/A

11. **Event Investigation Meeting Held:** Yes [] or No [X] **Date:** N/A **Time (military):** N/A

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

At the time of the event, a lockout/tagout (LO/TO) was in process to support semi-annual maintenance on 45B-EVU-1A and 45B-EVU-1B Buffalo Air Handling Units (AHUs) located on the northeast exterior of 2025E. On the Process Floor (Room 131); the following activities were in progress at various stages: calibrations on the polisher system, a routine Industrial Hygiene Surveillance, daily rounds and routines, and a walkdown of the Process Floor.

The below Work Orders (WO) were in progress:

- WO# 1129168, 2025/NORTH YARD: Semi-Ann 45B-EVU-1A INSP.
- WO# 1128960, 2025/NORTH YARD: Semi-Ann 45B-EVU-1B INSP.
- WO# 1136303, 2025/131: 30D AY AIT-60G-104 POLISHER COND. CAL
- WO# 1136307, 2025/131: 30 DAY AIT-60G-204 POLISHER COND. CAL
- WO# 1136311, 2025/131: 30 DAY AIT-60G-304 POLISHER COND. CAL

13. **Personnel Involved:** (Job positions, number of personnel, identify any support organizations or subcontractors)

The following employees reported smelling stronger than normal odors on Odor/Vapor Response Cards (OVRC)

- 4-WRPS Nuclear Chemical Operators (NCO)
- 1-WRPS Instrument Technician (IT)
- 1-WRPS Field Work Supervisor (FWS)
- 1-WRPS Engineer
- 1-WRPS ETF Shift Operating Manager (SOM)
- 1-WRPS ETF Operations Manager

Response personnel included:

- 3-WRPS Radiological Control Technicians (RCT)
- 2-WRPS Industrial Hygiene Technicians (IHT)
- 1-WRPS Industrial Hygiene Professional (IH)

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

On 9/10/24, between 0830 and 1100 hours, approximately twelve workers reported stronger than normal odors on the Process Floor (Room 131) at the ETF. The SOM notified the Central Shift Manager (CSM) to initiate TFC-OPS-OPER-C-67, *Response to Stronger than Normal Odors*. The odor was described as "septic/sewer," "musty," "peanuts," "smoky," "ammonia," "rotten," "burnt," "bitter," "peanut butter," and "earthy". Four of the nine workers documented symptoms on the Odor/Vapor Response Cards (OVRC). Four additional workers later reported symptoms. In total, eight employees reported symptoms and were evaluated at the Inomedic Health Applications (IHA) onsite medical provider.

IHTs performed Direct Read Instrumentation (DRI) response monitoring per Industrial Hygiene Sampling Plan, IHSP-POE-MULTI-TFCOPSOPERC67, at the sump, trenches around the sump, various areas throughout the Process Floor, and inside the Ventilation Off Gas (VOG) and Radiological Control Area (RCA) ventilation equipment rooms. DRI monitoring was performed while the VOG and RCA ventilation was secured and again once the ventilation was restored to operational. The VOG and RCA heating ventilation and air conditioning (HVAC) was not in operation at the time of the event. All DRI readings were below action limits (AL). A grab air sample was collected at Sump Tank 1, 20B-TK-1, for further Volatile Organic Compound (VOC) analysis.

By 1713 hours, all workers were released to return to work with no restrictions.

Summary of 09/10/2024 event:

On 09/10/2024, the VOG was shut down at 0654 hours followed by the shutdown of the RCA HVAC at 0705 hours to support semi-annual preventative maintenance work on the Buffalo AHUs utilizing WO# 1129168 and WO# 1128960. An announcement was made using the Private Automatic Exchange (PAX) communication system, notifying the ETF campus that ventilation was not in operation. Calibrations on the polisher system were being conducted per WO# 1136303, WO# 1136307, and WO# 1136311.

At approximately 1020 hours, an IHT was performing routine monitoring on the Process Floor for ammonia (NH₃) and VOCs when they reported a "burnt peanut butter" odor. Routine monitoring indicated VOC and NH₃ concentrations were below Als. However, when the IHT cracked the hatch over Sump Tank 1, 20B-TK-1, a sustained reading of 4 parts per million (ppm) of NH₃ was detected. The IHT noted that while the 4ppm reading was below the AL of 12 ppm, it was above anticipated background levels and is not typical of Process Floor conditions. The IHT notified the IH and the SOM of findings. In parallel, employees on the Process Floor began experiencing symptoms due to the reported odor. Symptoms reported included congestion, headache, sore throat, difficulty breathing, taste, light headedness, cough, and tingling.

At 1030 hours, a PAX announcement was made restricting access to the Process Floor due to the reported odors and the ETF entered TFC-OPS-OPER-C-67 at approximately 1052 hours. At the time of the odor event, the LOTO associated with LEF-24-078 supporting the work on the Buffalo AHUs were partially installed. It was decided TAF LEF-24-078 LOTOs would be removed to restore ventilation and the south roll-up door was opened to create airflow to mitigate odors.

Several employees indicated the odor was noticed as soon as they entered the Process Floor, and noted the odor was more concentrated around Sump Tank-1, 20B-TK-1. The hatch to the sump was slightly ajar to allow for a hose and electrical cord connected to a Little Giant submersible pump used to pump out the contents of the sump, reference Figure 1.

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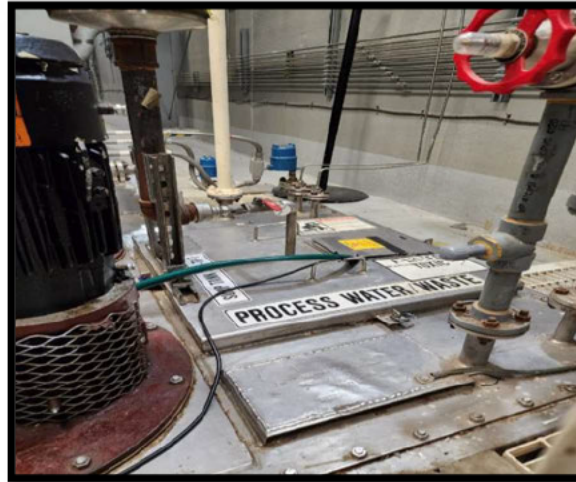


Figure 1-Sump Tank 1, 20B-TK-1

At 1256 hours, IHTs responded per TFC-OPS-OPER-C-67 Attachment A and conducted monitoring and sampling per IHSP-POE-MULTI-TFCOPSOPERC67. The DRI results were below ALs, see Table 1.

Table 1: Initial DRI Results Without Ventilation

Location	Ammonia AL=12ppm	VOC (10.6 eV PID)	VOC (11.7 eV PID)	Hydrogen Sulfide AL=0.5 ppm
At Sump & trenches around sump	Less than detectable	120 ppb	Less than detectable	Less than detectable
Throughout Process floor, mezzanine	Less than detectable	50-80 ppb	Less than detectable	Less than detectable
VOG and RCA HVAC Room, Brine Load-out, and storage area east of 2025E	Less than detectable	30-50 ppb	Less than detectable	Less than detectable

ppb=parts per billion

A grab air sample was collected from the 20B-TK-1 access hatch for further laboratory analytical evaluation.

At completion of the initial TFC-OPS-OPER-C-67 response at 1412 hours, the IHT noted the odor was still present. At 1427 hours, the RCA HVAC was returned to operation and the VOG returned to operation at 1431 hours. The IHTs performed addition sweeps after the ventilation had been back in operation for approximately one hour. The IHTs noted that the odor had noticeably decreased. DRI monitoring results indicated that all readings were below ALs, results are listed in Table 2.

Table 2: DRI Results With Ventilation

Location	Ammonia AL=12ppm	VOC (10.6 eV PID)	VOC (11.7 eV PID)	Hydrogen Sulfide AL=0.5 ppm
Throughout Process floor and sump	Less than detectable	50 ppb	Less than detectable	Less than detectable
Area reading perimeter	Less than detectable	30 ppb	Less than detectable	Less than detectable

Detectable VOC readings using the 10.6 eV PID were documented with and without ventilation. There was a negligible difference during the two sweeps performed by the IHTs.

At 1720 hours, TFC-OPS-OPER-C-67 was exited and access was restored to the Process Floor.

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

Odors were reported at the ETF (2025E) Process Floor (Room 131) and were documented as the most concentrated near Sump Tank 1, 20B-TK-1. The workers were wearing standard street clothing in addition to hard hats, safety glasses, and substantial footwear. The workers were not in an area requiring respiratory protection. Personal ammonia monitors (e.g., VentisPro or ToxiRAE) are not required for work at the ETF. The work location is posted as a Radiological Buffer Area (RBA)/Radiological Material Area (RMA).

The odor event took place indoors at standard conditions, as such the outdoor weather conditions at the time the odors were reported are not applicable to this event.

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

No impacts to facility safety status, operation capabilities, or facility reliability occurred.

Access to the ETF 2025E Process Floor was restricted from approximately 1030 to 1730 hours during the TFC-OPS-OPER-C-67 event response, causing delays to the following planned work activities:

- WO #1136323, 2025/131: MO.AIT-60G-106 Acid Con. ANLZR
- WO #1136303, 2025/131: 30D AY AIT-60G-104 POLISHER COND. CAL
- WO #1136307, 2025/131: 30 DAY AIT-60G-204 POLISHER COND. CAL
- WO #1136311, 2025/131: 30 DAY AIT-60G-304 POLISHER COND. CAL
- WO #1129168, 2025/NORTH YARD: Semi-Ann 45B-EVU-1A INSP.
- WO #1128960, 2025/NORTH YARD: Semi-Ann 45B-EVU-1B INSP.

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

- Access to the ETF 2025E Process Floor was restricted.
- The Shift Operating Manager (SOM) initiated TFC-OPER-C-67 response actions.
- The VOG and RCA HVAC were restored to operational.
- IHTs responded per TFC-OPS-OPER-C-67, Attachment A-Response Plan.
- Event Investigation EIR-2024-073, *Response to Odors at ETF*, was initiated.

18. Compensatory Actions Taken:

None.

19. Remedial Actions Taken:

None.

Other Actions Taken:

Prior to the next scheduled VOG and RCA ventilation outage (09/15/2024 - 09/19/2024) 20B-TK-1 was flushed four times and filled with verification (clean) water in an unsuccessful attempt to prevent odors from returning. Despite these measures, odors returned soon after VOG and RCA ventilation was shut down and persisted within the facility at similar strength despite attempts at control with portable fans and opened exterior doors. This suggests that the odor source is not likely 20B-TK-1 specifically, but other process tanks within the facility.

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20. Key Elements of the Investigation: (Key investigation points)

To summarize the conclusions of the Industrial Hygiene Investigative Report (IHIR) IHIR-000106, *TFC-OPS-OPER-C-67 Response at 2025E*, facility experience and process knowledge indicated chemicals used during Polisher Regeneration in conjunction with utilization of 20B-TK-1 to perform a Secondary Waste Receiving Tank (SWRT) transfer, and lack of process and facility ventilation was the cause of the odor event.

The primary odor source was assumed to be the 20B-TK-1 access hatch based on detectable DRI readings increasing as survey team moved towards the area. It is possible that other odor sources may have existed, specifically at openings of other process tanks such as Secondary Waste Receiving Tank (SWRT) SWRT-A and SWRT-B. However these sources are not easily accessible for survey purposes as compared to 20B-TK-1.

RCA and VOG ventilation was restarted to control odorous emissions from process tanks and follow-up DRI monitoring results indicated further actions were not necessary to protect worker safety and health. Therefore, the area was released from restricted access and work was allowed to continue.

Facility knowledge was provided by the ETF Facility and Engineering managers stating the odors were possibly the result of chemical reactions from chemical use during the regeneration of the Polisher System Ion Exchange Columns (IXCs). The Polisher IXC regeneration process utilizes acidic and basic chemical solutions to strip metals and other contaminants from the Ion Exchange Resin media. Those process chemicals and carried contaminants arrive at SWRT-1 where chemical reactions and resulting reaction products accumulate. Gaseous-phase reaction products are normally continuously extracted via VOG (vessel vent as noted in Figure 2) to prevent uncontrolled emissions from the SWRT during this process. Without the RCA ventilation being in operation the dilution of the facility ambient atmosphere significantly decreases.

