

EVENT INVESTIGATION REPORT

EIR-2018-046: Investigation of SX Farm Change Trailer AOP-015 Event



Figure 1: SX Farm

[Redacted]

Event Investigator

1/30/2019

Date

[Redacted]

PER Responsible Manager

1/30/2019

Date

PER No. WRPS-PER-2018-3072

SX Farm Change Trailer AOP-015 Event

AOP-015 Summary

Date/Time of Event	December 7, 2018 <ul style="list-style-type: none"> • MO2194 (TF-OPS-OPER-C-67): 1239hrs • MO2194 (TF-AOP-015): 1258hrs • MO298: 1410hrs
Location	<ul style="list-style-type: none"> • MO2194, SX Change Trailer (Inside and Outside) • MO298, North SX Change Trailer (Outside)
Personnel Affected	Eight (8) personnel reported odors: Evaluated at HPMC: <ul style="list-style-type: none"> • One (1)
Odor	<ul style="list-style-type: none"> • (7) Fish • (1) Musty
Symptoms	<ul style="list-style-type: none"> • Headache
Direct Read Instrumentation (DRI) Monitoring	Ammonia peak: 0 ppm (Action Level 12ppm) VOCs: 160 ppb (Action Level 2 ppm)
Sampling	No samples taken
Potential Source	Unknown/Undetermined
Wind Speed / Direction	@ 1239: North-Northeast @ 2 mph @ 1258: East @ 2 mph @ 1410: West @ .5 mph
Weather Conditions	Barometric pressure: 29.65 inHg (falling) Temperature @ 28 degrees
Waste Disturbing or Tank Work in Adjacent Area	Unplanned shutdown of SY Farm primary ventilation@ 1136. Restored at 1414.
Other Work in Adjacent Area	None

Investigation Summary

Workers were returning to SX farm after lunch on December 7th, 2018, when eight people encountered a fish odor outside MO2194 (SX South Change Trailer) at approximately 1215-1230. The Construction Manager (CM) called the Central Shift Manager (CSM), who dispatched Industrial Health Technicians (IHTs) in accordance with TF-OPS-OPER-C-67, Response to Readily Apparent or General Purpose Facility Odors. An IHT was already responding in SY farm performing sweeps due to AOP-021, Response to Tank Farm Ventilation Upset. The crew entered the South SX Farm change trailer (MO2194). SX crew was directed to fill out Odor Response Cards. All declined medical evaluation.

Approximately 15 minutes later when the change trailer door opened, a worker inside the change trailer encountered the odor. This worker reported a headache. The shift office was notified and the Field Work Supervisor (FWS) accompanied the worker to HPMC for medical evaluation. TF-AOP-015, Response to Reported Odors or Unexpected Changes to Vapor Conditions, was entered. IHTs were dispatched to the change trailer where the symptom occurred. There was some miscommunication between the CSM and the CM. The CSM, intended to direct the workers to relocate to the north change trailer (S Farm change trailer, MO 295), but the CM had the field crew relocate to the North SX farm change trailer (MO298). The lack of three-way communication and use of building numbers was identified as an opportunity for improvement, captured in PER-2019-0005. An unknown number of employees at the North SX change trailer MO298 reported odors at that location as well to the CSM, however no symptoms were experienced.

The CSM gave the CM direction to send the team out of the immediate area to the "North" change trailer, based on field reports of no-wind and since the odor was not suspected to be from tank vapor. The CSM directed the CM and team to leave the area and relocate to 2704HV until the AOP-015 had been address/cleared.

During the monitoring activities the AOP-015 area was not restricted (no SOEN or barricades posted). The only odor indication from inside the trailer was an increase of volatile organic compounds (VOCs), the peak was 160 parts per billion (ppb), but they were near "background" and assumed to come from off-gassing rubber shoe covers or matting as a potential source. TF-AOP-015 was exited at 1452 with a SOEN message "Sample Analysis for the TF-AOP-015 event has been completed and the results are below action limits. Exiting TF-AOP-015."

