TOC-WP-23-5788
Revision 0

C-67 Event Investigation Reports (Redacted) EIR-2023-074 (10/25/2023)

(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

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Washington River Protection Solutions

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P.O. Box 850
Richland, Washington 99352

APPROVED
By Lynn M Ayers at 3:10 pm, Nov 02, 2023

Release Approval Date

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: ESH&Q **2. Report Date:** 11/01/2023

3. Investigation Title: MO-511 C-67 Response

4. Investigation Report Number: EIR-2023-074

5. Responsible Manager: [redacted]

6. Event Investigator: [redacted]

7. Area / Building / Location: 200E/MO-511

8. Date and Approximate Time of Event: Date: 10/25/2023 **Time *(military)*:** 1000 Hours

9. Associated Action Request (AR) Number: WRPS-AR-2024-0227

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

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

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

Four workers reported a "propane like" odor inside their primary work location (MO-511).

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

MO-511 occupants that reported experiencing a stronger than normal odor:
- 1 Radiological Control Technician Supervisor
- 3 Radiological Control Technicians (RCTs)

Other MO-511 occupants when stronger than normal odor reported:
- 4 RCTs

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

On 10/25/2023, at approximately 1000 hours, one RCT reported a stronger than normal "propane like" odor while working at their desk in MO-511. The RCT indicated the odor was perceptible all morning.

At 1056 hours, the Central Shift Manager (CSM) received Odor Response Cards from the eight workers who were performing general office work in MO-511 at time the stronger than normal odor was reported. Four out of the eight workers indicated they experienced a "propane like" odor and four workers did not report experiencing stronger than normal odors. All eight workers were offered, and declined, precautionary medical surveillance by the onsite medical provider.

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

Inside office building MO-511.

Workers were wearing standard street clothes (which is considered Level D PPE) and were in a work location that is not posted as a radiological controlled area. Workers were performing work activities that do not require use of respiratory protection or a personal ammonia monitor (e.g., VentisPro).

The Hanford Site Meteorological Station #6 and Data Fusion and Advisory System (DFAS) application, powered by SmartSite™, was utilized for outdoor weather details at the time odors were reported. The Hanford Site Meteorological Station #32 and DFAS dashboard indicated the following weather conditions at 1000 hours on 10/25/2023:

- Wind Speed: 8.3 miles per hour (mph)
- Wind Direction: 316° (out of Northwest)
- Mixing Height: 700 feet above grade
- Stability Class: E (slightly stable conditions)
- Temperature: 43° F
- Barometric Pressure: 29.12 inches Hg
- Humidity: 86%

16. Impact to Facility: *(Caused by the event or a description of known consequences)*
Access was restricted to MO-511 for approximately two and a half hours. No operational impacts, impacts to facility safety status, or facility reliability occurred.

17. Immediate Actions Taken: *(List immediate actions taken to stabilize the scene or respond to the event)*
- CSM initiated TFC-OPS-OPER-C-67, restricted access to MO-511, and issued Shift Office Event Notification (SOEN).
- CSM made required TFC-OPS-OPER-C-67 notifications.
- CSM entered TF-AOP-001 for relocation of personnel from MO-511 and issued SOEN.
- Production Operations East (POE) IHTs initiated TFC-OPS-OPER-C-67 response actions and monitoring of MO-511 per IHSP-POEMULTI-TFCOPSOPERC67.
- Event Investigation EIR-2023-074 "MO-511 C-67 Response" was initiated.

18. Compensatory Actions Taken:
None.

19. Remedial Actions Taken:
None.

20. Key Elements of the Investigation: *(Key investigation points)*
To summarize the conclusions of IHIR-00083, "TFC-OPS-OPER-C-67 Response MO511," investigation and DRI monitoring could not readily identify the odor source. Although, odor descriptors provided by affected workers are not consistent with Tank Vapor sources. DRI 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 limit standpoint. As a result, the area was released from restricted access.

The following considerations support the IHIR-00083 conclusion:

(1) The affected worker who initially perceived the stronger than normal “propane like” odor stated they first checked for possible outside sources near MO-511, however, did not identify a readily apparent source. In addition, the affected worker reported they only perceived the “propane like” odor in Room 102 within MO-511 and did not observe the odor at other locations in or around MO-511.

(2) Affected Workers indicated a possible source of the odor could be vehicles parked north of MO-511. At the time of the TFC-OPS-OPER-C-67 field response, the two trucks parked north of MO-511 were not running. In addition, the odor descriptors provided by Affected Workers are inconsistent with the primary combustion engine by-products. While one possible combustion engine by-product (hydrogen sulfide) is associated with a natural gas odor, due to the location of the vehicles (north of MO511) and the air intake for MO511 (south side), the cause of the odor is unlikely to be from combustion engine emissions.

(3) A DRI equipped with sensors to monitor for hydrogen sulfide and carbon monoxide was utilized during the TFC-OPS-OPER-C-67 response based on the "propane-like" odor descriptor provided by affected workers, in addition to “carbon monoxide" like odor concerns previously reported by MO-511 occupants.

Both propane and carbon monoxide are odorless gases. The typical odors associated with propane is due to a foul-smelling odorant added to propane for leak detection purposes. Typical propane odorants, including mercaptan, are sulfur-based compounds. Butyl mercaptan and dodecyl mercaptan are commonly associated with "skunk" odor characteristics, whereas methyl mercaptan is associated with the "rotten cabbage" and "garlic" odor characteristics correlated with propane. The odors typically associated with carbon monoxide are the other odorous by-products resultant of the incomplete combustion of petroleum products from internal, intermittent combustion diesel and gasoline engines.

While propane powered BBQs are located within the vicinity/proximity of MO-511, personnel performing TFC-OPS-OPER-C-67 field response confirmed none were in use on 10/25/23.

Peak hydrogen sulfide (<0.1 ppm) and carbon monoxide (<1 ppm) readings obtained from the general areas inside MO-511, including Room 102, and outside MO-511 during TFC-OPS-OPER-C-67 response were below background levels.

(4) The POE IHTs performing TFC-OPS-OPER-C-67 response actions reported the "propane like" odors were no longer present/observed in the general areas inside or outside MO-511 during response. They noted the primary odor encountered during response was the personal diffuser/vaporizer located within MO-511 Room 102, however, the associated odor characteristic was inconsistent with the odor descriptors provided by Affected Workers.

(5) Quantitative Risk Assessment (QRA) modeling indicates MO-511 would not be within potential tank vapor exposure zones in either a waste disturbing or non-waste disturbing farm status during passive or active ventilation in AN-farm, AY/AZ-farm, AX-farm, A-farm, AW-farm, or AP-farm. Providing indication the source of the odor is highly improbable to be resultant of Tank Farm emissions.

(6) Evaluation of the weather details further 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 (Refer to Figure 1).

Figure 1 - DFAS PEZ Model

(7) While the reported odor descriptions are inconsistent with Tank Waste Chemical Vapors, due to the proximity of MO-511 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 Volatile Organic Compounds (VOCs) utilizing a DRI equipped 10.6 eV photoionization detector provides further indication for Tank Waste Chemical Vapors/COPCs.

Investigative TFC-OPS-OPER-C-67 DRI monitoring in the general areas inside and outside of MO-511, including Room 102, indicated less than detectable concentrations for ammonia (< 1 ppm) and VOCs (≤ 0.01 ppm), which is below anticipated background levels. Providing further indication the cause of the reported odor was unlikely to be resultant of Tank Farms exhauster emissions.