The IXCs were regenerated per ETF-60G-002, *Polisher Regeneration*, on 07/23/24. The waste from Polisher Regeneration flows to SWRT A and B, reference Figure 2. Both 4% Sodium Hydroxide and 4% Sulfuric Acid are introduced into the SWRTs through the IXC waste or through the chemical feed system for pH adjustment. SWRTs are equipped with an overflow line connected to Sump Tank 1. The contents of SWRT-A were transferred to SWRT-B on September 8th, utilizing Sump Tank 1, 20B-TK-1, as an intermediate transfer tank.

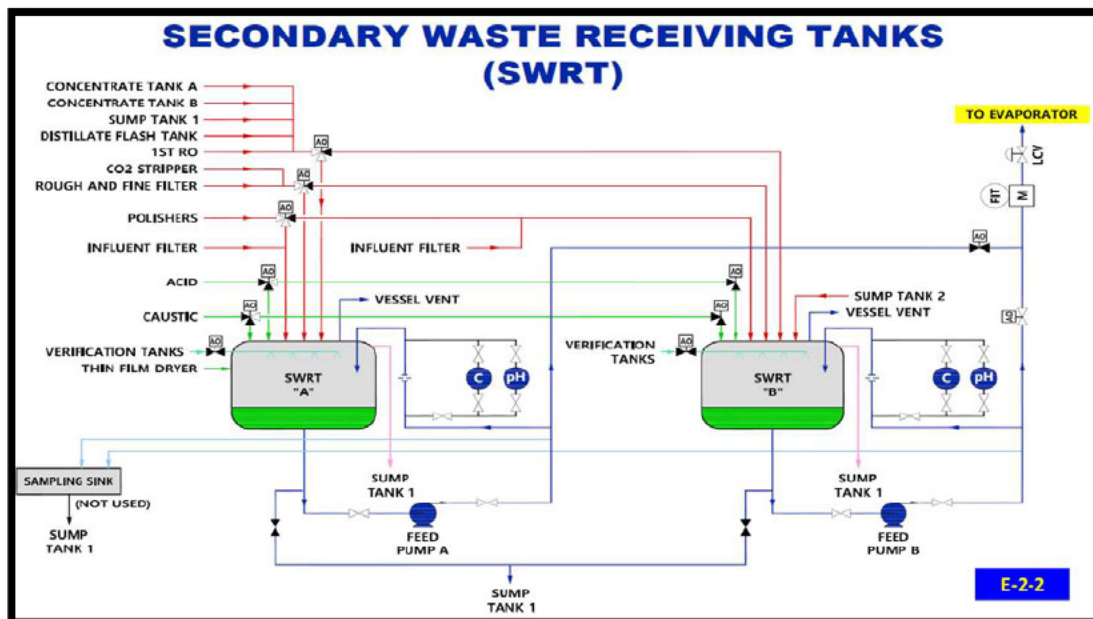


Figure 2: SWRT Process Flow

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The pH of the liquid contents of SWRT-A resulting from the Polisher Regeneration process was slightly acidic. The pH of Sump Tank 1, 20B-TK-1, was unknown prior to the addition of SWRT-A contents which were at a pH of 4.8. Ongoing chemical reactions may have been occurring within 20B-TK-1 at the time of the odor event.

At the time of the event, the RCA ventilation and the VOG ventilation were not in operation. When negative ventilation is not applied gaseous/vapor emissions from tanks are driven by release of gasses from solution and barometric/thermal gradients. The removal of VOG ventilation from tank 20B-TK-1 and other tanks within the facility allows for mixing of the various tank headspaces with surrounding facility atmosphere as soon as the pressure gradient between the tanks and the facility atmosphere are equalized. The removal of RCA ventilation significantly decreases the amount of dilution of the facility ambient atmosphere, allowing gaseous/vapor process tank emission to accumulate and dwell within the facility.

The IHIR noted the analytical results of the grab air sample specific chemical mixture within the sump tank that were contributing to the reported odors could not be positively determined, therefore, the resulting chemical reaction products could not be hypothesized. As the specific odorant chemical mixture was unknown, evaluation of exposure compared to applicable Occupational Exposure Limits (OELs) could not be performed. However, the source (i.e. 20B-TK-1) grab air sample results were found to be below OELs for the chemical compounds identified and below the applicable OELs for the tentatively identified compounds, reference Figure 3.

Identified Compounds	Result (ppm)	Applicable OEL (ppm)
Acetonitrile	0.116	20 TWA (ACGIH TLV)
Ethanol	0.008	1000 STEL (ACGIH TLV)
Acetone	0.026	250 TWA (ACGIH TLV)
Propanenitrile	0.008	6 TWA (NIOSH REL)
2-Butanone	0.003	200 TWA (ACGIH TLV)
Tentatively Identified Compounds*¹		
N,N-dimethyl-Methylamine	0.014	5 TWA (ACGIH TLV)
(Z)-2-Butenoic acid, methyl ester	0.002	N/A
Pyrazine	0.003	N/A
methyl-Pyrazine	0.003	N/A
Nonanal	0.002	N/A
Unknown Compound	0.04 (mg/m ³)* ²	N/A (unknown)

*¹ Tentatively Identified Compounds are analytes not associated with a calibration standard, but instead identified only through a Data System Library search based on retention time and mass. Results are not definitive as results are not subject to Laboratory Quality Control requirements.

*² ppm air concentration results could not be calculated as MW of compound is unknown, mass per volume result provided.

NOTE: 46 additional compounds provided by TO-17A were less than detectable (0.025 mg/m³). All analytes were below 10% of applicable OELs except for 2,5-Dihydrofuran (Less than detectable at 43% of OEL [0.002 ppm]) and 2-Methylfuran (Less than detectable at 37% of OEL [0.002 ppm]) due to RDL.

Figure 3: Grab sample results collected from the opening of Sump Tank 1, 20B-TK-1

Minimal odors are anticipated at the ETF, however, odors from routine processing does not necessarily equate to worker overexposure or exceedance of representative OELs. Anticipated ETF odors resultant of low levels of Hydrogen Sulfide (H₂S) gas, NH₃ gas, and various VOCs may occur from the following:

- Sulfate containing water, low airflow, and sulfur seeking bacteria stagnate in confined areas.
- Stagnant water within a confined area for an extended period of time.
- Natural decay of organic material through biological decomposition.

Analytical results from the grab sample collected from the 20B-TK-1 hatch opening were at or above published odor detection concentrations for some Tentatively Identified Compounds with similar odor descriptors as provided on OVRCS, reference Figure 4.

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Identified Compounds	Result (ppm)	Odor Threshold		Odor Characteristic
		Detectable	Recognizable	
Acetonitrile	0.116	13 ppm		"aromatic", "ether-like"
Ethanol	0.008	0.34 ppm	4.6 ppm	"characteristic", "wine-like", "medicinal"
Acetone	0.026	0.42 ppm	1.7 ppm	"characteristic-pungent"
Propanenitrile	0.008	Undefined		"heavy", "earthy", "slightly-floral"
2-Butanone	0.003	0.07 ppm	5.4 ppm	"sharp", "sweet", "acetone-like"
Tentatively Identified Compounds				
N,N-dimethyl-Methylamine,	0.014	0.00011 ppm	0.00021 ppm	"ammonia-like", "fishy"
(Z)-2-Butenoic acid, methyl ester	0.002	Undefined, <1 ppm		"pungent", "Sour"
Pyrazine	0.003	Undefined, often <0.00001 ppm		"pungent", "sweet", "corn-like", "nutty"
methyl-Pyrazine	0.003	60 ppm		"pungent", "earthy", "musty"
Nonanal	0.002	3 ppm		"pungent", "old people smell"
Unknown Compound	N/A	Unknown		Unknown

Figure 4: Grab sample results collected from the opening of Sump Tank 1, 20B-TK-1 compared to published Odor Thresholds.

While odors may be perceived, concentrations are still well below levels of worker exposure concern.

IHIR-000106 provided the following recommendations, which are captured within WRPS-AR-2024-2822:

- Communication that odors are expected during VOG and/or RCA ventilation outages should be increased ahead of implementation. Facility culture needs to include knowledge that odors are normal and typical of various operational activities and does not necessarily equate to overexposure.
- Evaluation of operational processes in which process chemicals and/or effluent contaminants are mixed should be performed to the extent that resulting gases/vapors can be ranked based on possible odorant formation and/or emission. Then processes which are anticipated to result in odorous emissions should not be performed without additional controls (e.g. ventilation, access restriction, communication) in place to eliminate potential worker exposure until exposure assessment can be performed to ensure that exposure to odorous emissions does not equate to potential exposure above OELs.

21. Positive Aspects Identified:

None.

22. Key Take Aways / Learning Opportunities:

Odors associated with stagnant water are anticipated at the ETF. Low levels of Hydrogen Sulfide gas, Ammonia, and various Volatile Organic Compounds may be produced by the stagnant water within confined areas for extended periods. Odors may be stronger when ventilation is not in operation as tank emissions settle across the Process Floor. Processes anticipated to result in odorous emissions should not be performed without additional controls such as access restriction, localized ventilation, and communication of anticipated odors.

23. Event Investigation:

- ☐ 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.

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Responsible Manager Approval:

Name (First, Middle Initial, Last)

Digitally signed by _____
Date: 2024.09.30 10:10:38 -07'00'

Signature / Date

CAS Manager Approval:

Name (First, Middle Initial, Last)

Digitally signed by _____
Date: 2024.09.30 10:16:38 -07'00'

Signature / Date

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

Event Title: TFC-OPS-OPER-C-67 Response at 2025E.		IHIR Number: IHIR-000106
		IHEI Number: N/A
Date: 09/10/2024	Time: 1050	Location: 2025E Process Floor

Event Summary and Timeline:

Event Summary:

At approximately 1050 on September 10th 2024, 8 employees reported stronger than normal “ammonia”, “fishy”, “septic/sewer”, “musty”, “peanuts” and “rotten” odors when accessing 20B-TK-1 in the 2025E Process Floor. Symptoms of “headache”, “scratchy throat/chest”, “sore throat”, and “nose stuffiness” were reported. The affected employees were transported to occupational medical provider for precautionary medical evaluation.

Field Response Timeline:

- 1030 Facility announcement made to restrict access to the process floor due to reported odors.
- 1041 Facility announcement made to restore access to the process floor as “ammonia levels below action level”.
- 1055 Effluent Treatment Facility (ETF) Industrial Hygienist (IH) contacts Direct Feed Low Activity Waste (DFLAW) IH to notify that TFC-OPS-OPER-C-67 event is imminent.
- 1056 ETF Shift Manager (SM) contacts DFLAW (IH):
- Support requested for support of TFC-OPS-OPER-C-67 field response actions.
 - Response to be implemented through ETF Shift Operations direction.
 - Report to ETF Shift Office (SO) as soon as practicable.
- 1102 SOEN: “Responding to stronger than normal odors per OPS-OPER-C-67 at ETF on the process floor. Personnel should avoid the area until response is complete. CSM”
- 1112 Production Operations (PO) IH and PO IH Level 3 (L3) Manager arrive at Production Operations (PO) Central Shift Office (CSO) and are briefed by Central Shift Manager (CSM):
- At approximately 1050 09/10/2024 “ammonia” odors encountered on 2025E Process Floor.
 - 1 employee reported undefined symptoms and was transported to on-site medical provider for medical evaluation.
 - Affected employee was performing a walkdown, no other employees were present on the process floor at the time of the event.
- 1114 CSM contacts ETF SM to inquire about symptoms and to request Odor/Vapor Response Card (O/VRCs):
- 3 employees total transported to on-site medical provider for precautionary medical evaluation.
 - Symptoms unknown.
- 1124 ETF Industrial Hygiene Technician (IHT) notifies PO IH L3 Manager:
- IHT was supporting access to 20B-TK-1 Sump at time of event.
 - Direct Reading Instrumentation (DRI) readings at 20B-TK-1 access hatch:
 - Ammonia (NH₃) – 4 parts per million (ppm)
 - Volatile Organic Compounds (VOCs) – 0.220 ppm
 - Hydrogen Sulfide (H₂S) – Less than Detectable (< 0.1 ppm)
 - Odor descriptors: “fishy”, “ammonia”.
- 1127 ETF IH notifies DFLAW IH to report that Radiologically Controlled Area (RCA) ventilation may not be in operation.
- 1132 PO IH L3 Manager briefs Environmental Safety Health and Quality (ESH&Q) Level 1 Manager on event status.
- 1143 DFLAW IH arrives at ETF SO to support field response actions.
- 1146 DFLAW IH is notified by ETF SM that response is to be implemented through Production Operations (PO) Central Shift Office (CSO).