At 1141 SY farm lost vacuum in all three tanks. AOP-021 was entered at 1207. The responding IH informed the CSM there was no odor at SY farm and farm sweeps had no positive indications on their DRI, therefore the odors encountered at SX farm were not believed to be attributed to loss of SY ventilation. Per TF-AOP-015 Sample Plan IHP-

09001 Rev. 6, IH monitored for Ammonia and VOCs. DRI readings indicated no elevated readings. Therefore, no bag samples were directed by the IH per the sample plan.

Event Timeline

Field Response Timeline:

- 1203: CSM dispatches PO Shift IHT to support TF-AOP-021 at 241-SY Farm
- 1207: SOEN: "Entered AOP-021 for SY Farm unplanned shut down, SY Farm is being posted as a EZ(VCZ). Access to SY Farm restricted. CSM"
- 1239: Odors reported to CSO:
 - "Fishy" odor
 - No symptoms reported,
 - Medical offered and declined
- 1244: IHT dispatched as per guidance of TF-OPS-OPER-C-67. PO Shift IHT Supervisor contacted by CSM and concurs with response actions:
 - PO Shift IHT to perform sweep in area of reported odors
 - PO Shift IHT will collect grab sample if readings above background are found
- 1245: PO S&H Manager contacts PO Shift IHT Supervisor to ensure PO Shift IHT creates SWIND survey documenting TF-OPS-OPER-C-67 response actions
- 1247: CSM contacts PO S&H Manager, 4 people reported Fishy odor in SX area, no symptoms, no medical, IHT's sent to sweep
- 1254: PO Shift IHT contacts CSM to report field findings:
 - No noticeable odors present in area of concern
 - NH3: 0 ppm
 - VOC: 0 ppb
- 1256: PO Shift IHT Supervisor contacts ST Team IH
- 1258: CSM enters TF-AOP-015
- 1259: PO Shift IHT Supervisor contacts PO Shift IHT to confirm TF-OPS-OPER-C-67 response actions
- 1303: PO Shift IHT Supervisor contacts R&C IHT supporting Projects OT to inquire about readings found during affected work evolution
- 1305: CSM contacts PO S&H Manager, 1 individual reported symptoms when opening door to change trailer, CSM was going to enter AOP-15
- 1310: CSM contacts PO S&H Manager, discuss scenario and actions with CSM and path forward responding with IHT's outside farm area
- 1315: PO S&H Manager contacted PO Shift IHT supervisor, discussed scenario, resources
- 1317: CSM dispatches Projects IHT to field to perform TF-AOP-015 response actions
- 1319: PO Shift IHT Supervisor contacts ST Team IH to notify about TF-AOP-015 entry
- 1321: SOEN: "Entered AOP-015 for odors reported outside SX Farm Change Trailer. Area is restricted unless authorized by CSM. CSM"
- 1324: PO S&H Manager contacted Projects S&H Manager to discuss events
- 1333: PO S&H Manager received call from CSM to discuss to actions needed for TF-AOP-015 after symptom reported
- 1338: PO S&H Manager contacts ST Team IH to give update TF-AOP-015 response actions
- 1344: PO Shift IHT Performs survey of SX Farm perimeter
- 1354: PO S&H Manager talked with Projects S&H Manager to discuss event updates
- 1401: PO S&H Manager talked with Projects S&H Manager to discuss additional events updates