(8) 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 29.280 at the 241-AN exhauster, 11.607 ppm at the 241-AW exhauster, 0 ppm at the POR-126 exhauster, 0 ppm at the POR-127, and 40.254 ppm at 702-AZ exhauster. The AP exhauster is not currently connected to VMDS, issues have been identified with the 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 10/18/2023 and 10/24/2023 was 9 ppm at the AP Exhauster. Conservatively utilizing the higher ammonia concentration observed in the 702-AZ exhauster, a predicted ground receptor ammonia concentration of 0.219 ppm (or 0.875% of the established Occupational Exposure Limit for ammonia) would be expected if AN, AP, AY/AZ, AX tank, or AW farm exhauster emissions were present.

The exhauster high level alarm conservatively established for A farm is 160 ppm. According to the Vapor Monitoring and Detection System (VMDS), the ammonia concentration observed at the time of event occurrence was 4.771 ppm at the POR-518 exhauster and 1.796 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 0.075 ppm (or 0.298% of the established Occupational Exposure Limit for ammonia) would be expected if A tank farm exhauster emissions were present.

Therefore, providing additional indication the reported odor was unlikely to be resultant of Tank Farms exhauster emissions.

(9) POE IHTs performed DRI monitoring of five ORCA/RTIC coolers stored within MO-511. The coolers are utilized for storage/transportation of water bottles and ice to field work locations. Additionally, the workers do not utilize cleaning products on the coolers. Investigative TFC-OPS-OPER-C-67 DRI monitoring of the general areas around the ORCA/RTIC coolers, when the coolers were closed/latched, indicated no readings above background levels. After opening the coolers, DRI monitoring obtained within the coolers indicated readings above the action limits for VOCs, hydrogen sulfide, and carbon monoxide. In response, the five coolers were removed from MO-511 and placed outside, leaving the lids open to air out (see Figure 2). The area around the coolers was cordoned off with caution tape and restricted access signs. After airing out the 5 coolers for approximately 30 minutes, follow-up DRI monitoring indicated peak readings were at or below background level for ammonia, carbon monoxide, hydrogen sulfide, and VOCS.

Figure 2 – ORCA/RTIC Coolers

The peak readings when the five coolers were closed, coolers were opened, and when the 5 coolers were aired out with the lid open outside were the following:

Location	Ammonia	VOCs	Hydrogen Sulfide	Carbon Monoxide
Coolers (closed)	< 1 ppm	< 0.010 ppm	< 0.1 ppm	< 1 ppm
Inside Coolers (open)	2 ppm	25.830 ppm	6.3 ppm	499 ppm
Inside Coolers (open) after Airing	< 1 ppm	0.020 ppm	< 0.1 ppm	< 1 ppm

Note: Carbon monoxide provides interference with the MultiRAE Pro hydrogen sulfide sensor. The hydrogen sulfide concentration observed was likely resultant of the carbon monoxide gases.

The DRI readings obtained within the coolers are consistent with the off-gassing of polyethylene degradation by-products. The coolers are comprised of rotationally molded polyethylene plastic materials. Polyethylene is not an inert material and is known to release additives and other degradation products such as carbon monoxide and hydrocarbons (e.g., ethylene and propylene). Further, UV radiation(sunlight) provides the activation energy necessary to initiate and/or enhance the degradation of polyethylene plastics. Once degradation is initiated, degradation products will continue to off-gas, even when in dark locations. Odor descriptors provided by Affected Workers are inconsistent with the polyethylene degradation by-products and the coolers cannot be confirmed as the source of the reported odor.

21. Positive Aspects Identified:

The five ORCA/RTIC coolers were removed from MO-511 and placed outside with lids open once POE IHTs determined the VOCs, hydrogen sulfide, and carbon monoxide readings were above the action limit.

22. Key Take Aways / Learning Opportunities:

It is a best practice to leave the ORCA/RTIC coolers open, or occasionally open to air out, to prevent accumulation of polyethylene degradation by-products.

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.

[X] This event does not require continuation of the Event Investigation process.

Responsible Manager Approval:

[redacted]

Name (First, Middle Initial, Last)

[redacted] Digitally signed by [redacted]
Date: 2023.11.01 15:45:12 -07'00'

Signature / Date

CAS Manager Approval:

[redacted]

Name (First, Middle Initial, Last)

[redacted]
Date: 2023.11.01 16:17:38 -07'00'

Signature / Date

Washington River Protection Solutions

INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT

Event Title:	PER Number:
TFC-OPS-OPER-C-67 Response MO511	N/A
	IHIR Number: IHIR-00083

Date:	Time:	Location:
10/25/2023	1000	MO511

Event Summary and Timeline:

Event Summary:
At approximately 1000 on 10/25/2023, four workers encountered a stronger than normal "propane-like" odors inside MO511. No symptoms were reported. All personnel declined precautionary medical surveillance.

Field Response Timeline:

1017 Production Operations-East (POE) Shift Industrial Hygiene Technician (IHT) Supervisor notifies POE Industrial Hygienist (IH) 1 of possible TFC-OPS-OPER-C-67
1017 POE IH-1 notifies POE IH-2 of possible TFC-OPS-OPER-C-67
1019 POE IHs arrive at Central Shift Office (CSO)
1019 POE Shift IHT Supervisor arrives at CSO and briefs Central Shift Manager (CSM) and POE IHs:
- Notified by Hanford Atomic Metal Trades Council (HAMTC) Safety Representative (Rep.)
- Worker reported "propane" odor inside MO511 to HAMTC Safety Rep.

1021 POE IHs discuss monitoring needs for "propane" odors
- Referenced TOC-IH-58956, "Monitoring Strategy for Response to Odors"
- Sensors needed for response actions:
  - Ammonia
  - Volatile Organic Compounds (VOC)- 10.6 eV photoionization detector (PID)
  - Hydrogen Sulfide

1023 POE IH-2 requests meteorological information for Station #6 from Hanford Weather Station
1023 CSM contacts HAMTC Safety Rep.
- CSM → HAMTC Safety Rep.: Odors reported in MO511?
- CSM → HAMTC Safety Rep.: Are you in the facility?
- HAMTC Safety Rep. → CSM: No
- HAMTC Safety Rep. → CSM: There has been an issue with Carbon Monoxide in the building
  - POE IH-1 requested POE Shift IHT Supervisor have a Carbon Monoxide sensor prepared
- CSM → HAMTC Safety Rep.: Are these abnormal odors?
- HAMTC Safety Rep. → CSM: Provides name of Worker who reported the odor

1025 CSM contacts Worker who reported odor to HAMTC Safety Rep.
- CSM → Worker: Odors reported in MO511?
- Worker → CSM: When asked, multiple people indicated they did not encounter the odor, but one worker encountered an odor
- CSM → Worker: Name of individual who encountered the odor?
- Worker → CSM: Provides name of Affected Worker
- CSM → Worker: Has there been a Carbon Monoxide problem inside MO511?
- Worker → CSM: Thought to be Carbon Monoxide. Industrial Hygiene performed sampling for one week. Carbon Dioxide was found at the intake. Carbon Dioxide readings increased towards the middle of the trailer. Carbon Dioxide readings were the highest at the North end of the trailer. All Carbon Dioxide readings were within acceptable levels.
- CSM → Worker: Was the odor described as "propane"?
- Worker → CSM: Yes. Affected Worker stated they checked for possible sources outside near trailer. None were found. Only encountered the odor in their office.
- CSM → Worker: Implementing TFC-OPS-OPER-C-67. Everyone will need to exit the trailer.

1027 POE Shift IHT Supervisor → POE Shift IHTs:
- Direct Reading Instrument (DRI) with Hydrogen Sulfide sensor needed

1028 POE Shift IHT-1 → POE Shift IHT Supervisor, POE Shift IHT-2, and POE Shift IHT-3:
- DRI with Hydrogen Sulfide sensor will be prepared

NOTE: Field Response Timeline continued on next page.