Note: Field Response Timeline continued on next page.

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INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT (IHIR) (Continued)

Event Summary and Timeline:

Field Response Timeline continued:

1150 CSM contacts ETF Operations Manager (OM):

- ETF OM currently at on-site medical provider.
- ETF OM will provide 2 O/VRCs to CSM as soon as practicable.
- 4 additional workers are in transport to other occupational medical provider location.

1151 DFLAW IH arrives at CSO and is briefed on event status by PO IH and PO IH L3 Manager.

1158 ETF OM contacts CSM:

- 2 employees at on-site medical provider report symptoms of “scratchy throat/chest”, “headache”.

1215 DFLAW IH informs CSM of weather conditions at time of initiating event from Data Fusion Advisory System (DFAS):

- Stability Class D
- Wind speed 5.6 mph from 289 degrees (from West-Northwest)
- Mixing height 1200 ft above grade

1216 ETF SM notifies PO L3 Manager:

- 2 additional employees are heading to off-site occupational medical provider for precautionary medical evaluation.
- Vessel Off Gas (VOG) and Radiologically Controlled Area (RCA) Ventilation was shut-down at 0705 09/10/2024.
- Contents of 20B-TK-1 is “unknown”.

1218 DFLAW IH informs CSM of Vapor Monitoring Detection System (VMDS) Ammonia (NH₃) readings @ 1050 09/10/2024:

- POR-518 – N/A
- POR-519 – 3.342 ppm
- AN VTP – N/A
- AW VTP – 8.827 ppm
- POR-126 – 0.000 ppm
- POR-127 – 0.000 ppm
- 702-AZ VTP – 0.000 ppm
- AP VTP – 0.000 ppm

1220 DFLAW IH consults TOC-IH-58956 to determine field response actions for “ammonia”, “fishy” odors.

1226 2 O/VRCs received by CSM:

- Odor descriptors: “septic/sewer”, “musty”, “peanuts”.
- Symptoms: “sore throat”, “nose stuffiness”.

1232 CSM contacts ETF Area Dayshift Manager (ADM) to request O/VRCs from affected employees at off-site occupational medical provider.

1235 TFC-OPS-OPER-C-67 Attachment A Page 1 signed by DFLAW IH, Shift PO RadCon Planner, and CSM.

1239 ETF Industrial Safety Professional (IS) reports slight odor in air compressor/hydrogen peroxide (H₂O₂) storage room.

1244 ETF IS reports “non ammonia-like” odor blowing out of 2025E exterior door on South side of facility.

1248 DFLAW IH provides event response briefing to Field Response Team (3 Radiological Control Technicians [RCT], 2 IHT, 1 IH):

- Perform monitoring as per IHSP-POE-MULTI-TFCOPSOPERC67:
 - NH₃ – Action Limit 12 ppm
 - VOCs (10.6 eV PID) – Action Limit N/A, for indication purposes only.
 - VOCs (11.7 eV PID) – Action Limit N/A, for indication purposes only.
 - H₂S – Action Limit 0.5 ppm
 - Survey areas around 20B-TK-1 for potential odor sources, collect grab sample of odor source (if applicable) and/or ambient atmosphere for analytical processing.
 - Survey all accessible areas of the 2025E Process Floor.
- Respiratory Protection Equipment (RPE) – voluntary use
- Monitor in and around affected area.

1251 CSM contacts ETF SM to report field response team is in route to 2025E.

1303 Field Response Team arrives at 2025E and is provided direction to monitor at 20B-TK-01 by ETF SM.

1305 Field Response Team enters 2025E Process Floor to perform field response actions.

Note: Field Response Timeline continued on next page.

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INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT (IHIR) (Continued)

Event Summary and Timeline:

Field Response Timeline continued:

1310 PO IH sends O/VRCs to ETF ADM at off-site occupational medical provider for population and submission by affected employees.

1330 Field Response Team completes field response actions:

- Response Team encountered strong “burnt peanut butter”, “potting soil” odor throughout the process floor, strongest near 20B-TK-1. Odor was present, but faint on mezzanine, brine load-out, and near 2025E South roll-up door. 2025E South roll-up door was approximately half open with large fan blowing towards outside. Typical “chlorine/pool” odors were present in the VOG and RCA ventilation equipment rooms.
- DRI monitoring results:
 - At the sump and the trenches around the sump:
 - Ammonia – Less than detectable (<1.0 ppm)
 - Volatile Organic Compounds (10.6 eV PID) – 120 ppb
 - Volatile Organic Compounds (11.7 eV PID) – Less than detectable (<0.01 ppm)
 - Hydrogen Sulfide – Less than detectable (<0.1 ppm)
 - Area readings throughout the process floor, mezzanine:
 - Ammonia – Less than detectable (<1.0 ppm)
 - Volatile Organic Compounds (10.6 eV PID) – 50-80 ppb
 - Volatile Organic Compounds (11.7 eV PID) – Less than detectable (<0.01 ppm)
 - Hydrogen Sulfide – Less than detectable (<0.1 ppm)
 - Area readings in VOG and RCA ventilation equipment rooms, Brine Load-Out area, and storage area on East side of 2025E Process Floor:
 - Ammonia – Less than detectable (<1.0 ppm)
 - Volatile Organic Compounds (10.6 eV PID) – 30-50 ppb
 - Volatile Organic Compounds (11.7 eV PID) – Less than detectable (<0.01 ppm)
 - Hydrogen Sulfide – Less than detectable (<0.1 ppm)

1332 H₂S sensor passes post-use-function-test.

1335 Field Response Team departs from 2025E

1338 PO IH L3 Manager updates ESH&Q Manager on event response.

1339 6 additional O/VRCs arrive at CSO:

- Odor Descriptors: “Rotten”, “ammonia”, “musty”, “septic/sewer”, “smoky”, “earthy”, “cigar”.
- Symptoms reported: “Cough”, “sore throat”, “taste”, “light headedness”, “headache”, “difficulty breathing”.

1352 All other DRI sensors pass post-use-function-test.

1409 CSM contacts ETF SM:

- Field Response survey results provided.
- Requests VOG and RCA ventilation be restarted to mitigate odors.
- Access restriction to remain in place until follow-up survey results indicate VOCs at background levels.

1430 ETF SM reports that VOG and RCA ventilation has been re-started.

1449 CSM contacts DFLAW IH to report that ETF SM believes odor is from sulfuric acid (H₂SO₄) in 20B-TK-1 from Ion Exchange Column (IXC) Polisher re-generation.

Note: Field Response Timeline continued on next page.

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

Event Summary and Timeline:

Field Response Timeline continued:

1615 Follow-up survey is conducted:

- Similar odor is present, but less strong.
- DRI monitoring results:
 - Area readings throughout the process floor and 20B-TK-1 area:
 - Ammonia – Less than detectable (<1.0 ppm)
 - Volatile Organic Compounds (10.6 eV PID) – 50 ppb (peak reading)
 - Volatile Organic Compounds (11.7 eV PID) – Less than detectable (<0.01 ppm)
 - Hydrogen Sulfide – Less than detectable (<0.1 ppm)
 - Area readings of facility perimeter:
 - Ammonia – Less than detectable (<1.0 ppm)
 - Volatile Organic Compounds (10.6 eV PID) – 30 ppb (peak reading)
 - Volatile Organic Compounds (11.7 eV PID) – Less than detectable (<0.01 ppm)
 - Hydrogen Sulfide – Less than detectable (<0.1 ppm)

1700 Follow-up survey DRI sensors passed-post-use-function-test.

1730 SOEN: "C-67 Odor Response is complete at ETF. All readings are below background. Normal Access is restored at ETF. CSM"

Field Response Timeline Acronyms:

ADM	Area Dayshift Manager
CSM	Central Shift Manager
CSO	Central Shift Office
DFAS	Data Fusion & Advisory System
DFLAW	Direct Feed Low Activity Waste
DOE	Department of Energy
DRI	direct reading instrument
ESH&Q	Environmental, Safety, Health, & Quality
ETF	Effluent Treatment Facility
eV	electron-volts
H ₂ O ₂	Hydrogen Peroxide
H ₂ S	Hydrogen Sulfide
H ₂ SO ₄	Sulfuric Acid
IH	Industrial Hygienist
IHT	Industrial Hygiene Technician
IS	Industrial Safety
mph	miles per hour
NH ₃	Ammonia
O/VRC	Odor/Vapor Response Card
PID	photoionization detector
POC	Point of Contact
PO	Production Operations
ppm	parts per million
RCA	Radiologically Controlled Area
RCT	Radiological Control Technician
S&H	Safety & Health
SM	Shift Manager
SO	Shift Office
SOEN	Shift Office Event Notification
VMDS	Vapor Monitoring Detection System
VOC	Volatile Organic Compound
VOG	Vessel Off Gas

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

Sampling/Monitoring Results:

Direct Reading Instrument Monitoring Results:

- Response Team encountered strong “burnt peanut butter”, “potting soil” odor throughout the process floor, strongest near 20B-TK-1. Odor was present, but faint on mezzanine, brine load-out, and near 2025E South roll-up door. 2025E South roll-up door was approximately half open with large fan blowing towards outside. Typical “chlorine/pool” odors were present in the VOG and RCA ventilation equipment rooms.

- DRI readings acquired during initial field response:

Location	NH ₃	VOCs (10.6 eV PID)	VOCs (11.7 eV PID)	H ₂ S
At 20B-TK-1 access hatch	< 1 ppm	0.120 ppm	< 0.010 ppm	< 0.010 ppm
Trench access immediately adjacent to 20B-TK-1	< 1 ppm	0.110 ppm	< 0.010 ppm	< 0.010 ppm
General accessible areas of Process Floor	< 1 ppm	0.080 ppm	< 0.010 ppm	< 0.010 ppm
Mezzanine	< 1 ppm	0.050 ppm	< 0.010 ppm	< 0.010 ppm
VOG and RCA ventilation equipment rooms	< 1 ppm	0.050 ppm	< 0.010 ppm	< 0.010 ppm
Brine load-out and storage areas	< 1 ppm	0.030 ppm	< 0.010 ppm	< 0.010 ppm

- DRI readings acquired during follow-up response:

Location	NH ₃	VOCs (10.6 eV PID)	VOCs (11.7 eV PID)	H ₂ S
At 20B-TK-1 access hatch and around sump area	< 1 ppm	0.050 ppm	< 0.010 ppm	< 0.010 ppm
General accessible areas of Process Floor	< 1 ppm	0.050 ppm	< 0.010 ppm	< 0.010 ppm
Perimeter of 2025E	< 1 ppm	0.030 ppm	< 0.010 ppm	< 0.010 ppm

Sampling Results:

- A grab sample was collected from the opening of 20B-TK-1 access hatch. The grab sample was transferred to Carbotrap 300 TDU media for VOC analysis by Gas Chromatography/Mass Spectrometry by method TO-17A.