- 1403: Projects IHT reports preliminary TF-AOP-015 response action field data to CSM:
- NH3: 0 ppm
 - VOC: 40 ppb
 - Odors could be from rubber overshoes "off-gassing"
- 1411: PO S&H Manager contacts IH Program Manager and IH Programs Manager to discuss event and actions going forward as well as notify before contacting IH Program TF-AOP-015 SME
- 1412: CSM contacts Projects IHT and directs extension of field response actions:
- Extend sweep to S Farm change trailer (MO-295)
- 1418: Projects IHT reports field response findings at SX Change trailer (MO-298) to CSM:
- NH3: 0 ppm
 - VOC: 0 ppb
- 1430: PO Shift IHT performs sweep inside of SY Farm after 241-SY VTP was restarted
- Hg: 3 ng/m³
 - NH3: 0 ppm
 - VOC: 0 ppb
- 1446: PO S&H Manager contacts CSM with event updates
- 1452: Programs IH TF-AOP-015 SME contacts CSM and reports that no hazards were detected and TF-AOP-015 can be exited
- 1454: PO S&H Manager contacts IH Program Manager and IH Programs Manager with updates on field findings
- 1455: PO S&H Manager briefs IH Programs TF-AOP-015 SME on field response actions and findings
- 1458: PO S&H Manager talked with CSM and concurred with path forward after discussion with IH Programs TF-AOP-015 SME
- 1504: PO S&H Manager contacts IH Program Manager and IH Programs Manager to follow up on event response actions and findings.
- 1509: CSM informs PO S&H Manager that TF-AOP-015 3.1.13 criteria for RPE was met and requests completion of an Odor Response Plan that the CSM drafted at earliest convenience
- 1527: SOEN: "Initiated Event Investigation "SX Farm Change Trailer AOP-015 Event". POC: Becky White. CSM"
- 1551: SOEN: "Sample analysis for the TF-AOP-015 event has been completed and the results are below action limits. Exiting TF-AOP-015. CSM"
- 1749: CSM requests PO S&H Manger initiate IHIR at earliest convenience.
- 1819: SOEN: "Exited AOP-021 for SY VTP unplanned shut down, normal access restored. CSM"

Immediate Actions Taken

Notifications were made, CSM followed guidance from TF-OPS-OPER-C-67. After a symptom was reported the CSM entered TFC-AOP-015. Area was restricted for personnel working in the area. IH completed direct reading instruments (DRI) inside SX change trailer (MO2194) and detected 160 ppb VOCs. The VOCs were attributed to off-gassing rubber shoes/matting. The symptomatic worker was taken to HPMC by the FWS, and later released without restriction. Some of the remaining field workers moved to the North SX change trailer, where similar odors were encountered. With the CSM concurrence, the field crew workers relocated to 2704HV.

Discussion of Potential Cause

The investigation conducted a review of the known Tank Farms chemicals of potential concern (COPC). After cross-referencing the National Institute for Occupational Safety and Health (NIOSH), three chemicals were found on the COPC list and have a "fish" descriptor according to NIOSH: Dimethylamine, Methylamine, and Pyridine. All three chemicals were used in Redox processing, and all three are likely chemicals found in west area tank farms, specifically SY and SX farms. Pyridine has the lowest odor threshold at 0.004 parts per million (ppm) (4 ppb), Dimethylamine's odor threshold is 0.05ppm (50ppb), and Methylamine's odor threshold is 0.02ppm (20ppb). The MultiRae instruments have the ability to detect COPCs as VOCs, the VOCs recorded a peak of 160ppb. All three of the suspect COPCs, according to the DRI monitoring data are below the action level (AL) or occupational exposure level (OEL). Review of TWINS data and cartridge testing data identified -amines (chemicals with fish odor descriptors) and was evaluated by the Chemical Protection Modeling team.

The modeled sources include SX-Farm, SY-Farm and S-Farm passive breather filters accounting for the loss of SY ventilation during the time of the odor event. Model results indicate the maximum concentration of fish odor COPCs from the tank waste (pyridine and ethylamine) exposed to the workers was ~ 1-10 part per trillion (ppt) (3 orders of magnitude below the odor thresholds). A review of non-COPC chemicals in the S-Farm complex tanks indicated an additional three fish smelling compounds (pyrimidine, pyrazine and 2-methylaziridine) all with similar maximum concentrations to pyridine. Based upon these modeling results indicating levels of exposure well below order thresholds, these sources were determined as not a likely cause of the odors. See attachment 3 for further discussion.

MSA applied herbicide to the interior of SY tank farm on December 5th. The herbicide is not the likely source of the AOP-015 due to the chemical composition. MSA uses Dibro 2+2, which is described as having a faint paint like odor, which is inconsistent with the odor description provided by the employees. Dibro 2+2 is not likely the source of the odors according to the MSDS for odor descriptors. See attachment 3 for further discussion.