Event Summary and Timeline:

Field Response Timeline continued:

1028 POE Shift IHT Supervisor → POE Shift IHTs:
- DRI equipped with Ammonia, VOC, Carbon Monoxide, and Hydrogen Sulfide needed
- Calibration gas for all sensors is located in MO2253

1029 POE IHs check Data Fusion & Advisory System (DFAS), powered Smart Site™, for current weather details:
- Wind Speed: 8.3 mph
- Wind Direction: 316° (out of Northwest)
- Mixing Height: 500 feet above grade
  - o POE IHs relay the current mixing height to CSM
- Stability Class: E (slightly stable conditions)

1030 CSM directs POE Shift IHT Supervisor to:
- Post restricted access signs for MO511
- Ensure everyone is out of MO511

1032 POE Shift IHT-2 → POE Shift IHT Supervisor, POE Shift IHT-1, and POE Shift IHT-3:
- DRI equipped with all four sensors may be available at MO2253

1032 POE IHs check Vapor Monitoring Detection System (VMDS) exhauster ammonia readings (@ 1000):
- POR518 (241-A): 4.771 ppm
- POR519 (241-A): 1.796 ppm
- 241-AN: 29.280 ppm
- 241-AW: 11.607 ppm
- POR126 (241-AX): 0 ppm
- POR127 (241-AX): 0 ppm
- 702AZ (241-AY/AZ): 40.254 ppm
- 241-AP: N/A

All available readings << High Alarm set point

1033 Shift Office Event Notification (SOEN): "Initiating TFC-OPS-OPER-C-67 "Response to Stronger than Normal Odors" for a reported propane odor in MO-511. Access is restricted to MO-511. CSM"

1034 POE IH-3 arrives at CSO

1038 POE Shift IHT-1 → POE Shift IHT Supervisor, POE Shift IHT-2, and POE Shift IHT-3:
- Necessary DRI acquired, in route to MO2253 for Pre-Use Function Test

1039 CSM provides POE IHs room number for Affected Worker
- Room #102

1040 POE Shift IHT-1 updates CSM and POE IHs:
- In route to IHT MO2252 to prepare DRI

1040 POE Shift IHT Supervisor → Environmental, Safety, Health, & Quality (ESH&Q) Level 1 Manager, Industrial Hygiene Level 2 Manager, & POE Level 3 Safety & Health (S&H) Manager:
- TFC-OPS-OPER-C-67 response in MO511 (next to 272AW)
- "Propane-like" odor reported
- Currently preparing TFC-OPS-OPER-C-67 Response Plan and DRI for field response

1040 POE Shift IHT Supervisor returns to CSO
- Restricted access posted and MO511 cleared

1041 POE Shift IHT Supervisor requests Odor Vapor Response Cards (OVRC) to take to Affected Workers
- Notes 8-10 personnel exited MO511

1041 CSM updated Department of Energy (DOE) Facility Representative (Fac. Rep.) on TFC-OPS-OPER-C-67:
- Provides current status of response actions
- No known sources of odor descriptor located within MO511
- Electrical facility (not generator powered)

1042 POE Shift IHT Supervisor departs CSO with OVRCs for Affected Workers
- POE Shift IHT Supervisor will offer precautionary medical surveillance to Affected Workers

1050 POE Shift IHT-3 → POE Shift IHT Supervisor, POE Shift IHT-1, and POE Shift IHT-2:
- All POE IHTs needed for response?

1052 POE Shift IHT Supervisor → POE Shift IHTs:
- Only one needed

NOTE: Field Response Timeline continued on next page.

Field Response Timeline continued:

1055 POE Shift IHT Supervisor → ESH&Q Level 1 Manager, Industrial Hygiene Level 2 Manager, & POE Level 3 S&H Manager:
- No symptoms reported
- All Affected Workers declined precautionary medical surveillance

1055 POE IHs check VMDS Alternate Ammonia Monitoring
- 241-AP Farm 10/24/2023 @ 1959: 5 ppm
- << High Alarm set point

1056 POE Shift IHT Supervisor returns to CSO with Affected Workers' OVRC
- "Propane" was the odor descriptor
- Initial Affected Worker indicated an odor was perceptible all morning
- All Affected Workers declined precautionary medical surveillance

1058 POE IHs complete OVRC review
- Four personnel indicated a "propane-like" odor was encountered
- Eight personnel total were within MO511 at the time of the Initiating Event

1104 CSM and POE IH-2 sign TFC-OPS-OPER-C-67 Attachment A Sheet 1 of 2, Response Plan

1111 POE Shift IHT Supervisor → ESH&Q Level 1 Manager, Industrial Hygiene Level 2 Manager, & POE Level 3 S&H Manager:
- Eight Affected Workers total
- Four of the eight encountered a "propane-like" odor

1114 POE Shift IHT-1 arrives at CSO

1114 POE IH-1 provides POE Shift IHT-1 briefing for response:
- Monitor per IHSP-POE-MULTI-TFCOPSOPERC67:
  - DRI equipped with the following sensors:
    - Ammonia
    - VOC 10.6 eV PID
    - Carbon Monoxide
    - Hydrogen Sulfide
  - Map of locations within MO511 odor was encountered
    - Survey at location identified one map and in Room 102
  - Survey general area inside MO511
- Respiratory Protection Equipment not required, Voluntary Use

1115 POE Shift IHT-1, POE IH-2, POE IH-4, and POE Shift IHT Supervisor (Field Response Personnel) depart CSO to begin field response actions

1116 Field Response Personnel arrive at MO511

1123 POE IH-4 → POE Level 3 S&H Manager and POE IH-1:
- Provides update on initial finding in Room 102
- Primary odor encountered thus far is the vaporizer located within Room 102

1128 POE IH-2 → POE Level 3 S&H Manager and POE IH-1:
- Carbon Monoxide has been found inside of a cooler
- Preliminary readings:
  - Carbon Monoxide 100 ppm
  - Hydrogen Sulfide 1 ppm

1129 POE IH-1 discuss initial field response findings with POE IH-3 and CSM

1135 POE IH-2 → POE Level 3 S&H Manager and POE IH-1:
- Total of 5 coolers located in MO511
- High readings are being obtained within the coolers

1137 POE IH-1 → POE Level 3 S&H Manager and POE IH-2:
- Provides table of Cross-Sensitivity (interferences) for MultiRAE Pro Carbon Monoxide sensor

1141 POE IH-2, POE IH-4, and POE Shift IHT Supervisor return to CSO
- Five coolers total
  - Coolers were found closed with a tight seal
- Marked "Production Ops. Surveillance RadCon"
- Peak readings observed by responding POE IHs:
  - Ammonia: 2 ppm
  - Hydrogen Sulfide: 1.2 ppm
  - VOC: 25.8 ppm
  - Carbon Monoxide: 151 ppm

1143 POE IH-1 asks POE Shift IHT Supervisor to obtain more information on coolers and their use

NOTE: Field Response Timeline continued on next page.