Identified Compounds	Result (ppm)	Applicable OEL (ppm)
Acetonitrile	0.116	20 TWA (ACGIH TLV)
Ethanol	0.008	1000 STEL (ACGIH TLV)
Acetone	0.026	250 TWA (ACGIH TLV)
Propanenitrile	0.008	6 TWA (NIOSH REL)
2-Butanone	0.003	200 TWA (ACGIH TLV)

Tentatively Identified Compounds*¹

N,N-dimethyl-Methylamine	0.014	5 TWA (ACGIH TLV)
(Z)-2-Butenoic acid, methyl ester	0.002	N/A
Pyrazine	0.003	N/A
methyl-Pyrazine	0.003	N/A
Nonanal	0.002	N/A
Unknown Compound	0.04 (mg/m ³)* ²	N/A (unknown)

*¹ Tentatively Identified Compounds are analytes not associated with a calibration standard, but instead identified only through a Data System Library search based on retention time and mass. Results are not definitive as results are not subject to Laboratory Quality Control requirements.

*² ppm air concentration results could not be calculated as MW of compound is unknown, mass per volume result provided.

NOTE: 46 additional compounds provided by TO-17A were less than detectable (0.025 mg/m³). All analytes were below 10% of applicable OELs except for 2,5-Dihydrofuran (Less than detectable at 43% of OEL [0.002 ppm]) and 2-Methylfuran (Less than detectable at 37% of OEL [0.002 ppm]) due to RDL.

NOTE: Sampling/Monitoring Results continued on next page:

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

Sampling/Monitoring Results:

Sampling/Monitoring Results continued.

Sampling/Monitoring Results Acronyms:

ACGIH	American Conference of Governmental Industrial Hygienists
DRI	Direct Reading Instrumentation
eV	Electron Volts
H ₂ S	Hydrogen Sulfide
mg/m ³	Milligrams per cubic meter
MW	Molecular Weight
NH ₃	Ammonia
NIOSH	National Institute of Occupational Safety and Health
PID	Photo Ionization Detector
ppm	Parts Per Million
RCA	Radiological Controlled Area (ventilation)
RDL	Reporting Detection Limit
REL	Recommended Exposure Limit
STEL	Short Term Exposure Limit (typically 15 minutes)
TLV	Threshold Limit Value
TWA	Time Weighted Average (typically 8 hours)
VOCs	Volatile Organic Compounds
VOG	Vessel Off Gas (ventilation)

SWIHD References:

Event Response Site Wide Industrial Hygiene Database DRI and Air Surveys:

- DRI # 24-07305 "TFC-OPS-OPER-C-67 response at ETF"
- Air # 24-07323 "TFC-OPS-OPER-C-67 Grab Sample 2025E 20B-TK-1"

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. Voluntary-use of Respiratory Protection Equipment was offered to event response participants, but was declined.

While the odor description is inconsistent with Tank Waste Chemical Vapors, due to the proximity to the Tank Farms and workforce cultural expectations, 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 (IHIR) (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™, dashboard for the approximate time of the Event:

DFAS Multi-Farm View Exhauster Plume Model: 09/10/2024 @ 0830 (time of first indication of odors as provided on O/VRCs):



NOTE: 241-AN, 241-AW Farm and POR-518/519 Exhausters are not connected to the DFAS; however, approximate exhauster plumes were added based on other modeled plumes.

NOTE: Additional Information continued on next page.

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

Additional Information:

Additional Information continued:

DFAS Multi-Farm View Exhauster Plume Model: 09/10/2024 @ 1050 (approximate time of initiating event):



NOTE: 241-AN, 241-AW Farm and POR-518/519 Exhausters are not connected to the DFAS; however, approximate exhauster plumes were added based on other modeled plumes.

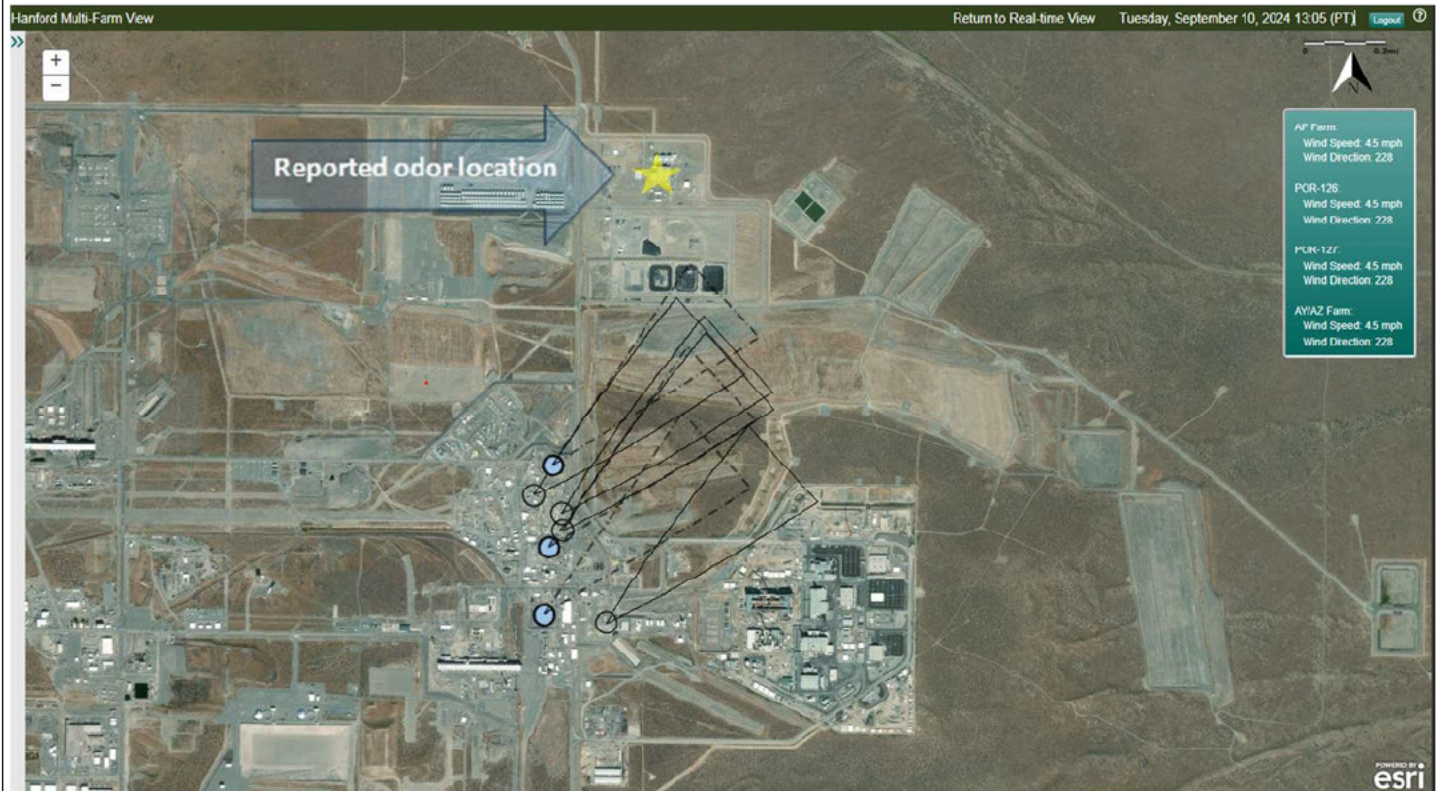
NOTE: Additional Information continued on next page.

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

Additional Information:

Additional Information continued:

DFAS Multi-Farm View Exhauster Plume Model: 09/11/2024 @ 1305 (approximate time of field response actions):



NOTE: 241-AN, 241-AW Farm and POR-518/519 Exhausters are not connected to the DFAS; however, approximate exhauster plumes were added based on other modeled plumes.

DFAS Weather Conditions: 09/10/2024 @ 0830 (time of first indication of odors as indicated on O/VRCs):

- Wind Speed: 7.4 mph (15-minute average)
- Wind Direction: 308° (out of West-Northwest)
- Mixing Height: 140 feet above grade
- Stability Class: D (neutral conditions)

DFAS Weather Conditions: 09/10/2024 @ 1050 (approximate time of initiating event):

- Wind Speed: 5.6 mph (15-minute average)
- Wind Direction: 289° (out of West-Northwest)
- Mixing Height: 1200 feet above grade
- Stability Class: D (neutral conditions)

NOTE: Additional Information continued on next page.

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

Additional Information:

Additional Information continued:

DFAS Weather Conditions: 09/10/2024 @ 1305 (current weather data for Field Response Actions, per TFC-OPS-OPER-C-67 4.2.8.a):

- Wind Speed: 11.6 mph (15-minute average)
- Wind Direction: 228° (out of Southwest)
- Mixing Height: 1500 feet above grade
- Stability Class: D (neutral conditions)

The atmospheric stability is the tendency of the atmosphere to increase or decrease the vertical displacement of air through mode of force such as the wind. This function is closely related to the ability of the atmosphere to disperse pollutants. Atmospheric stability cannot be measured directly. Rather, it is generally estimated based on the wind velocity and the solar radiation (Casal, 2008). The stability is also impacted by the slope of the temperature relative to altitude (environmental lapse rate) (CushmanRoisin, 2012). The National Oceanic and Atmospheric Administration (NOAA) Pasquill stability classes are denoted by 7 letters ranging from A (extremely unstable conditions) to G (extremely stable conditions). An unstable atmosphere is characterized by significant vertical displacement of air, a negative vertical temperature gradient (the temperature decreases with height), along with frequent fluctuations in wind direction and strong solar radiation. A stable atmosphere has low turbulence, positive vertical temperature (temperature increases with height), little fluctuation in the wind direction, and limited solar radiation (Casal, 2008). Exhauster plumes may move horizontally (stability classes A, B, C, and D) or vertical (stability classes E, F, and G). Horizontal plumes found during unstable and neutral states are further characterized by their pattern: fanning, fumigation, coning, looping, and lofting. At Hanford Tank Farms exhauster plumes may interact with ground level during stability class A conditions if the Mixing Height constricts plume dispersion at sufficiently low levels (typically less than 100 ft. above grade). The concentration of plume-borne contaminants at the ground level receptor is dependent on the concentration of the emission and the factor of dilution occurring through dispersion as the plume emission moves away from the emission point.

Vapor Monitoring Detection System (VMDS)

Active ventilation systems exhaust a mixture of all connected tanks with output through a "stack". The emission of exhaust ventilation systems is monitored either continuously by the VMDS or periodically by alternate monitoring.

VMDS exhauster ammonia readings on 09/10/2024 @ 0830 (time of first indication of odors as indicated on O/VRCs):

- POR518 (241-A): N/A
- POR519 (241-A): 3.509 ppm
- 241-AN: N/A
- 241-AW: 10.476 ppm
- POR126 (241-AX): 0.000 ppm
- POR127 (241-AX): 0.000 ppm
- 702AZ (241-AY/AZ): 0.000 ppm
- 241-AP: 0.000 ppm

NOTE: Additional Information continued on next page.

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

Additional Information:

Additional Information continued:

VMDS exhauster ammonia readings on 09/10/2024 @ 1050 (approximate time of initiating event):

- POR518 (241-A): N/A
- POR519 (241-A): 3.598 ppm
- 241-AN: N/A
- 241-AW: 14.132 ppm
- POR126 (241-AX): 0.000 ppm
- POR127 (241-AX): 0.000 ppm
- 702AZ (241-AY/AZ): 0.000 ppm
- 241-AP: 0.000 ppm

VMDS exhauster ammonia readings on 09/10/2024 @ 1305 (current weather data for Field Response Actions):

- POR518 (241-A): N/A
- POR519 (241-A): 3.541 ppm
- 241-AN: N/A
- 241-AW: 9.876 ppm
- POR126 (241-AX): 0.467 ppm
- POR127 (241-AX): 0.000 ppm
- 702AZ (241-AY/AZ): 0.000 ppm
- 241-AP: 0.000 ppm

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

NOTE: Additional Information continued on next page.

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

Additional Information:

Additional Information continued:

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		
241-SY	Primary	310 ppm	620 ppm

Vapor Monitoring Detection System (VMDS) summary: 09/04/2024 @ 0830 to 09/10/2024 @ 1050:

Tank Farm	Exhauster	Minimum ^{*A}	Maximum ^{*A}
241-A	POR518/POR519	N/A	7.640 ppm
241-AN	Primary	N/A	N/A
241-AP	Primary	0.000 ppm	0.000 ppm
241-AW	Primary	3.871 ppm	29.290 ppm
241-AX	POR126/POR127	0.000 ppm	27.265 ppm
241-AY/AZ	702AZ	0.000 ppm	0.000 ppm

^{*A} VMDS Alternate Real Time Monitoring performed 09/04/2024 to 09/010/2024 for 241-A (POR518/POR519), 241-AN, 241-AP, 241-AY/AZ, and 241-SY.