Additionally in the 1990's, SX farm was treated with Tall Oil Emulsion. This was commonly referred to as "fish guts". The Tall Oil Emulsion was used as a ground fixative to control contamination within the tank farms. It is unlikely to be a source due to the length of time since applied and the fact that Tall Oil Emulsion is biodegradable.

Preliminary Extent of Condition Review/Historical Review

A search of the PER database did not result in any other "fish" described odors. In the past 24 months 2 AOP-015s were entered in SX Farm on September 2018 and March of 2017. An AOP-015 was entered in SY Farm in February of 2018. However, the odor descriptors and symptoms were not similar. EIR-2018-033, EIR-2018-010, and EIR-2017-013 address the AOP-015 entries.

Recommendations/Proposed Corrective Actions

As the source of the odor was indeterminate, there are no proposed corrective actions tied to causation. However, there were several process improvements identified during the course of the investigation as follows:

- Upon being notified of four individuals who smelled a fishy odor outside MO2194 (SX Change Trailer) the CSM entered procedure TFC-OPS-OPER-C-67, and not TF-AOP-015. This was reportedly due to an assumption that fish like odors would not likely result from tank vapors combined with TF-AOP-015 excluding "animal odors" which could be interpreted to apply to "fish" odors. This issue was also identified by a Facility Representative and is captured under PER-2019-0005.

It is recommended to revise TF-AOP-015, to clarify animal odors in terms of applicability to AOP-015 eliminating future confusion. There are three identified COPCs with "fish" as an odor descriptor.

- Specific building numbers were not used when relocating employees during the AOP-015 response resulting in miscommunication and confusion. It is important that shift managers are familiar with and verify building locations prior to relocating affected employees during a TF-AOP-15 event. This was also identified by a Facility Representative and is captured in PER-2019-0006.
- As allowed by procedure there were no bag samples taken during this AOP-015 response, however the SOEN message exiting the AOP-015 stated "sample analysis for the TF-AOP-015 event has been completed and the results are below action limits." which could be misleading as sampling data was listed as N/A per the IHIR. It is recommended to revise TF-AOP-015 exit statement since the collection of bag samples is not always required.
- Evaluate if there is a benefit to obtain bag samples as an additional source of data in support of AOP-015 event investigations separate from the bag sampling determinations related to AOP-015 response actions.

Attachments:



Attachment 1: Location of workers who reported Odors.

Attachment 2: Industrial Hygiene Investigative Report

Attachment 3: APGEMS – TF Plume Modeling for December 7, 2018 AOP-015 Event

Attachment 1: Location of workers who reported Odors



-  Location of odor
-  Worker




Attachment 2: Industrial Hygiene Investigative Report

Washington River Protection Solutions TF-AOP-015 INDUSTRIAL HYGIENE INVESTIGATION REPORT		PER Number: N/A
Time/Date & Event location: 1215 12/07/2018 SX Farm Change Trailer		EIR Number: 2018-046
<p>1. <u>Event Summary (including number of workers involved and activity in progress):</u></p> <p>At approximately 1215 on December 7th 2018 8 workers reported "fishy, rotten egg, onion, musty, rotten" odors outside of 241-SX Farm near the change trailer (MO-2194).</p> <ul style="list-style-type: none"> Was an IHT Present during initiating event? [] Yes [X] No <p><u>IH Monitoring/ Sample Survey Reports:</u></p> <p>18-10313: "Response to Odors SX Farm" 18-10382: "SX odor response" 18-10314: "SY Farm Exhauster Farm Sweep"</p> <p><u>Weather Conditions at Time of Event:</u></p> <ul style="list-style-type: none"> Weather station: 21 Wind Direction and Speed: E 1mph Barometric Pressure (steady/rising/falling): 29.65 inHg falling Temperature (F°): 28 Humidity: 78% 		

Attachment 2: Industrial Hygiene Investigative Report (Cont.)