Field Response Timeline continued:

1143 POE Shift IHT Supervisor contacts an Affected Worker
- POE Shift IHT Supervisor → Affected Worker: What do the coolers store?
- Affected Worker → POE Shift IHT Supervisor: Water bottles
- POE IH-3 → POE Shift IHT Supervisor → Affected Worker: Cleaning products used on coolers?
- Affected Worker → POE Shift IHT Supervisor: No
- POE IH-1 → POE Shift IHT Supervisor → Affected Worker: Cooling packs utilized?
- Affected Worker → POE Shift IHT Supervisor: No, just ice

1147 POE IHs and CSM discuss path forward on coolers
- Remove cooler from MO511
- Place outside open to air out

1150 POE IH-2, POE IH-4, and POE Shift IHT Supervisor depart CSO to remove coolers from MO511
1150 CSM contacts POE Shift Operating Engineer (OE) to put up boundary around coolers
1155 POE Shift IHT Supervisor → POE IH-1:
- Coolers have been removed from MO511
- POE Shift IHT-1 called and stated DRI passed Post-Function Test

1158 Performance Assurance (PA) Technical Specialist contacts POE IH-2 for updated on TFC-OPS-OPER-C-67
1213 CSM and POE IH-2 sign TFC-OPS-OPER-C-67 Attachment A Sheet 2 of 2, Response Plan
1258 SOEN: "TFC-OPS-OPER-C-67 actions completed and exited TF-AOP-001 for MO-511 odor response. Access restored to MO-511. CSM"

Field Response Timeline Acronyms:

CSM	Central Shift Manager	OE	Operating Engineer
CSO	Central Shift Office	OVRC	Odor/Vapor Response Card
DFAS	Data Fusion & Advisory System	PA	Performance Assurance
DOE	Departement of Energy	PID	photoionization detector
DRI	direct reading instrument	POE	Production Operations-East
ESH&Q	Environmental, Safety, Health, & Quality	ppm	parts per million
eV	electron-volts	S&H	Safety & Health
HAMTC	Hanford Atomic Metal Trades Council	SOEN	Shift Office Event Notification
IH	Industrial Hygienist	VMDS	Vapor Monitoring Detection System
IHT	Industrial Hygiene Technician	VOC	Volatile Organic Compound
mph	miles per hour		

Sampling/Monitoring Results:

Direct Reading Instrument Monitoring Results:

- Monitoring performed in and around Affected Area
  - Comments by Responding IHT- "IHT entered MO-511 through northern door and began checking for odors. Checked office 102 first and then the whole building with no readings above background. Was asked to check coolers in the building and had no readings with coolers closed. [Cooler at] Location #1 had water bottles inside cooler and no readings. [Cooler at] Location #2 was brand new cooler and when opened got high readings on everything but NH3. Location #3 [had] 3 used cooler's and 2 out of the 3 had high reading[s, and 1 with] no readings."
- Peak readings during response:

Location	Ammonia	VOCs	Hydrogen Sulfide	Carbon Monoxide
General Area inside MO511	< 1 ppm	< 0.010 ppm	< 0.1 ppm	< 1 ppm
General Area outside MO511	< 1 ppm	< 0.010 ppm	< 0.1 ppm	< 1 ppm
MO511 Room 102	< 1 ppm	0.030 ppm	< 0.1 ppm	< 1 ppm
Coolers (closed)	< 1 ppm	< 0.010 ppm	< 0.1 ppm	< 1 ppm
Inside Coolers (open)	2 ppm	25.830 ppm	6.3 ppm	499 ppm
Inside Coolers (open) after Airing	< 1 ppm	0.020 ppm	< 0.1 ppm	< 1 ppm

NOTE: Sampling/Monitoring Results continued on next page.

Sampling/Monitoring Results:

- Indoor Air Quality (IAQ) Monitoring on 09/12/2023 to 09/14/2023
  - Comments by IHT Surveyor- "Indoor air quality monitoring was performed per [IH] at MO511 trailer. Monitoring was done via the IAQ instrument at IH discretion. Instrument was set out on 9/12/2023 at 0837 and picked up on 9/14/2023 at 1220. Instrument was placed on desk #19 in the NE corner of MO511. Datalog was set for 2 minute intervals. Peak readings will be recorded on the readings tab and datalog attached.

    After instrument pick up, a quick 12 minute survey was conducted outside the trailer at the IH request. Survey ran from 1223-1235 on 9/14/2023. Exact location was in between MO511 and MO533, about 6ft from the HVAC intake for MO511. Those peak readings will be recorded on the readings tab and datalog attached. Datalog was set for 10 second intervals on the outdoor survey."
- Readings during IAQ Monitoring:

Location	Carbon Dioxide	Carbon Monoxide
MO511 Desk #19 (NE Corner of trailer)	386 - 890 ppm	< 0.1 ppm
Outside MO511 (Between MO511 & MO533)	354 - 450 ppm	< 0.1 ppm

Refer to IHIR-00083 Attachment A for SmartSite™ Summary, Response Map, and Response Pictures.

SWIHD References:

Event Response Site Wide Industrial Hygiene Database DRI Survey:
- # 23-07142 "TFC-OPS-OPER-C-67 response at MO511"

Indoor Air Quality Monitoring Site Wide Industrial Hygiene Database DRI Survey:
- # 23-6342 "MO511 IAQ Monitoring"

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.

Review of Past Indoor Air Quality Monitoring Results:

- Indoor Air Quality (IAQ) monitoring was performed inside MO511 on 09/12/2023 to 09/14/2023. The IAQ DRI was set at desk #19 and datalogged carbon monoxide and carbon dioxide results from 09/12/2023 at 0837 to 09/14/2023 at 1220, utilizing a two minute interval. The carbon monoxide results were < 0.1 ppm and the carbon dioxide results ranged from 386 ppm to 890 ppm. The peak carbon dioxide reading occurred on 09/14/2023 at 06:59:28 for one interval. The next two highest readings also occurred on 09/14/2023 for one interval, 739 ppm (06:45:28) and 736 ppm (7:01:28). Additionally, monitoring was performed outside MO511 on 09/14/2023 between 1223 and 1235. The carbon monoxide results were < 0.1 ppm and the carbon dioxide results ranged from 354 ppm to 450 ppm.

  Carbon dioxide is a by-product of normal cell function and is removed from the body via the lungs in the exhaled air. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) states acceptable outdoor carbon dioxide concentrations range from 300-500 ppm. Monitoring for carbon dioxide may be utilized as a rough indicator of the effectiveness of ventilation (OSHA, 2011). The OSHA PEL-TWA and ACGIH TLV-TWA is 5,000 ppm. The ACGIH TLV-STEL is 30,000 ppm. The IAQ monitoring results inside MO511 are within acceptable levels.

NOTE: Additional Information continued on next page.

Additional Information:

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.

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:

10/25/2023 @ 1000 (approximate time of initiating event):
- Wind Speed: 8.3 mph (15 minute average)
- Wind Direction: 316.3° (out of Northwest)
- Mixing Height: 700 feet above grade
- Stability Class: E (slightly stable conditions)

Review of the DFAS application, powered by SmartSite™, Weather Details dashboard for current conditions during response actions, per TFC-OPS-OPER-C-67 4.2.8:

10/25/2023 @ 1029 (current weather data for Response actions):
- Wind Speed: 8.3 mph (15 minute average)
- Wind Direction: 316° (out of Northwest)
- Mixing Height: 500 feet above grade
- Stability Class: E (slightly stable conditions)

Meteorological information from the Hanford Weather Station for Station #6 on 10/25/2023 @ 1000:
- Temperature: 43°F
- Relative Humidity: 86%
- Wind Speed: 8 mph
- Wind Direction: Out of Northwest
- Barometric Pressure: 29.12 inches of mercury and increasing

Vapor Monitoring Detection System (VMDS) exhauster ammonia readings on 10/26/2023 @ 1000:
- POR518 (241-A): 4.711 ppm
- POR519 (241-A): 1.796 ppm
- 241-AN: 29.280 ppm
- 241-AW: 11.607 ppm
- POR126 (241-AX): 0 ppm
- POR127 (241-AX): 0 ppm
- 702AZ (241-AY/AZ): 40.254 ppm
- 241-AP: N/A

NOTE: Additional Information continued on next page.

Additional Information continued:

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		

Vapor Monitoring Detection System (VMDS) 10/18/2023 @ 1033 to 10/25/2023 @ 1033:

Tank Farm	Exhauster	Minimum*A	Maximum*A
241-A	POR518/POR519	0 ppm	5.542 ppm
241-AN	Primary	28.460 ppm	63.207 ppm
241-AW	Primary	0 ppm	23.540 ppm
241-AX	POR126/POR127	0 ppm	40.682 ppm
241-AY/AZ	702AZ	0 ppm	49.225 ppm

*A VMDS Alternate Real Time Monitoring performed 10/18/2023 to 10/24/2023 for 241-AP, 241-AX (POR126/POR127), and 241-AY/AZ.