The 241-SY 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 09/04/2024 to 09/10/2024:

Tank Farm	Exhauster	Minimum	Maximum
241-A	POR518/POR519	1	3
241-AN	Primary	15	23
241-AP	Primary	0	22
241-AW	Primary	N/A	N/A
241-AX	POR126/POR127	N/A	N/A
241-AY/AZ	702AZ	6	20
241-SY	Primary	25	34

NOTE: Additional Information continued on next page.

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

Additional Information:

Additional Information continued:

Odor descriptors provided by Affected Workers are inconsistent with Tank Vapors. Additionally, review of the DFAS application, powered by SmartSite™, Weather Details dashboard and VMDS exhaust ammonia readings for the approximate time of the Event, indicate the cause of the odor is unlikely to be from Tank Farm Exhauster emissions; as concentrations at emission points was insufficient to allow for the possibility of notable concentrations at the ground receptor, weather conditions did not allow for ground-plume interaction, and the event location was located a significant distance from ant Tank Farm chemical vapor emission points.

Monitoring Selections Based on Information Provided by Affected Workers:

Based on the odor descriptors provided upon submission of the Odor/Vapor Response Cards DRI monitoring for Ammonia, VOCs (10.6 eV PID and 11.7 eV PID), and Hydrogen Sulfide was requested:

ETF specific monitoring strategy:

Minimal odors associated with stagnant water is an anticipated occurrence at the Effluent Treatment Facility (ETF). Low levels of Hydrogen Sulfide (H₂S) gas, Ammonia (NH₃), and various Volatile Organic Compounds (VOCs) may be produced by the stagnant water at the ETF when within a confined area for an extended period.

Low levels of Hydrogen Sulfide (H₂S) gas is produced at the ETF when sulfate containing water, low airflow, and sulfur seeking bacteria stagnate within a confined area for an extended period. Hydrogen Sulfide gas has an offensive distinct rotten egg odor that is detectable at very low concentrations. The American Industrial Hygiene Association (AIHA) Odor Threshold for Chemicals with Established Health Standards, 2nd Edition, lists the lower range of odor values for H₂S as 40 ppt (or 0.04 ppb or 0.00004 ppm). While odors may be readily perceived, concentrations are still well below levels of worker exposure concern. H₂S gas production rate is a function of sulfate/bacteria/organics concentrations, temperature, and dissolved oxygen. Relatively moderate levels of sulfate ions are both introduced (via sulfuric acid) and inherent in the wastewater treated at the ETF. High source concentrations are not expected as the ETF wastewater streams do not contain the high sulfate/bacteria/organics found with sanitary waste (i.e. sewage). The limiting factor at the ETF is primarily the relatively low bacterial levels, followed by moderate to low levels of sulfate.

The resolution of direct reading instrument (DRI) equipped with a H₂S sensor (0.1 ppm) is comparatively inadequate as a detection tool at the concentrations perceived by the human olfactory sense. While the resolution of the direct reading instrument (DRI) equipped with a H₂S sensor is insufficient to detect H₂S at the lower range of odor threshold values, it is sufficient to detect H₂S at concentrations that approach the established occupational exposure limits (OELs).

- Action Limit: 0.5 ppm
- ACGIH 8-hour time-weighted-average (TWA) Threshold Limit Value (TLV): 1 ppm
- ACGIH 15-minute short-term-exposure-limit (STEL) TLV: 5 ppm

Low levels of NH₃ gas are produced at the ETF primarily as the result of natural decay of organic material through biological decomposition. The biological decomposition process produces a great number of odors from decomposition of organic material into simpler intermediate chemical compounds which can be re-introduced into the environment in the form of solids (particulates), liquids (volatile organic compounds such as alcohols, organic acids), and gases (H₂S, sulfur dioxide [SO₂], ammonia, methane[CH₄]) (Silva, 2002; Texas A&M, 2009). NH₃ gas has an offensive pungent, irritating odor that is detectable at very low concentrations. The American Industrial Hygiene Association (AIHA) Odor Threshold for Chemicals with Established Health Standards, 2nd Edition, lists the lower range of odor values for H₂S as 43 ppb (or 0.043 ppm). While odors may be readily perceived, concentrations are still well below levels of worker exposure concern.

The resolution of direct reading instrument (DRI) equipped with a NH₃ sensor (1 ppm) is comparatively inadequate as a detection tool at the concentrations perceived by the human olfactory sense. While the resolution of the direct reading instrument (DRI) equipped with an NH₃ sensor is insufficient to detect NH₃ at the lower range of odor threshold values, it is sufficient to detect NH₃ at concentrations that approach the established occupational exposure limits (OELs).

NOTE: Additional Information continued on next page.

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

Additional Information:

Additional Information continued:

- Action Limit: 12 ppm
- ACGIH 8-hour time-weighted-average (TWA) Threshold Limit Value (TLV): 25 ppm
- ACGIH 15-minute short-term-exposure-limit (STEL) TLV: 35 ppm

Low levels of volatile organic compounds (VOC) are produced at the ETF primarily as the result of natural decay of organic material through biological decomposition. The biological decomposition process produces a great number of odors from decomposition of organic material into simpler intermediate chemical compounds which can be re-introduced into the environment in the form of solids (particulates), liquids (volatile organic compounds such as alcohols, organic acids), and gases (H₂S, SO₂, NH₃, CH₄) (Silva, 2002; Texas A&M, 2009). DRI monitoring for VOCs at ETF is utilized for indication purposes only.

Chemical Use Vapors:

If chemical use is the suspected source of odors, a review of the applicable MSDS/GHS-SDS will be conducted to determine the appropriate DRI and applicable manufacturer's correction factor (CF). The development of a compound specific AL will be performed on a case-by-case and documented on the Response Plan.

As specific chemical constituents in use at ETF general area or 20B-TK-1 could not be identified by the ETF Shift Manager at the time of response plan development, VOC monitoring utilizing both 10.6 eV PID and 11.7 eV PID was selected for indication purposes only.

Monitoring Strategy References:

Refer to [TOC-IH-58956](#) for more detail on the monitoring strategy for response to odors.

Refer to [SIHEA-PO-ETF-01](#) Attachment F for more detail on the monitoring strategy utilized for routine work at ETF.

Odor Characteristics and Odor Thresholds of Identified and Tentatively Identified Compounds:

Analytical results from the grab sample collected from the 20B-TK-1 hatch opening were at or above published odor detection concentrations for some Tentatively Identified Compounds with similar odor descriptors as provided on O/VRCs.

Identified Compounds	Result (ppm)	Odor Threshold		Odor Characteristic
		Detectable	Recognizable	
Acetonitrile	0.116	13 ppm		"aromatic", "ether-like"
Ethanol	0.008	0.34 ppm	4.6 ppm	"characteristic", "wine-like", "medicinal"
Acetone	0.026	0.42 ppm	1.7 ppm	"characteristic-pungent"
Propanenitrile	0.008	Undefined		"heavy", "earthy", "slightly-floral"
2-Butanone	0.003	0.07 ppm	5.4 ppm	"sharp", "sweet", "acetone-like"
Tentatively Identified Compounds				
N,N-dimethyl-Methylamine,	0.014	0.00011 ppm	0.00021 ppm	"ammonia-like", "fishy"
(Z)-2-Butenoic acid, methyl ester	0.002	Undefined, <1 ppm		"pungent", "Sour"
Pyrazine	0.003	Undefined, often <0.00001 ppm		"pungent", "sweet", "corn-like", "nutty"
methyl-Pyrazine	0.003	60 ppm		"pungent", "earthy", "musty"
Nonanal	0.002	3 ppm		"pungent", "old people smell"
Unknown Compound	N/A	Unknown		Unknown

NOTE: Additional Information continued on next page.

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

Additional Information:

Additional Information continued:

Chemicals associated with Odor Descriptors provided by O/VRCs and Associated Odor Thresholds:

The American Industrial Hygiene Association "Odor Thresholds for Chemicals with Established Health Standards" (2nd Edition) and the American Industrial Hygiene Association "Odor Thresholds for Chemicals" (4th Edition) provides a reference list of chemicals associated with typical odor descriptors. Below is the reference list of chemicals associated with odor descriptors provided by O/VRCs and their applicable OELs. Chemicals where the odor detection concentration is similar to or greater than the associated OEL are notated in gray.

Odor Descriptor	Chemical	Lowest Detection Concentration	Lowest Recognition Concentration	Applicable OEL
Ammonia (ammoniacal)	1,1-Dimethylhydrazine	6.1 to 14 ppm	N/A	0.01 ppm TWA (ACGIH TLV)
	1-Methoxy-2-Propanol	0.0029 ppm	N/A	50 ppm TWA (ACGIH TLV)
	Ammonia	0.057 ppm	0.57 ppm	25 ppm TWA (ACGIH TLV)
	Amyl Amine (1-Pentanamine)	15.8 ppm	N/A	N/A
	Cycloheptylamine	67 ppm	N/A	10 ppm TWA (NIOSH REL)
	Cyclohexylamine	2.42 ppm	N/A	10 ppm TWA (ACGIH TLV)
	Diethanolamine	N/A	0.279 ppm	1 mg/m ³ TWA (ACGIH TLV)
	Diethylamine	0.0033 to 0.033 ppm	0.06 ppm	5 ppm TWA (ACGIH TLV)
	Diethylaminoethanol	0.01 ppm	0.04 ppm	10 ppm TWA (NIOSH REL)
	Diisopropylamine	0.14 ppm	0.39 ppm	5 ppm TWA (ACGIH TLV)
	Dimethylamine	0.00076 ppm	0.012 ppm	5 ppm TWA (ACGIH TLV)
	Ethanolamine	2.6 ppm	24 ppm	3 ppm TWA (ACGIH TLV)
	Ethyl Acrylate (Acrylic Acid Ethyl Ester)	0.000066 ppm	0.00037 ppm	5 ppm TWA (ACGIH TLV)
	Ethylamine	0.045 ppm	0.81 ppm	5 ppm TWA (ACGIH TLV)
	Ethylenediamine	0.71 ppm	2 ppm	10 ppm TWA (ACGIH TLV)
	Ethyleneimine (Aziridine)	0.71 ppm	N/A	0.05 ppm TWA (ACGIH TLV)
	Formamide	82 ppm	N/A	10 ppm TWA (ACGIH TLV)
	Hydrazine	3 ppm	N/A	0.01 ppm TWA (ACGIH TLV)
	Isopropylamine (2-Propylamine)	0.025 ppm	0.7 ppm	5 ppm TWA (ACGIH TLV)
	Methyl Hydrazine	1.01 to 3.03 ppm	N/A	0.01 ppm TWA (ACGIH TLV)
	Methylamine	0.00095 ppm	0.0095 ppm	5 ppm TWA (ACGIH TLV)
	Morpholine	0.01 ppm	0.07 ppm	20 ppm TWA (ACGIH TLV)
	n,n-Dimethylacetamide	3.199 ppm	48 ppm	10 ppm TWA (ACGIH TLV)
	n-Butylamine (1-Butanamine)	0.08 ppm	0.24 ppm	5 ppm STEL (ACGIH TLV)
	n-Dipropylamine	0.02 ppm	N/A	5 ppm TLV (ACGIH TLV)
	n-Ethylmorpholine	0.085 ppm	0.25 ppm	5 ppm TWA (ACGIH TLV)
	n-Propyl Amine (1-Propanamine)	0.061 ppm	N/A	N/A
	Propylene Diamine	0.014 ppm	0.048 ppm	0.1 mg/m ³ TWA (NIOSH REL)
	Pyrrolidine (Azacyclopentane)	20 ppm	N/A	N/A
	sec-Butylamine	0.17 ppm	N/A	N/A
	tert-Butylamine	0.17 ppm	N/A	N/A
	Triethanolamine (Trolamine)	> 10 ppm	N/A	5 mg/m ³ TWA (ACGIH TLV)
	Triethylamine	0.0053 ppm	0.27 ppm	0.5 ppm TWA (ACGIH TLV)
	Trimethylamine	0.00011 ppm	0.00021 ppm	5 ppm TWA (ACGIH TLV)
Odor Descriptor	Chemical	Lowest Detection Concentration	Lowest Recognition Concentration	Applicable OEL
Earthy	Ethyl Acrylate (Acrylic acid ethyl ester)	0.000066 ppm	0.00037 ppm	5 ppm TWA (ACGIH TLV)
	2-Ethylhexyl Acetate	0.073 ppm	0.137 ppm	N/A
	Ethyl Mercaptan (Ethanethiol)	0.000017 ppm	0.00029 ppm	0.5 ppm TWA (ACGIH TLV)
	Hexyl Propionate	0.008 ppm	N/A	10 ppm TWA (ACGIH TLV)
	Mesityl Oxide (Methyl Isobutyl Ketone)	0.017 ppm	0.05 ppm	20 ppm TWA (ACGIH TLV)
	Picolines (Methyl Pyridines)	0.0026 ppm	0.0236 ppm	1 ppm TWA (ACGIH TLV)
	Propionaldehyde (Propanal)	0.001 ppm	0.015 ppm	100 ppm TWA (ACGIH TLV)
	Quinoline	0.0057 ppm	0.0095 ppm	N/A
	Turpentine	0.0000003 ppm	4.49 ppm	20 ppm TWA (ACGIH TLV)

NOTE: Additional Information continued on next page.