Washington River Protection Solutions TF-AOP-015 INDUSTRIAL HYGIENE INVESTIGATION REPORT	PER Number: N/A
Time/Date & Event location: 1215 12/07/2018 SX Farm Change Trailer	EIR Number: 2018-046
<p>Field Response Timeline:</p> <p>1203: GSM dispatches PO Shift IHT to support TF-AOP-021 at 241-SY Farm</p> <p>1207: SOEN: "Entered AOP-021 for SY Farm unplanned shut down, SY Farm is being posted as a EZ(VCZ). Access to SY Farm restricted. CSM"</p> <p>1239: Odors reported to CSO:</p> <ul style="list-style-type: none"> • "Fishy" odor • No symptoms reported, • Medical offered and declined <p>1244: IHT dispatched as per guidance of TF-OPS-OPER-C-67. PO Shift IHT Supervisor contacted by CSM and concurs with response actions:</p> <ul style="list-style-type: none"> • PO Shift IHT to perform sweep in area of reported odors • PO Shift IHT will collect grab sample if readings above background are found <p>1245: PO S&H Manager contacts PO Shift IHT Supervisor to ensure PO Shift IHT creates SWIHD survey documenting TF-OPS-OPER-C-67 response actions</p> <p>1247: CSM contacts PO S&H Manager, 4 people reported Fishy odor in SX area, no symptoms, no medical, IHT's sent to sweep</p> <p>1254: PO Shift IHT contacts CSM to report field findings:</p> <ul style="list-style-type: none"> • No noticeable odors present in area of concern • NH3: 0 ppm • VOC: 0 ppb <p>1256: PO Shift IHT Supervisor contacts ST Team IH</p> <p>1258: CSM enters TF-AOP-015</p> <p>1259: PO Shift IHT Supervisor contacts PO Shift IHT to confirm TF-OPS-OPER-C-67 response actions</p> <p>1303: PO Shift IHT Supervisor contacts R&C IHT supporting Projects OT to inquire about readings found during affected work evolution</p> <p>1305: CSM contacts PO S&H Manager, 1 individual reported symptoms when opening door to change trailer, CSM was going to enter AOP-15</p> <p>1310: CSM contacts PO S&H Manager, discuss scenario and actions with CSM and path forward responding with IHT's outside farm area</p> <p>1315: PO S&H Manager contacted PO Shift IHT supervisor, discussed scenario, resources</p> <p>1317: CSM dispatches Projects IHT to field to perform TF-AOP-015 response actions</p> <p>1319: PO Shift IHT Supervisor contacts ST Team IH to notify about TF-AOP-015 entry</p> <p>1321: SOEN: "Entered AOP-015 for odors reported outside SX Farm Change Trailer. Area is restricted unless authorized by CSM. CSM"</p> <p>1324: PO S&H Manager contacted Projects S&H Manager to discuss events</p> <p>1333: PO S&H Manager received call from CSM to discuss to actions needed for TF-AOP-015 after symptom reported</p> <p>1338: PO S&H Manager contacts ST Team IH to give update TF-AOP-015 response actions</p> <p>1344: PO Shift IHT Performs survey of SX Farm perimeter</p> <p>1354: PO S&H Manager talked with Projects S&H Manager to discuss event updates</p> <p>1401: PO S&H Manager talked with Projects S&H Manager to discuss additional events updates</p>	

Attachment 2: Industrial Hygiene Investigative Report (Cont.)