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 10/18/2023 to 10/24/2023:

Tank Farm	Exhauster	Minimum	Maximum
241-AP	Primary	3 ppm	9 ppm
241-AX	POR126/POR127	0 ppm	4 ppm
241-AY/AZ	702AZ	31 ppm	41 ppm

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 exhauster ammonia readings for the approximate time of the Event, indicate the cause of the odor is unlikely to be from Tank Farm Exhauster emissions.

NOTE: Additional Information continued on next page.

Additional Information continued:

Monitoring Selections Based on Information Provided by Affected Workers:

- Based on the odor descriptor "propane-like", monitoring for hydrogen sulfide and ammonia vapors was performed:
  - The American Industrial Hygiene Association (AIHA) Odor Threshold for Chemicals with Established Health Standards, 2nd Edition, lists butane and propane as being associated with the odor character "Natural Gas". Propane is a colorless, odorless gas. The typical odor associated with propane is due to a foul-smelling odorant often added to propane for leak detection purposes. Typical propane odorant is sulfur-based, including mercaptan. The chemicals butyl mercaptan and dodecyl mercaptan are associated with the odor character "skunk". Methyl mercaptan is associated with the odor characters "rotten cabbage" and "garlic".
- Based on the comment "trouble with Carbon Monoxide", monitoring for carbon monoxide vapors was performed.

Refer to TOC-IH-58956 for more detail on the monitoring strategy for response to odors.

RPP-TE-58833 MO511 Remodel HVAC Evaluation:

- MO511 was re-purposed from a conference room trailer to support/office trailers. MO511 consists of two trailer modules, each with their own HVAC unit. The HVAC units share a single thermostat/ control that drives the units in unison. The supply ducting consists of a main trunk in the ceiling space with registers/diffusers mounted in the drop ceiling. The return for each unit is through a single wall mounted return register in the wall of each trailer module.

  The MO511 HVAC units each have a 1,100 CFM airflow (max). There is 275 CFM of fresh make-up (max) for each unit (550 CFM combined). MO511 was re-designed for a maximum continuous occupancy of 40 people. The HVAC units utilize a heat pump for heating and cooling. Additionally, there is induction heating as a backup. The minimum flow to meet indoor air quality requirements of ASHRAE 62.1 and WAC 51-52-0403 is 5 CFM per person (40 people = 200 CFM).

  "All air is carried from the trailer back to a central air return at one end [South] of trailer. This longitudinal flow path is essentially one open space [no actual return air ducting] will not allow for different areas of 'clean' ventilation zones to be established with pressure differentials" (no return air ducting) (H-2-840786 SH 03; RPP-TE-58833).

Potential Near-by Sources as Indicated on OVRCs:

- The OVRCs submitted by Affected Workers noted multiple trucks were parked north of MO511. At the time of the field response, the two trucks parked north of MO511 were not running. The air intake for MO511 is located on the south side of the building.

  Diesel and gasoline engines are both internal, intermittent combustion engines. "In diesel engines, the fuel is self-ignited as it is injected into air that has been heated by compression. In gasoline engines, the fuel is ignited by sparking-plugs. The major byproducts of the complete combustion of petroleum-based fuels in an internal combustion engine are carbon dioxide (13%) and water (13%), with nitrogen from air comprising most (73%) of the remaining exhaust. A very small portion of the nitrogen is converted to nitrogen oxides [i.e., nitric oxide (NO), nitrogen dioxide (NO2)] and some nitrated hydrocarbons" (IARC, 1989).

  Incomplete combustion of petroleum products results in the emission of carbon monoxide, unburnt fuel, and lubricating oil, as well as the oxidation and nitration products of the fuel and lubricating oil. The incomplete combustion byproducts are comprised of thousands of chemical components present in both gaseous and particulate phases. Some of the significant constituents in the gaseous phase include acrolein, ammonia, benzene, 1,3-butadiene, formaldehyde, formic acid, heterocyclics and derivates, hydrocarbons (C1-C18) and derivatives, hydrogen cyanide, hydrogen sulfide, methane, methanol, nitric acid, nitrous acid, nitrogen oxides, polycyclic aromatic hydrocarbons, sulfur dioxide, and toluene. The concentration found in the exhaust depends on several factors including the engine type, engine operating conditions, composition of the fuel and lubricating oil, and the emission control system (IARC, 1989).

NOTE: Additional Information continued on next page.

Additional Information continued:

Primary Combustion Engine Byproducts Odor Descriptors & OELs

Constituent	Odor Descriptor	Odor Threshold	ACGIH TLV	OSHA PEL
Carbon Monoxide	Odorless	N/A	25 ppm (TWA)	50 ppm (TWA)
Nitric Oxide	Sharp, sweet	N/A	25 ppm (TWA)	25 ppm (TWA)
Nitrogen Dioxide	Bleach	0.058 ppm	0.2 ppm (TWA)	5 ppm (Ceiling)
Sulfur Dioxide	Metallic	0.33 ppm	0.25 ppm (STEL)	5 ppm (TWA)

(ACGIH, 2016; AIHA, 2013; NIH, n.d.; OSHA, n.d.)

Odor descriptors provided by Affected Workers are inconsistent with the primary combustion engine byproducts. While hydrogen sulfide is associated with a natural gas odor, due to the location of the vehicles and the air intake for MO511, the cause of the odor is unlikely to be from combustion engine emissions.

MO511 Coolers:

During the TFC-OPS-OPER-C-67 field response, all readings were at or background levels with the exception of inside of three out of five coolers located within MO511. These coolers were found in the closed position. Follow-up discussions with the workers indicated the coolers were utilized for storage/transportation of water bottles. Ice is the only product utilized for cooling. Additionally, the workers do not utilize cleaning products on the coolers.

- Three ORCA 20 Quart Coolers
  - o Roto-molded plastic (ORCA, n.d.)- polyethylene (The Cooler Zone, n.d.)
- Two RTIC 20 Qt Hard Cooler (RTIC, n.d.)
  - o Rotationally molded plastic. The rotomolding procedure ensure that every part of the cooler is made with a continuous thick wall with no imperfections (RTIC, n.d.).

The most commonly used rotomolding materials include linear low-density polyethylene (LLDPE), high-density polyethylene (HDPE), and polypropylene (PP) (Gregstorm Corp., 2015). Polyethylene is not an inert material and is known to release additives and other degradation products. Royer et. al. (2018) conducted research on the production of hydrocarbon gases from polyethylene and other plastics at ambient temperatures, focusing on methane and ethylene emissions. Methane and ethylene react with hydroxide (OH) in the atmosphere, resulting in an increase in carbon monoxide concentrations. Additionally, Royer et. al. (2018) reported rates of ethane and proplyene production. Ethane is known to enhance the level of tropospheric ozone and carbon monoxide concentrations.

The driving factors for the hydrocarbon gas emissions from polyethylene plastics include solar photon flux, especially in the UV portion of the spectrum. The UV radiation provides the activation energy necessary to initiate the degradation of polyethylene plastics due to the bond cleavage and depolymerisation (Royer et. al., 2018). While UV radiation enhanced the degradation process, Royer et. al. (2018) results indicated that UV radiation is not essential for the initiation, nor the continual production of hydrocarbons. However, once initiated by solar radiation, the emission of these gases will continue even in the dark, at a rate dependent on previous UV radiation exposure.

Below is a review of the polyethylene degradation byproducts DRI sensor interferences (cross-sensitivities). Most degradation byproducts are detectable on multiple MultiRAE Pro sensors. Those that elicit no response (confirmed) from a sensor will be listed NR. Those where the cross-sensitivity data was not provided will be listed N/A.

NOTE: Additional Information continued on next page.