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

Additional Information:

Additional Information continued:

Odor Descriptor	Chemical	Lowest Detection Concentration	Lowest Recognition Concentration	Applicable OEL
Fishy (Fish sauce; Fish, Fishy)	1,1-Dimethylhydrazine	6.1 ppm	N/A	0.01 ppm TWA (ACGIH TLV)
	2,4-Dichlorophenol	0.000041 ppm	N/A	N/A
	Cyclohexylamine	2.42 ppm	N/A	10 ppm TWA (ACGIH TLV)
	Dibutylamine	0.079 ppm	0.265 ppm	N/A
	Diethylamine	0.0033 to 0.033 ppm	0.06 ppm	5 ppm TWA (ACGIH TLV)
	Diisopropylamine	0.14 ppm	0.39 ppm	5 ppm TWA (ACGIH TLV)
	Dimethyl Ethanolamine	0.015 ppm	0.045 ppm	N/A
	Dimethyl Formamide	0.047 ppm	100 ppm	10 ppm TWA (ACGIH TLV)
	Ethylamine	0.045 ppm	0.81 ppm	5 ppm TWA (ACGIH TLV)
	Isobutylamine	0.0015 ppm	N/A	N/A
	Isopropylamine	0.025 ppm	0.7 ppm	5 ppm TWA (ACGIH TLV)
	Methyl Ethanolamine	1.0 ppm	3.4 ppm	N/A
	Methylamine	0.00095 ppm	0.0095 ppm	5 ppm TWA (ACGIH TLV)
	Morpholine	0.01 ppm	0.07 ppm	20 ppm TWA (ACGIH TLV)
	n-Butylamine	0.08 ppm	0.24 ppm	5 ppm Ceiling (ACGIH TLV)
	Nicotine	0.0099 ppm	N/A	0.5 mg/m ³ TWA (ACGIH TLV)
	n-n-Dimethylacetamide	3.199 ppm	48 ppm	10 ppm TWA (ACGIH TLV)
	Phosphine	N/A	0.022 ppm	0.3 ppm TWA (ACGIH TLV)
	Pyridine	0.007 ppm	0.021 ppm	1 ppm TWA (ACGIH TLV)
	sec-Butylamine	0.017 ppm	N/A	5 ppm Ceiling (ACGIH TLV)
	Triethylamine	0.0053 ppm	0.27 ppm	0.5 ppm TWA (ACGIH TLV)
	Trimethylamine	0.00011 ppm	0.00021 ppm	5 ppm TWA (ACGIH TLV)
Odor Descriptor	Chemical	Lowest Detection Concentration	Lowest Recognition Concentration	Applicable OEL
Musty	2-Butoxyethanol	0.043 ppm	0.35 ppm	2 ppm TWA (ACGIH TLV)
	2-Ethoxyethanol	0.3 ppm	0.54 ppm	5 ppm TWA (ACGIH TLV)
	2-Ethylhexyl Alcohol (2-Ethyl Hexanol)	0.024 ppm	N/A	N/A
	Acetaldehyde	0.001 ppm	0.015 ppm	25 ppm Ceiling (ACGIH TLV)
	Acetophenone	0.002 ppm	0.59 ppm	10 ppm TWA (ACGIH TLV)
	Benzene Hexachloride (Lindane)	0.00013 ppm	N/A	0.5 mg/m ³ TWA (ACGIH TLV)
	Butyraldehyde (Butanal)	0.00035 ppm	0.004 ppm	N/A
	Diethylamine	0.00076 ppm	0.012 ppm	5 ppm TWA (ACGIH TLV)
	Ethylenediamine	1.3 ppm	4.5 ppm	10 ppm TWA (ACGIH TLV)
	Furfuryl Alcohol (2-furanmethanol)	8 ppm	N/A	10 ppm TWA (ACGIH TLV)
	Hydrogen Cyanide	0.009 ppm	1.99 ppm	4.7 ppm Ceiling (ACGIH TLV)
	Isobutyl Alcohol (Isobutyl Cellosolve)	0.019 ppm	0.11 ppm	50 ppm TWA (ACGIH TLV)
	Isophorone	0.0003 ppm	0.53 ppm	5 ppm Ceiling (ACGIH TLV)
	Isopropyl Alcohol	1.6 ppm	3.2 ppm	400 ppm TWA (NIOSH REL)
	Methyl n-butyl Ketone (2-Hexanone)	0.024 ppm	N/A	1 ppm TWA (NIOSH REL)
	n-Butyl Acrylate	0.00055 ppm	0.0027 ppm	2 ppm TWA (ACGIH TLV)
	Nickel Carbonyl	0.5 ppm	N/A	0.05 ppm Ceiling (ACGIH TLV)
	n-Propyl Alcohol (1-Propanol)	0.03 ppm	0.081 ppm	100 ppm TWA (ACGIH TLV)
	Phosgene	0.12 ppm	0.12 ppm	0.1 ppm TWA (ACGIH TLV)
	Quinoline	0.0057 ppm	0.0095 ppm	N/A
Odor Descriptor	Chemical	Lowest Detection Concentration	Lowest Recognition Concentration	Applicable OEL
Peanuts (Nutty)	2,5-Diethyl Pyrazine	0.01 ppm	N/A	N/A
	1-Octanol	N/A	0.0009 ppm	N/A
	2,5-Diethyl Pyrazine	0.01 ppm	N/A	N/A
	Hexyl Mercaptan (1-Hexanethiol)	0.0000041 ppm	N/A	0.5 ppm Ceiling (NIOSH REL)
	Methyl Pyrazine	60 ppm	N/A	N/A
	n-Valeraldehyde (pentanal)	0.0004 ppm	0.0026 ppm	50 ppm TWA (ACGIH TLV)
	Pentanol	0.0017 ppm	0.23 ppm	N/A
	Propionaldehyde (Propanal)	0.001 ppm	0.0084 ppm	20 ppm TWA (ACGIH TLV)

NOTE: Additional Information continued on next page.

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

Additional Information:

Additional Information continued:

Odor Descriptor	Chemical	Lowest Detection Concentration	Lowest Recognition Concentration	Applicable OEL
Rotten	Diethanolamine	N/A	0.279 ppm	1 mg/m ³ TWA (ACGIH TLV)
	Dimethylamine	0.00076 ppm	0.012 ppm	5 ppm TWA (ACGIH TLV)
	Ethyl Mercaptan	0.000017 ppm	0.00029 ppm	0.5 ppm TWA (ACGIH TLV)
	Hydrogen Sulfide	0.00007 ppm	0.00046 to 0.00093 ppm	1 ppm TWA (ACGIH TLV)
	Methyl Mercaptan	0.0000002 ppm	0.000071 ppm	0.5 ppm TWA (ACGIH TLV)
Odor Descriptor	Chemical	Lowest Detection Concentration	Lowest Recognition Concentration	Applicable OEL
Septic/Sewer	Hydrogen Sulfide	0.00007 ppm	0.00046 to 0.00093 ppm	1 ppm TWA (ACGIH TLV)
	Butane (see Propyl Mercaptan)	N/A	N/A	1000 ppm STEL (ACGIH TLV)
	Ethyl Mercaptan	0.000017 ppm	0.00029 ppm	0.5 ppm TWA (ACGIH TLV)
	Methyl Mercaptan	0.0000002 ppm	0.000071 ppm	0.5 ppm TWA (ACGIH TLV)
	Propane (see Propyl Mercaptan)	N/A	N/A	1000 ppm STEL (ACGIH TLV)
	Propyl Mercaptan (1-Propanethiol)	0.000013 ppm	0.00074 ppm	0.5 ppm Ceiling (NIOSH REL)
Odor Descriptor	Chemical	Lowest Detection Concentration	Lowest Recognition Concentration	Applicable OEL
Smoky/Cigar (Burnt; Burnt Plastic; Smoky)	2,3-Pentanedione (Acetylpropionyl)	0.0098 ppm	N/A	0.0093 ppm TWA (NIOSH REL)
	Benzaldehyde	0.0009 ppm	0.01 ppm	N/A
	Cresol	0.00000398 ppm	0.00023 ppm	20 mg/m ³ TWA (ACGIH TLV)
	Ethyl Lactate (Lactic Acid)	14 ppm	N/A	N/A
	Furan	9.90 ppm	N/A	0.001 ppm TWA (HTFOEL)
	Furfuryl Alcohol	8 ppm	N/A	10 ppm TWA (ACGIH TLV)
	Isobutyric Acid	8.1 ppm	N/A	N/A
	Methyl n-butyl Ketone (2-Hexanone)	0.024 ppm	0.068 ppm	N/A
	n-Butyric Acid (Butanoic Acid)	0.00019 ppm	0.001 ppm	N/A

Odor Threshold References:

- American Industrial Hygiene Association (2013). Odor Thresholds for Chemicals with Established Health Standards, 2nd Edition.
- American Industrial Hygiene Association (2024). Odor Thresholds for Chemicals, 4th Edition.

ETF Operational Configuration Timeline:

The ETF facility manager provided anecdotal evidence based on facility knowledge and experience that the odors were the result of chemical reactions resulting from chemical use during regeneration of the Polisher System Ion Exchange Columns to and subsequent transfer of Secondary Waste Receiving Tank (SWRT)-A in conjunction with the VOG and RCA ventilation outage. The following timeline provides specific facility configurations and actions associated with this hypothesis:

On July 15th 2024 initial cleaning of Tank 20B-TK-1 was performed to support Bi-Annual Resource Conservation and Recovery Act (RCRA) Inspections as per WO1020792 "2025-E131 Biennial 20B-TK-1 (Sump Tank 1) RCRA Tank Inspection (ENV)". Work scope involved performance of:

- hot water pressure washing of tank walls and floor,
- removal of liquids via sump pump to a storage tote,
- and removal of solids with a compressed air powered vacuum to a storage tote.

On July 23rd and July 24th 2024 the Polisher System Ion Exchange Columns (IXCs) were re-generated as per ETF-60G-002 "Polisher Regeneration" which introduces both 4% Sodium Hydroxide (NaOH) solution and 4% Sulfuric Acid (H₂SO₄) solution through the IXCs, with resulting effluent going to SWRT-A. Before Polisher Regeneration SWRT-A was at 0.6% capacity. At the conclusion of Polisher Regeneration SWRT-A was at 53.5% capacity, pH was approximately 4.7.

NOTE: Additional Information continued on next page.

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

Additional Information:

Additional Information continued:

On July 27th SWRT-A and SWRT-B contents were transferred to the surge tank 60A-TK-1 reducing SWRT-A contained volume from 53.5% to 10.7%.