Washington River Protection Solutions		PER Number: N/A
TF-AOP-015 INDUSTRIAL HYGIENE INVESTIGATION REPORT		
Time/Date & Event location: 1215 12/07/2018 SX Farm Change Trailer		EIR Number: 2018-046
<p>1403: Projects IHT reports preliminary TF-AOP-015 response action field data to CSM:</p> <ul style="list-style-type: none"> • NH3: 0 ppm • VOC: 40 ppb • Odors could be from rubber overshoes "off-gassing" <p>1411: PO S&H Manager contacts IH Program Manager and IH Programs Manager to discuss event and actions going forward as well as notify before contacting IH Program TF-AOP-015 SME</p> <p>1412: CSM contacts Projects IHT and directs extension of field response actions:</p> <ul style="list-style-type: none"> • Extend sweep to S Farm change trailer (MO-295) <p>1418: Projects IHT reports field response findings at SX Change trailer (MO-298) to CSM:</p> <ul style="list-style-type: none"> • NH3: 0 ppm • VOC: 0 ppb <p>1430: PO Shift IHT performs sweep inside of SY Farm after 241-SY VTP was restarted</p> <ul style="list-style-type: none"> • Hg: 3 ng/m³ • NH3: 0 ppm • VOC: 0 ppb <p>1446: PO S&H Manager contacts CSM with event updates</p> <p>1452: Programs IH TF-AOP-015 SME contacts CSM and reports that no hazards were detected and TF-AOP-015 can be exited</p> <p>1454: PO S&H Manager contacts IH Program Manager and IH Programs Manager with updates on field findings</p> <p>1455: PO S&H Manager briefs IH Programs TF-AOP-015 SME on field response actions and findings</p> <p>1458: PO S&H Manager talked with CSM and concurred with path forward after discussion with IH Programs TF-AOP-015 SME</p> <p>1504: PO S&H Manager contacts IH Program Manager and IH Programs Manager to follow up on event response actions and findings.</p> <p>1509: CSM informs PO S&H Manager that TF-AOP-015 3.1.13 criteria for RPE was met and requests completion of an Odor Response Plan that the CSM drafted at earliest convenience</p> <p>1527: SOEN: "Initiated Event Investigation "SX Farm Change Trailer AOP-015 Event". POC: Becky White. CSM"</p> <p>1551: SOEN: "Sample analysis for the TF-AOP-015 event has been completed and the results are below action limits. Exiting TF-AOP-015. CSM"</p> <p>1749: CSM requests PO S&H Manger inflate IHIR at earliest convenience.</p> <p>1819: SOEN: "Exited AOP-021 for SY VTP unplanned shut down, normal access restored. CSM"</p>		
Field IH Author:		
 <small>Please Print and Last Name</small>		 <small>Signature</small>
		 <small>Please Use</small>
		12/14/18 <small>Date</small>

Attachment 2: Industrial Hygiene Investigative Report (Cont.)

Washington River Protection Solutions		PER Number: N/A
TF-AOP-015 INDUSTRIAL HYGIENE INVESTIGATION REPORT		EIR Number: 2018-046
Time/Date & Event location: 1215 12/07/2018 SX Farm Change Trailer		
<p>2. GCMS Sample Results:</p> <p>Bag samples were not collected for this AOP 015 investigation. As no source was identified and direct monitoring measurements for NH3 were less than the instrument's level of detection (DL). VOC measurements were below background. Sample Plan IHP-09001 R6 permits the responding industrial hygienist to collect bag samples at their direction. In this case the industrial hygienist did not give direction to collect bag samples.</p>		
<p>Programs IH Author:</p> <div style="border: 1px solid black; height: 20px; width: 100%; background-color: black; margin-bottom: 5px;"></div> <div style="display: flex; justify-content: space-between; font-size: small;"> Print First and Last Name Signature Phone No. Date </div> <div style="text-align: right; margin-top: 5px;">12-12-18</div>		

Attachment 2: Industrial Hygiene Investigative Report (Cont.)

Washington River Protection Solutions TF-AOP-015 INDUSTRIAL HYGIENE INVESTIGATION REPORT	PER Number: N/A
Time/Date & Event location: 1215 12/07/2018 SX Farm Change Trailer	EIR Number: 2018-046
3. Additional information: <ul style="list-style-type: none"> • Odor Response Cards received: 	