Additional Information continued:

Polyethylene Degradation Byproduct Correction Factors

MultiRAE Pro Sensor	Methane	Ethylene	Proplyene	Carbon Monoxide
Ammonia	N/A	N/A	N/A	NR
VOC	NR	9	1.4	NR*A
Hydrogen Sulfide	N/A	N/A	N/A	200*B
Carbon Monoxide*C	N/A	6.25*B	N/A	1

(Honeywell, 2018; RAE Systems by Honeywell, 2018)

*A Inferred based on an ionization potential of 14.01 eV, thus exceeding the capability of the 10.6 eV PID (NIH, n.d.).
*B Calculated from listed concentrations and response without filter. CF = Concentration/Response.
*C MultiRAE Pro Carbon Monoxide sensor installed- range of 0 to 500 ppm & resolution of 1 ppm.

Based on the known MultiRAE Pro sensor interferences, the DRI readings obtained within the coolers are consistent with the off-gassing of polyethylene degradation byproducts.

MultiRAE Pro Sensor	Peak Reading	Plausible Cross-Senstivities
Ammonia	2 ppm	Indeterminate
VOC	25.83 ppm	Ethylene, Propylene
Hydrogen Sulfide	6.3 ppm	Carbon Monoxide
Carbon Monoxide	499 ppm	Carbon Monoxide, Ethylene

Detected Constituents & Polyethylene Degradation Byproducts Odor Descriptors & OELs

Constituent	Odor Descriptor	Odor Threshold	ACGIH TLV	OSHA PEL
Ammonia	Pungent, irritating	0.043 ppm	25 ppm (TWA)	50 ppm (TWA)
Carbon Monoxide	Odorless	N/A	25 ppm (TWA)	50 ppm (TWA)
Ethylene	Grassy	17 ppm	200 ppm (TWA)	N/A
Hydrogen Sulfide	Rotten Eggs	0.00004 ppm	1 ppm (TWA)	20 ppm (Ceiling)
			5 ppm (STEL)	50 ppm (Peak)
Propylene	Grassy, aromatic	10.1 ppm	500 ppm (TWA)	N/A

(ACGIH, 2016; AIHA, 2013; OSHA, n.d.)

The polyethylene degradation byproducts, combined with the use of the coolers as provided by Affected Workers, are consistent with the DRI results obtained within the coolers. However, odor descriptors provided by Affected Workers are inconsistent with the polyethylene degradation byproducts. It should be noted the human odor perception is a psychophysical phenomenon that is experienced when one or more chemicals encounter the receptors of the olfactory nerves. Odor perception/odor threshold and symptoms vary widely between individuals (TOC-IH-58956). The coolers cannot be confirmed as source of the odor.

NOTE: Additional Information continued on next page.

Additional Information continued:

Additional Information Acronyms:

ACGIH	American Conference of Governmental Industrial Hygienists		
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers		
AIHA	American Industrial Hygiene Association		
IARC	International Agency for Research on Cancer		
CF	correction factor		
CFM	cubic feet per minute	OSHA	Occupational Safety & Health Administration
COPC	chemicals of potential concern	OVRC	Odor/Vapor Response Card
DFAS	Data Fusion & Advisory System	PEL	Permissible Exposure Limit
DRI	direct reading instrument	PID	photoionization detector
eV	electron-volts	PP	polypropylene
HDPE	high-density polyethylene	ppm	parts per million
HVAC	heating, ventilation, air conditioning	STEL	Short Term Exposure Limit
IAQ	indoor air quality	TLV	Threshold Limit Value
LLDPE	linear low-density polyethylene	TWA	Time Weighted Average
mph	miles per hour	UV	ultra-violet
NR	no response	VMDS	Vapor Monitoring Detection System
OH	hydroxide	VOC	Volatile Organic Compounds

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Refer to IHIR-00083 Attachment A for SmartSite™ Summary, Response Map, and Response Pictures.

Recommendations/Conclusions:

Recommendations:

- Consider follow-up Indoor Air Quality monitoring of MO511.
- Continue evaluation of the coolers.

Conclusions:

During the TFC-OPS-OPER-C-67 field response, the Direct Reading Instrumentation monitoring inside of three out of five coolers found within MO511 were above action limits. All other readings throughout MO511 during the response were at or below background levels, including outside of the coolers while closed (as found configuration).

As elevated readings were obtained inside of the coolers, the coolers were removed from MO511 and cordoned outside with caution tape/restricted access signs and left opened. Readings were taken inside of the coolers after they had been outside open for approximately 30 minutes. The follow-up results were consistent with background levels. As Direct Reading Instrumentation monitoring of remaining areas within MO511 did not indicate further action was necessary to protect worker safety and health, the area was released from restricted access and work was allowed to continue.

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 exhauster ammonia readings for the approximate time of the Event, the cause of the odor is unlikely to be from Tank Farm Exhauster emissions. The atmospheric stability at the time of the event was slightly stable conditions and the mixing height was 700 feet above grade.

Affected Workers indicated a possible source of the odor as vehicles parked north of MO511. The odor descriptors provided by Affected Workers are inconsistent with the primary combustion engine byproducts. While one possible combustion engine byproduct (hydrogen sulfide) is associated with a natural gas odor, due to the location of the vehicles (north of MO511) and the air intake for MO511 (south side), the cause of the odor is unlikely to be from combustion engine emissions.

The MO511 coolers were found in the closed position and opened as part of the field investigation. Follow-up discussions with the workers indicated the coolers were utilized for storage/ transportation of water bottles and ice is the only product utilized for cooling. Additionally, the workers do not utilize cleaning products on the coolers. The coolers are utilized as intended.

The cooler material (polyethylene plastic) off-gassing byproducts (normal process for material), combined with the use of the coolers as provided by Affected Workers, are consistent with the elevated DRI results obtained within the coolers. Therefore, the coolers are the source of the elevated readings obtained during the field response.

While the coolers elicited elevated readings, the odor descriptors provided by Affected Workers are inconsistent with the polyethylene off-gassing byproducts. It should be noted the human odor perception is a psychophysical phenomenon that is experienced when one or more chemicals encounter the receptors of the olfactory nerves. Odor perception/odor threshold and symptoms vary widely between individuals. The coolers cannot be confirmed as the source of the odor.

Although elevated readings were obtained inside the coolers, monitoring performed to support response actions did not readily identify an odor source consistent with the Affected Workers odor description. General area readings within MO511 indicated that further response action was not necessary to protect worker safety and health.

Other:

- No symptoms reported and all Affected Workers declined precautionary medical surveillance.
- Event Investigation Report (EIR) #2023-074.

Washington River Protection Solutions

INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT(Continued)

Industrial Hygienist:

[redacted] [redacted] ned by [redacted] Date: 2023.10.31 09:14:18 -07'00'

Print First and Last Name *Signature / Date*

Industrial Hygiene Level 2 Manager:

[redacted] [redacted] Digitally signed by [redacted] Date: 2023.10.31 10

Print First and Last Name *Signature / Date*

ODOR/VAPOR RESPONSE CARD

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

- Date and time of event: 10-25-23 -AM-
- Check Applicable:
  - ☒ Odor ☐ Ammonia Alarm *(6 ppm)* ☐ Ammonia Alarm *(12 ppm)* ☐ Alarm *(other - describe)*: _____
- Your name and the work you were performing: [redacted], Admin duties
- Other Work Underway? Describe: _____
- Location of event *(mark area on map and wind direction)*: MD 511
- Name(s) of others in or near the affected area: _____
- Was Industrial Hygiene present, who? _____
- Describe the odor:
  - ☐ Sweet ☐ Sour ☐ Smoky ☐ Septic/Sewer ☐ Musty ☐ Rotten
  - ☐ Metallic ☐ Onion ☐ Earthy ☐ Ammonia ☐ Citrus ☐ Solvent
  - ☒ Other *(describe)*: Propane
- 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.