On July 29th 2024 Tank 20B-TK-1 was re-cleaned as per WO1020792 to ensure no residual material remained before performance of the Bi-Annual RCRA inspection.

On August 12th 2024 the Bi-Annual RCRA inspection of 20B-TK-1 was performed.

On August 22nd 20B-TK-1 began receiving effluent from throughout the plant and achieved a volume of 45% by the end of September 7th 2024.

On September 8th 2024 1920 through 2355 SWRT-A was transferred to SWRT-B utilizing 20B-TK-1 as a surge tank, including a 5 minute flush of SWRT-A with verification water as per ETF-60I-008 "Secondary Waste Receiving Tank Operation". At the conclusion of the SWRT transfer the volume of 20B-TK-1 was 27%. During the transfer the pH of SWRT-A contents was approximately 4.8, the pH of 20B-TK-1 contents is unknown.

The VOG ventilation was shut down at 0654 on September 10th 2024 and RCA ventilation was shut down at 0705 on September 10th 2024 to support maintenance activities (LEF-24-078 "RCA Ventilation Maintenance and Filter Replacement").

NOTE: Additional Information continued on next page.

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

Additional Information:

Additional Information continued:

Additional Information Acronyms:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
AL	Action Limit
CF	correction factor
CH ₄	Methane
COPC	chemicals of potential concern
DFAS	Data Fusion & Advisory System
DRI	direct reading instrument
ETF	Effluent Treatment Plant
eV	electron-volts
GHS-SDS	Globally Harmonized System Safety Data Sheet
H ₂ S	Hydrogen Sulfide
MSDS	Material Safety Data Sheet
NH ₃	Ammonia
NOAA	National Oceanic and Atmospheric Administration
OEL	Occupational Exposure Limit
OSHA	Occupational Safety & Health Administration
O/VRC	Odor/Vapor Response Card
PEL	Permissible Exposure Limit
pH	Percent Hydrogen
PID	photoionization detector
ppb	parts per Billion
ppm	parts per million
ppt	Parts per trillion
QRA	Quantitative Risk Assessment
RCA	Radiologically Controlled Area (ventilation)
REL	Recommended Exposure Limit
RPE	Respiratory Protection Equipment
SO ₂	Sulfur Dioxide
STEL	Short Term Exposure Limit
SWRT	Secondary Waste Receiving Tank
TLV	Threshold Limit Value
TWA	Time Weighted Average
VMDS	Vapor Monitoring Detection System
VOC	Volatile Organic Compounds
VOG	Vessel Off Gas (ventilation)

NOTE: Additional Information continued on next page.

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

Additional Information:

Additional Information continued:

Additional Information 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.
- American Industrial Hygiene Association (2024). Odor Thresholds for Chemicals, 4th Edition.
- American Industrial Hygiene Association (2013). Odor Thresholds for Chemicals with Established Health Standards, 2nd Edition.
- [ETF-60I-008](#) "Secondary Waste Receiving Tank Operation"
- Honeywell (2018). Technical Note TN-106: A Guideline for PID Instrument Response. Retrieved from https://prod-edam.honeywell.com/content/dam/honeywell-edam/sps/his/en-us/products/gas-and-flame-detection/documents/Technical-Note-106_A-Guideline-for-Pid-Instrument-Response.pdf
- LEF-24-078 "RCA Ventilation Maintenance and Filter Replacement"
- Memo WRPS-1904672.1, TANK FARM EXHAUST ~ CK CONCENTRATION ALARM/ ACTION LEVELS FOR AMMONIA
- National Institute of Standards and Technology. NIST Chemistry WebBook, SRD#69. Retrieved from: <https://webbook.nist.gov/chemistry/>
- NIOSH Pocket Guide to Chemical Hazards. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.
- Occupational Safety & Health Administration (n.d.). Permissible Exposure Limits- Annotated Tables, OSHA Annotated Table Z-1. Retrieved from <https://www.osha.gov/annotated-pels/table-z-1>
- [SIHEA-PO-ETF-01](#) "Routine Work Activities at ETF" Attachment F
- [TOC-IH-58956](#). Monitoring Strategy for Response to Odors: Common Odor Sources in the 200 East, 200 West, & 600 Areas.
- WO1020792 "2025-E131 Biennial 20B-TK-1 (Sump Tank 1) RCRA Tank Inspection (ENV)"

Recommendations/Conclusions:

Recommendations:

Communication that odors are expected during VOG and/or RCA ventilation outages should be increased ahead of implementation. Facility culture needs to include knowledge that odors are normal and typical of various operational activities and does not necessarily equate to overexposure.

Evaluation of operational processes in which process chemicals and/or effluent contaminants are mixed should be performed to the extent that resulting gases/vapors can be ranked based on possible odorant formation and/or emission. Then processes which are anticipated to result in odorous emissions should not be performed without additional controls (e.g ventilation, access restriction, communication) in place to eliminate potential worker exposure until exposure assessment can be performed to ensure that exposure to odorous emissions does not equate to potential exposure above OELs.

Conclusions:

Odor descriptors provided by Affected Workers are inconsistent with Tank Vapors. Based on a review of the DFAS application, powered by SmartSite™, Weather Details dashboard and VMDS exhaust ammonia readings for the approximate time of the Event, and distance of event location from Tank Farm emission points, the cause of the odor is unlikely to be from Tank Farm Exhauster emissions. The atmospheric stability at the time of the event was neutral conditions and the mixing height was 1200 feet above grade.

Facility Management utilizing facility experience and process knowledge indicated that chemicals utilized during Polisher Regeneration in conjunction with utilization of 20B-TK-1 to perform SWRT transfer, and lack of process and facility ventilation was the cause of the odor event:

- The Polisher IXC regeneration process utilizes acidic and basic chemical solutions to strip metals and other contaminants from the Ion Exchange Resin media. Those process chemicals and carried contaminants arrive at SWRT-1 where chemical reactions and resulting reaction products accumulate. Gaseous-phase reaction products are normally continuously extracted via VOG to prevent uncontrolled emissions from the SWRT during this process.
- The pH of the liquid contents of SWRT-A resulting from the Polisher regeneration process was slightly acidic. The pH of the contents of 20B-TK-1 prior to mixing with SWRT-A effluent was unknown. Ongoing chemical reactions may have been occurring within 20B-TK-1 during the time of the event.
- At the time of the event the RCA ventilation and the VOG ventilation were not in operation. When negative ventilation is not applied gaseous/vapor emissions from tanks are driven by release of gasses from solution and barometric/thermal gradients. The removal of VOG ventilation from tank 20B-TK-1 and other tanks within the facility allows for mixing of the various tank headspaces with surrounding facility atmosphere as soon as the pressure gradient between the tanks and the facility atmosphere are equalized. The removal of RCA ventilation significantly decreases the amount of dilution of the facility ambient atmosphere, allowing gaseous/vapor process tank emission to accumulate and dwell within the facility.

The primary odor source was assumed to be the 20B-TK-1 access hatch based on DRI reading gradient increasing as survey team moved towards the area. It is possible that other odor sources may have existed, specifically at openings of other process tanks such as SWRT-A and SWRT-B, however those sources are not easily accessible for survey purposes as compared to 20B-TK-1.

Although a source was identified the specific chemical mixture contributing to the odors would not be positively identified utilizing available DRI equipment and analytical techniques applied to the source grab sample. The diversity of odor descriptors reported did not allow for deductive determination of chemical constituents. Tank contents could not be positively determined, and so resulting reaction products could not be hypothesized. As the specific odorant chemical mixture is unknown, evaluation of exposure as compared to applicable OELs could not be performed, however source sample results were found to be below OELs for chemical compounds identified. A review of possible chemicals based on odor descriptors shows that most plausible chemical odor thresholds are well below applicable TWA OELs. As the event was of short duration, and personnel exited the area soon after odors were reported, it is unlikely applicable OELs were exceeded.

RCA and VOG ventilation were restarted to control odorous emissions from process tanks and follow-up survey DRI instrumentation results indicated that further actions were not necessary to protect worker safety and health, therefore the area was released from restricted access and work was allowed to continue.

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

Other:

Prior to the next scheduled VOG and RCA ventilation outage (09/15/2024 – 09/19/2024) 20B-TK-1 was cleaned with Ethylenediaminetetraacetic acid (EDTA) solution, flushed, and filled with verification (clean) water in an unsuccessful attempt to prevent odors from returning. Despite these measures the odor returned soon after VOG and RCA ventilation was shut-down and persisted within the facility at similar strength despite attempts at control with portable fans and opened exterior doors. This suggests that the odor source is not likely 20B-TK-1 specifically, but other process tanks within the facility.

Associated Documents:

iCAS Number: N/A

EIR Number: EIR 2024-073

Industrial Hygienist:

Print First and Last Name

Signature / Date

Digitally signed by _____

Date: 2024.09.25 13:30:10 -07'00'

Industrial Hygiene Level 3 Manager:

Print First and Last Name

Signature / Date

Digitally signed by _____

Date: 2024.09.25 13:28:00 -07'00'

Industrial Hygiene Level 2 Manager:

Print First and Last Name

Signature / Date

Digitally signed by _____

Date: 2024.09.26 05:07:00 -07'00'

ODOR/VAPOR RESPONSE CARD

1. Complete below information and map (Page 1).

- Date and time of event: 9.10.24
- Check Applicable:
 - ☒ Odor
 - ☐ Ammonia Alarm (6 ppm)
 - ☐ Ammonia Alarm (12 ppm)
 - ☐ Alarm (other - describe):
- Your name and the work you were performing:
[REDACTED] We were performing a Calibration @ ETF on the process floor (2025E) NW corner
- Other Work Underway? Describe:
- Location of event (mark area on map and wind direction):
2025E ETF process floor
- Name(s) of others in or near the affected area:
[REDACTED]
- Was Industrial Hygiene present, who?
No
- Describe the odor:
 - ☒ Sweet
 - ☐ Sour
 - ☒ Smoky
 - ☐ Septic/Sewer
 - ☐ Musty
 - ☐ Rotten
 - ☐ Metallic
 - ☐ Onion
 - ☐ Earthy
 - ☐ Ammonia
 - ☐ Citrus
 - ☐ Solvent
 - ☒ Other (describe): Burnt, Better
- Is source known/likely? Describe:
Possible Acid from Polisher on ETF Process floor
- Your symptoms? ☐ None
 - ☐ Headache
 - ☐ Dizziness
 - ☐ Nausea
 - ☐ Cough
 - ☐ Fatigue
 - ☐ Weakness
 - ☒ Sore Throat
 - ☐ Difficulty Breathing
 - ☐ Eye Irritation
 - ☐ Rash
 - ☐ Itch
 - ☒ Tingling
 - ☐ Numbness
 - ☒ Taste
 - ☐ Other (describe):

2. Provide this completed card (Page 1 & 2) to Supervisor, Industrial Hygiene, your Union Safety Representative or the CSM. If received by Supervisor/IH/U-SR, Supervisor/IH/U-SR will ensure card is provided to the CSM.

ODOR/VAPOR RESPONSE CARD

1. Complete below information and map (Page 1).

• Date and time of event: 8:30am 9-10-24

• Check Applicable:

☒ Odor ☐ Ammonia Alarm (6 ppm) ☐ Ammonia Alarm (12 ppm) ☐ Alarm (other - describe):

• Your name and the work you are performing:

[REDACTED] Cal on polishers

• Other Work Underway? Describe:

• Location of event (mark area on map and wind direction):

Process floor 2025 E

• Name(s) of others in or near the affected area:

• Was Industrial Hygiene present, who?

no

• Describe the odor:

☐ Sweet	☐ Sour	☐ Smoky	☒ Septic/Sewer	☒ Musty	☐ Rotten
☐ Metallic	☐ Onion	☐ Earthy	☐ Ammonia	☐ Citrus	☐ Solvent
☐ Other (describe):					

• Is source known/likely? Describe:

no

• Your symptoms? ☒ None

☐ Headache	☐ Dizziness	☐ Nausea	☐ Cough	☐ Fatigue
☐ Weakness	☐ Sore Throat	☐ Difficulty Breathing	☐ Eye Irritation	☐ Rash
☐ Itch	☐ Tingling	☐ Numbness	☐ Taste	
☐ Other (describe):				

2. Provide this completed card (Page 1 & 2) to Supervisor, Industrial Hygiene, your Union Safety Representative or the CSM.
If received by Supervisor/IH/U-SR, Supervisor/IH/U-SR will ensure card is provided to the CSM.

ODOR/VAPOR RESPONSE CARD

1. Complete below information and map (Page 1).

- Date and time of event: 9/10/24 0830-1100

- Check Applicable:

☒ Odor ☐ Ammonia Alarm (6 ppm) ☐ Ammonia Alarm (12 ppm) ☐ Alarm (other - describe): _____

- Your name and the work you were performing:

[REDACTED] weekly waste / laundry waste

- Other Work Underway? Describe:

calibration

- Location of event (mark area on map and wind direction):

Process floor

- Name(s) of others in or near the affected area:

[REDACTED]

- Was Industrial Hygiene present, who?

no

- Describe the odor:

☐ Sweet ☐ Sour ☐ Smoky ☐ Septic/Sewer ☒ Musty ☐ Rotten
☐ Metallic ☐ Onion ☐ Earthy ☐ Ammonia ☐ Citrus ☐ Solvent
☒ Other (describe): _____

- Is source known/likely? Describe:

peanuts

- Your symptoms? ☐ None

☐ Headache ☐ Dizziness ☐ Nausea ☐ Cough ☐ Fatigue
☐ Weakness ☒ Sore Throat ☐ Difficulty Breathing ☐ Eye Irritation ☐ Rash
☐ Itch ☐ Tingling ☐ Numbness ☐ Taste
☒ Other (describe): nose stuffiness

2. Provide this completed card (Page 1 & 2) to Supervisor, Industrial Hygiene, your Union Safety Representative or the CSM.
If received by Supervisor/IH/U-SR, Supervisor/IH/U-SR will ensure card is provided to the CSM.

ODOR/VAPOR RESPONSE CARD

1. Complete below information and map (Page 1).

- Date and time of event: 9/10/24 10:00 am.
- Check Applicable:
 - ☒ Odor
 - ☐ Ammonia Alarm (6 ppm)
 - ☐ Ammonia Alarm (12 ppm)
 - ☐ Alarm (other - describe): _____
- Your name and the work you were performing:
[REDACTED] plant process floor walk down
- Other Work Underway? Describe:
N/A
- Location of event (mark area on map and wind direction):
2025E Process floor
- Name(s) of others in or near the affected area:
[REDACTED]
- Was Industrial Hygiene present, who?
no
- Describe the odor:
 - ☐ Sweet
 - ☐ Sour
 - ☐ Smoky
 - ☐ Septic/Sewer
 - ☒ Musty
 - ☐ Rotten
 - ☐ Metallic
 - ☐ Onion
 - ☒ Earthy
 - ☐ Ammonia
 - ☐ Citrus
 - ☐ Solvent
 - ☐ Other (describe): _____
- Is source known/likely? Describe:
unknown
- Your symptoms? ☐ None
 - ☒ Headache
 - ☐ Dizziness
 - ☐ Nausea
 - ☐ Cough
 - ☐ Fatigue
 - ☐ Weakness
 - ☒ Sore Throat
 - ☒ Difficulty Breathing
 - ☐ Eye Irritation
 - ☐ Rash
 - ☐ Itch
 - ☐ Tingling
 - ☐ Numbness
 - ☒ Taste
 - ☐ Other (describe): _____

2. Provide this completed card (Page 1 & 2) to Supervisor, Industrial Hygiene, your Union Safety Representative or the CSM.
If received by Supervisor/IH/U-SR, Supervisor/IH/U-SR will ensure card is provided to the CSM.

ODOR/VAPOR RESPONSE CARD

1. Complete below information and map (Page 1).

- Date and time of event: 10:00 AM
- Check Applicable:
 - ☒ Odor
 - ☐ Ammonia Alarm (6 ppm)
 - ☐ Ammonia Alarm (12 ppm)
 - ☐ Alarm (other - describe): _____
- Your name and the work you were performing:
[REDACTED] SUMP 2 WALKDOWN/INSPECTION
- Other Work Underway? Describe:
N/A
- Location of event (mark area on map and wind direction):
SUMP TANK 2 (PROCESS FLOOR NORTH AREA)
- Name(s) of others in or near the affected area:
[REDACTED]
- Was Industrial Hygiene present, who?
NO, [REDACTED] CAME AFTER WE EXITED FLOOR
- Describe the odor:
 - ☐ Sweet
 - ☐ Sour
 - ☒ Smoky
 - ☐ Septic/Sewer
 - ☒ Musty
 - ☐ Rotten
 - ☐ Metallic
 - ☐ Onion
 - ☒ Earthy
 - ☒ Ammonia
 - ☐ Citrus
 - ☐ Solvent
 - ☒ Other (describe): AN ASHED OUT CIGAR
- Is source known/likely? Describe:
SOURCES SAID SUMP 1 off-GASSING BUT NOT VERIFIED
- Your symptoms? ☐ None
 - ☐ Headache
 - ☐ Dizziness
 - ☐ Nausea
 - ☒ Cough
 - ☐ Fatigue
 - ☐ Weakness
 - ☒ Sore Throat
 - ☐ Difficulty Breathing
 - ☐ Eye Irritation
 - ☐ Rash
 - ☐ Itch
 - ☐ Tingling
 - ☐ Numbness
 - ☒ Taste
 - ☒ Other (describe): LIGHT HEADACHES

2. Provide this completed card (Page 1 & 2) to Supervisor, Industrial Hygiene, your Union Safety Representative or the CSM. If received by Supervisor/IH/U-SR, Supervisor/IH/U-SR will ensure card is provided to the CSM.

ODOR/VAPOR RESPONSE CARD

1. Complete below information and map (Page 1).

- Date and time of event: 1000
- Check Applicable:
☒ Odor ☐ Ammonia Alarm (6 ppm) ☐ Ammonia Alarm (12 ppm) ☐ Alarm (other - describe): _____
- Your name and the work you were performing:
[REDACTED] responding to report of odors
- Other Work Underway? Describe:
N/A
- Location of event (mark area on map and wind direction):
2025 E process area
- Name(s) of others in or near the affected area:
[REDACTED]
- Was Industrial Hygiene present, who?
No
- Describe the odor:

☐ Sweet	☐ Sour	☐ Smoky	☒ Septic/Sewer	☒ Musty	☐ Rotten
☐ Metallic	☐ Onion	☐ Earthy	☐ Ammonia	☐ Citrus	☐ Solvent
☐ Other (describe): _____					
- Is source known/likely? Describe:
yes, sum tank 1
- Your symptoms? ☒ None

☐ Headache	☐ Dizziness	☐ Nausea	☐ Cough	☐ Fatigue
☐ Weakness	☐ Sore Throat	☐ Difficulty Breathing	☐ Eye Irritation	☐ Rash
☐ Itch	☐ Tingling	☐ Numbness	☐ Taste	
☐ Other (describe): _____				

2. Provide this completed card (Page 1 & 2) to Supervisor, Industrial Hygiene, your Union Safety Representative or the CSM.
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ODOR/VAPOR RESPONSE CARD

1. Complete below information and map (Page 1).

• Date and time of event: 9/10/24 1100

• Check Applicable:

☒ Odor ☐ Ammonia Alarm (6 ppm) ☐ Ammonia Alarm (12 ppm) ☐ Alarm (other - describe): _____

• Your name and the work you were performing:

[REDACTED] replacing rpe

• Other Work Underway? Describe: _____

• Location of event (mark area on map and wind direction):

ETF power Floor

• Name(s) of others in or near the affected area: _____

• Was Industrial Hygiene present, who?

No

• Describe the odor:

☐ Sweet	☐ Sour	☐ Smoky	☒ Septic/Sewer	☒ Musty	☒ Rotten
☐ Metallic	☐ Onion	☐ Earthy	☒ Ammonia	☐ Citrus	☐ Solvent
☐ Other (describe): _____					

• Is source known/likely? Describe: _____

• Your symptoms? ☒ None

☐ Headache	☐ Dizziness	☐ Nausea	☐ Cough	☐ Fatigue
☐ Weakness	☐ Sore Throat	☐ Difficulty Breathing	☐ Eye Irritation	☐ Rash
☐ Itch	☐ Tingling	☐ Numbness	☐ Taste	
☐ Other (describe): _____				

2. Provide this completed card (Page 1 & 2) to Supervisor, Industrial Hygiene, your Union Safety Representative or the CSM. If received by Supervisor/IH/U-SR, Supervisor/IH/U-SR will ensure card is provided to the CSM.

ODOR/VAPOR RESPONSE CARD

1. Complete below information and map (Page 1).

- Date and time of event: 9/10/24 1052
- Check Applicable:
☒ Odor ☐ Ammonia Alarm (6 ppm) ☐ Ammonia Alarm (12 ppm) ☐ Alarm (other - describe): _____
- Your name and the work you were performing:
[REDACTED] Opening Roll-up door on South Side of Process Floor
- Other Work Underway? Describe:
No
- Location of event (mark area on map and wind direction):
Sump 1 area / Process Floor / 202SE
- Name(s) of others in or near the affected area:
[REDACTED]
- Was Industrial Hygiene present, who?
No
- Describe the odor:

☐ Sweet	☐ Sour	☐ Smoky	☐ Septic/Sewer	☒ Musty	☐ Rotten
☐ Metallic	☐ Onion	☐ Earthy	☐ Ammonia	☐ Citrus	☐ Solvent
☐ Other (describe): _____					
- Is source known/likely? Describe:
Believe to be from Sump 1, Ventilation turned off for maintenance.
- Your symptoms? ☒ None

☐ Headache	☐ Dizziness	☐ Nausea	☐ Cough	☐ Fatigue
☐ Weakness	☐ Sore Throat	☐ Difficulty Breathing	☐ Eye Irritation	☐ Rash
☐ Itch	☐ Tingling	☐ Numbness	☐ Taste	
☐ Other (describe): _____				

2. Provide this completed card (Page 1 & 2) to Supervisor, Industrial Hygiene, your Union Safety Representative or the CSM. If received by Supervisor/IH/U-SR, Supervisor/IH/U-SR will ensure card is provided to the CSM.

ODOR/VAPOR RESPONSE CARD

1. Complete below information and map (Page 1).

- Date and time of event: 9-10-24 ~ 1100
- Check Applicable:
☒ Odor ☐ Ammonia Alarm (6 ppm) ☐ Ammonia Alarm (12 ppm) ☐ Alarm (other - describe): _____
- Your name and the work you were performing:
[REDACTED] - PROCESS FLOOR WALKDOWN
- Other Work Underway? Describe:
NO OTHER WORK IN AREA
- Location of event (mark area on map and wind direction):
202SE PROCESS FLOOR NEAR 203-TIC-1 AND EVAPORATOR
- Name(s) of others in or near the affected area:
[REDACTED]
- Was Industrial Hygiene present, who?

- Describe the odor:

☐ Sweet	☐ Sour	☐ Smoky	☐ Septic/Sewer	☐ Musty	☒ Rotten
☐ Metallic	☐ Onion	☐ Earthy	☒ Ammonia	☐ Citrus	☐ Solvent
☐ Other (describe): _____					
- Is source known/likely? Describe:
LIKELY SOURCE IS 203-TIC-1 WITH VESSEL VENTILATION OFF
- Your symptoms? ☒ None

☐ Headache	☐ Dizziness	☐ Nausea	☐ Cough	☐ Fatigue
☐ Weakness	☐ Sore Throat	☐ Difficulty Breathing	☐ Eye Irritation	☐ Rash
☐ Itch	☐ Tingling	☐ Numbness	☐ Taste	
☐ Other (describe): _____				

2. Provide this completed card (Page 1 & 2) to Supervisor, Industrial Hygiene, your Union Safety Representative or the CSM. If received by Supervisor/IH/U-SR, Supervisor/IH/U-SR will ensure card is provided to the CSM.