[redacted]

ODOR/VAPOR RESPONSE CARD

Instructions:

1. Notify Immediate Supervisor.
2. Co[redacted]hift Manager (CSM), at [redacted]
3. Complete both pages of this form and include as many details as possible, including:
   a. Approximate location, see map at right;
   b. Wind direction, speed and description, such as stable or gusty wind;
   c. Environmental conditions, such as hot, cold, windy, rainy;
   d. Other work or contractors in the area;
   e. Anything else you think is relevant.
4. Provide the completed card to your Supervisor*, Industrial Hygiene*, Union Safety Representative* or the CSM.

* If received by Supervisor, IH, or Union Safety Representative, the Supervisor/IH/ Union-SR will ensure card it is provided to the CSM.

MO 511
Room 102

I was smelling something all morning, then I thought propane and guzzed the trailer - some people said they also smelled something We were evacuated. [redacted]

[redacted]

ODOR/VAPOR RESPONSE CARD

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

- Date and time of event: 10/25/23

Check Applicable:

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

- Your name and the work you were performing: MO-511
- Other Work Underway? Describe: Office work
- Location of event *(mark area on map and wind direction)*:
- 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: Propane smell
- 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.

[redacted]

ODOR/VAPOR RESPONSE CARD

Instructions:

1. Notify Immediate Supervisor.
2. Contact Central Shift Manager (CSM), at [redacted]
3. Complete both pages of this form and include as many details as possible, including:
   a. Approximate location, see map at right;
   b. Wind direction, speed and description, such as stable or gusty wind;
   c. Environmental conditions, such as hot, cold, windy, rainy;
   d. Other work or contractors in the area;
   e. Anything else you think is relevant.
4. Provide the completed card to your Supervisor*, Industrial Hygiene*, Union Safety Representative* or the CSM.

* If received by Supervisor, IH, or Union Safety Representative, the Supervisor/IH/ Union-SR will ensure card it is provided to the CSM.

MO-511

[redacted]

ODOR/VAPOR RESPONSE CARD

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

- Date and time of event: 10/25/23 10:30
- Check Applicable:
  ☒ Odor ☐ Ammonia Alarm *(6 ppm)* ☐ Ammonia Alarm *(12 ppm)* ☐ Alarm *(other - describe)*: _____
- Your name and the work you were performing: [redacted] in ther Trailer writing a Survey
- Other Work Underway? Describe: N/A
- Location of event *(mark area on map and wind direction)*: MO-511
- Name(s) of others in or near the affected area: N/A
- Was Industrial Hygiene present, who? NO
- Describe the odor:
  ☐ Sweet ☐ Sour ☐ Smoky ☐ Septic/Sewer ☐ Musty ☐ Rotten
  ☐ Metallic ☐ Onion ☐ Earthy ☐ Ammonia ☐ Citrus ☐ Solvent
  ☒ Other *(describe)*: Propane Smelling
- Is source known/likely? Describe: Not sure, probably a car outside
- 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.

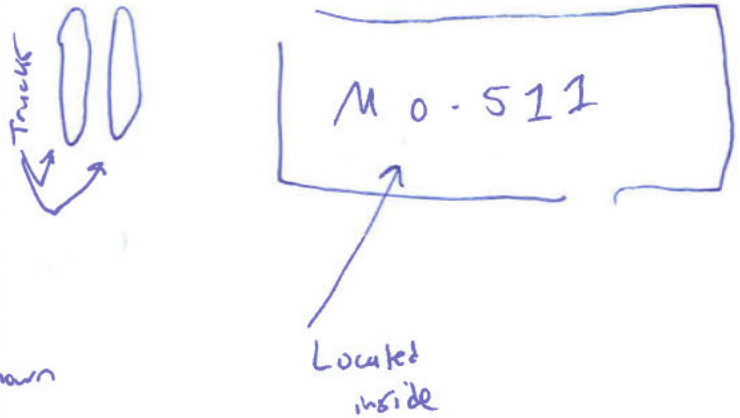
[redacted]

ODOR/VAPOR RESPONSE CARD

Instructions:

1. Notify Immediate Supervisor.
2. Contact Central Shift Manager (CSM), at [redacted]
3. Complete both pages of this form and include as many details as possible, including:
   a. Approximate location, see map at right;
   b. Wind direction, speed and description, such as stable or gusty wind;
   c. Environmental conditions, such as hot, cold, windy, rainy;
   d. Other work or contractors in the area;
   e. Anything else you think is relevant.
4. Provide the completed card to your Supervisor*, Industrial Hygiene*, Union Safety Representative* or the CSM.

* If received by Supervisor, IH, or Union Safety Representative, the Supervisor/IH/ Union-SR will ensure card it is provided to the CSM.



[redacted]

ODOR/VAPOR RESPONSE CARD

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

- Date and time of event: 10/25/23
- Check Applicable:
  - ☒ Odor ☐ Ammonia Alarm *(6 ppm)* ☐ Ammonia Alarm *(12 ppm)* ☐ Alarm *(other - describe)*:
- Your name and the work you were performing: [redacted] reading Procedures
- Other Work Underway? Describe: No
- Location of event *(mark area on map and wind direction)*: No 511
- 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)*: Propane
- 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.

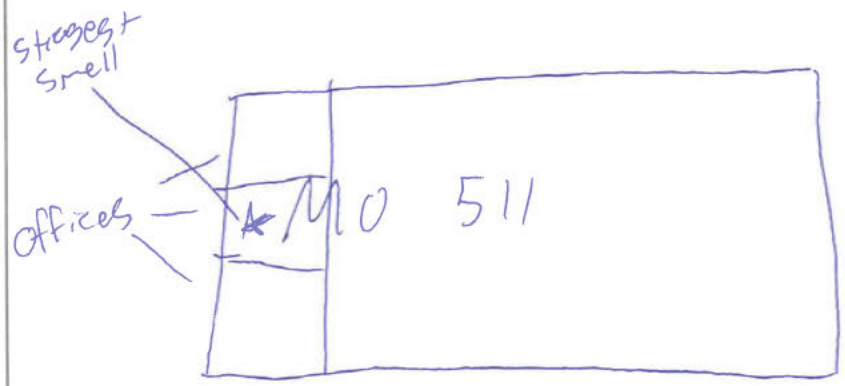
[redacted]

ODOR/VAPOR RESPONSE CARD

Instructions:

1. Notify Immediate Supervisor.
2. Contact Central Shift Manager (CSM), at [redacted]
3. Complete both pages of this form and include as many details as possible, including:
   a. Approximate location, see map at right;
   b. Wind direction, speed and description, such as stable or gusty wind;
   c. Environmental conditions, such as hot, cold, windy, rainy;
   d. Other work or contractors in the area;
   e. Anything else you think is relevant.
4. Provide the completed card to your Supervisor*, Industrial Hygiene*, Union Safety Representative* or the CSM.

* If received by Supervisor, IH, or Union Safety Representative, the Supervisor/IH/ Union-SR will ensure card it is provided to the CSM.



[redacted]

ODOR/VAPOR RESPONSE CARD

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

- Date and time of event: 10/25/23 10:20 AM
- Check Applicable:
  ☑ Odor ☐ Ammonia Alarm *(6 ppm)* ☐ Ammonia Alarm *(12 ppm)* ☐ Alarm *(other - describe)*: _____
- Your name and the work you were performing: [redacted] office work
- Other Work Underway? Describe:
- Location of event *(mark area on map and wind direction)*:
  ZOOE MOSH
- Name(s) of others in or near the affected area:
- 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:
- 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.

[redacted]

ODOR/VAPOR RESPONSE CARD

Instructions:

1. Notify Immediate Supervisor.
2. Contact Central Shift Manager (CSM), at [redacted]
3. Complete both pages of this form and include as many details as possible, including:
    a. Approximate location, see map at right;
    b. Wind direction, speed and description, such as stable or gusty wind;
    c. Environmental conditions, such as hot, cold, windy, rainy;
    d. Other work or contractors in the area;
    e. Anything else you think is relevant.
4. Provide the completed card to your Supervisor*, Industrial Hygiene*, Union Safety Representative* or the CSM.

* If received by Supervisor, IH, or Union Safety Representative, the Supervisor/IH/ Union-SR will ensure card it is provided to the CSM.

MO 511

[redacted]

ODOR/VAPOR RESPONSE CARD

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

- Date and time of event: 10/25/23 1030 am
- Check Applicable:
  - ☒ Odor ☐ Ammonia Alarm *(6 ppm)* ☐ Ammonia Alarm *(12 ppm)* ☐ Alarm *(other - describe)*:
- Your name and the work you were performing: [redacted] / computer work
- Other Work Underway? Describe: multiple trucks and crane very close to building
- Location of event *(mark area on map and wind direction)*: 200E MO-511
- 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: I was to congested to smell an odor / many trucks and crane very close
- 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.

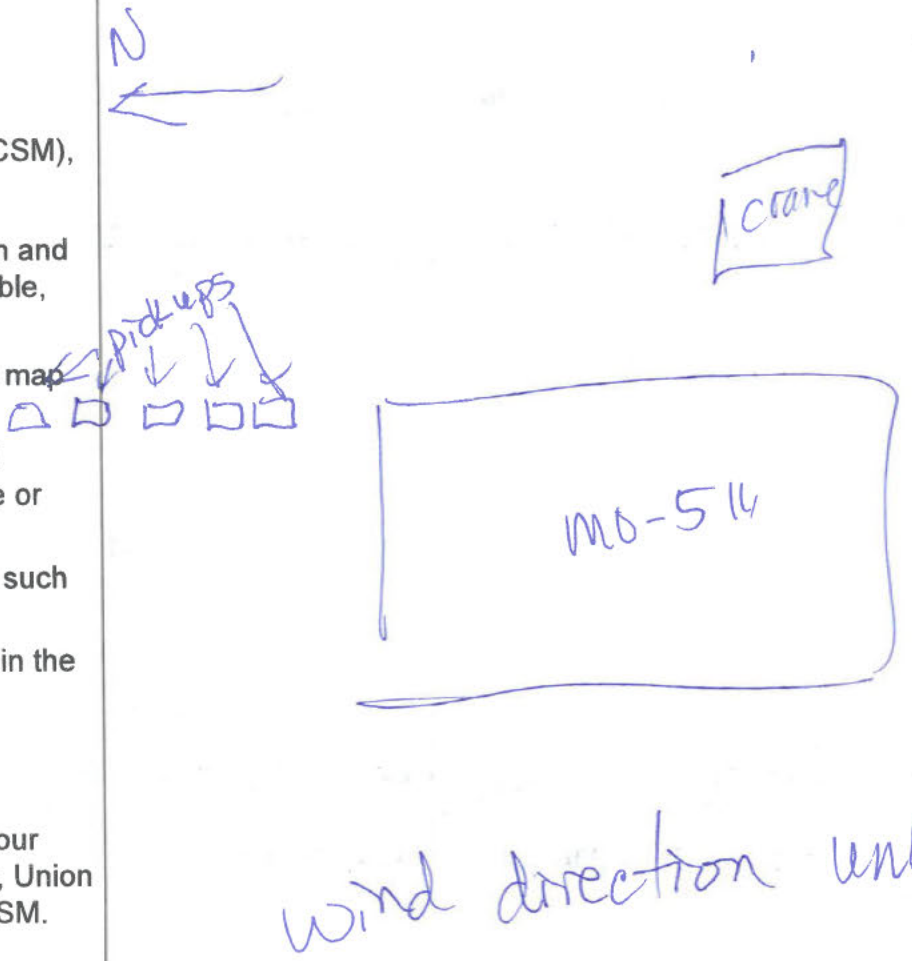
[redacted]

ODOR/VAPOR RESPONSE CARD

Instructions:

1. Notify Immediate Supervisor.
2. Contact Central Shift Manager (CSM), at [redacted]
3. Complete both pages of this form and include as many details as possible, including:
   a. Approximate location, see map at right;
   b. Wind direction, speed and description, such as stable or gusty wind;
   c. Environmental conditions, such as hot, cold, windy, rainy;
   d. Other work or contractors in the area;
   e. Anything else you think is relevant.
4. Provide the completed card to your Supervisor*, Industrial Hygiene*, Union Safety Representative* or the CSM.

* If received by Supervisor, IH, or Union Safety Representative, the Supervisor/IH/ Union-SR will ensure card it is provided to the CSM.



[redacted]

ODOR/VAPOR RESPONSE CARD

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

- Date and time of event: 10-25-23 1000 AM
- Check Applicable:
  - ☐ Odor ☐ Ammonia Alarm *(6 ppm)* ☐ Ammonia Alarm *(12 ppm)* ☐ Alarm *(other - describe)*: N/A
- Your name and the work you were performing: office work
- Other Work Underway? Describe: N/A
- Location of event *(mark area on map and wind direction)*: MO 511
- Name(s) of others in or near the affected area: N/A
- Was Industrial Hygiene present, who? N/A
- Describe the odor:
  - ☐ Sweet ☐ Sour ☐ Smoky ☐ Septic/Sewer ☐ Musty ☐ Rotten
  - ☐ Metallic ☐ Onion ☐ Earthy ☐ Ammonia ☐ Citrus ☐ Solvent
  - ☐ Other *(describe)*:
- Is source known/likely? Describe: N/A
- 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.

[redacted]

ODOR/VAPOR RESPONSE CARD

Instructions:

1. Notify Immediate Supervisor.
2. Contact Central Shift Manager (CSM), at [redacted]
3. Complete both pages of this form and include as many details as possible, including:
   a. Approximate location, see map at right;
   b. Wind direction, speed and description, such as stable or gusty wind;
   c. Environmental conditions, such as hot, cold, windy, rainy;
   d. Other work or contractors in the area;
   e. Anything else you think is relevant.
4. Provide the completed card to your Supervisor*, Industrial Hygiene*, Union Safety Representative* or the CSM.

* If received by Supervisor, IH, or Union Safety Representative, the Supervisor/IH/ Union-SR will ensure card it is provided to the CSM.

Walked in Room M0511 5 min. was told to evacuate so I left.

[redacted]

ODOR/VAPOR RESPONSE CARD

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

- Date and time of event: 10/25/23 1045
- Check Applicable:
  ☒ Odor ☐ Ammonia Alarm *(6 ppm)* ☐ Ammonia Alarm *(12 ppm)* ☐ Alarm *(other - describe)*: _____
- Your name and the work you were performing: [redacted]
- Other Work Underway? Describe: _____
- Location of event *(mark area on map and wind direction)*: MOSU 200E
- Name(s) of others in or near the affected area: _____
- 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: _____
- 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.

[redacted]

ODOR/VAPOR RESPONSE CARD

Instructions:

1. Notify Immediate Supervisor.
2. Contact Central Shift Manager (CSM), at [redacted]
3. Complete both pages of this form and include as many details as possible, including:
    a. Approximate location, see map at right;
    b. Wind direction, speed and description, such as stable or gusty wind;
    c. Environmental conditions, such as hot, cold, windy, rainy;
    d. Other work or contractors in the area;
    e. Anything else you think is relevant.
4. Provide the completed card to your Supervisor*, Industrial Hygiene*, Union Safety Representative* or the CSM.

* If received by Supervisor, IH, or Union Safety Representative, the Supervisor/IH/ Union-SR will ensure card it is provided to the CSM.

[redacted]