Odor Response Card

1. Contact CAH [redacted] complete below bulleted information and map.

- Date and time odor was noticed: 12/7/18 1230
- Your name and the work you were performing: [redacted] SX Farm
- Location of odors (mark area on map and wind direction): South side
- Name of others in or near the affected area: _____
- Was an IWT present? NO
- Describe the odor: Sewer Gas Steam Sulfur Chemical Smoke Other Unknown
- Possible source: Exhaust from the SX Farm
- Your symptoms (if any): Headache Dizziness/Light-headed Nausea Cough Fatigue/Weakness/Myalgias Hoarseness/Throat Difficulty Breathing Watery/Irritated Eyes/Itchy or Red Mucous Tingling/Parosmia/Parosmia Rash/Itching Other _____

2. Send this card to the Central Shift Office.

Odor Response Card

Odors Detected with/without immediate symptoms:

1. Notify immediate supervisor.
2. Contact Central Shift Manager.
3. Complete and return to Central Shift Office as soon as possible.

Odors Detected Symptoms

4. Notify immediate supervisor.
5. Contact CAH [redacted] complete below bulleted information and map.
 - Your name and the work you were performing
 - Date and time odor was noticed
 - Location of odors (mark area on map and wind direction)
 - Describe the odor
 - Name of others in or near the affected area
 - Was an IWT present?
 - Possible source
6. Provide information on the back of card.
7. Send this card immediately to the Central Shift Office.

Attachment 2: Industrial Hygiene Investigative Report (Cont.)

Washington River Protection Solutions TF-AOP-015 INDUSTRIAL HYGIENE INVESTIGATION REPORT	PER Number: N/A
Time/Date & Event location: 1215 12/07/2018 SX Farm Change Trailer	EIR Number: 2018-046

Odor Response Card

1. Contact CSM, [redacted] complete below bulleted information and map.

- Date and time odor was noticed 12-18 / 13:25:00
- Your name and the work you were performing [redacted] at change trailer
- Location of odors (mark area on map and wind direction) Change Trailer at 12
- Name of others in or near the affected area _____
- Was an IHT present? NO
- Describe the odor Sweet Sour Musty Metallic Smoky Stale Other _____
 Bleaching Solution Esters Other _____
- Possible source _____
- Your symptoms (if any) Headache Dizziness Eye Irritation Nausea Cough
 Fatigue Irritation No Symptoms Burning Throat Difficulty Breathing Water Irritation
 Skin Irritation Stinging Numbness Parosmia Numb/tingling
 Other _____

2. Send this card to the Central Shift Office.

Odor Response Card

Odors Detected with No Immediate symptoms

- Notify immediate supervisor.
- Contact Central Shift Manager.
- Provide below bulleted information
- Complete map, return to Central Shift Office as soon as practicable.

Odors Detected with Symptoms

- Notify immediate supervisor.
- Contact CSM, [redacted] complete below bulleted information and map.
 - Your name and the work you were performing
 - Your symptoms (if any)
 - Date and time odor was noticed
 - Location of odors (mark area on map and wind direction)
 - Describe the odor
 - Name of others in or near the affected area
 - Was an IHT present?
 - Possible source
- Provide information on the back of card
- Send this card immediately to the 4-Case Shift Office.

Attachment 2: Industrial Hygiene Investigative Report (Cont.)

Washington River Protection Solutions TF-AOP-015 INDUSTRIAL HYGIENE INVESTIGATION REPORT	PER Number: N/A
Time/Date & Event location: 1215 12/07/2018 SX Farm Change Trailer	EIR Number: 2018-046

Odor Response Card

1. Contact GSM, [REDACTED] complete below bulleted information and map.

- Date and time odor was noticed 12/7/18 1430 01 0924
- Your name and the work you were performing: [REDACTED] 77 SX Farm
- Location of odors (mark area on map and wind direction) 1215
- Name of others in or near the affected area [REDACTED]
- Was an IRT present? no
- Describe the odor: event sour heavy earthy metallic salty rotten other
 cleaning solution ammonia other fishy odor
- Possible source _____
- Your symptoms (if any): headache dizziness/light-headed nausea cough
 fatigue/drowsiness/irritation sore/burning throat difficulty breathing watery/itchy
 eyes/itchy with vision tingling/numbness/paralysis chest/aching
 other itchy eyes

2. Send this card to the Central Shift Office.

Odor Response Card

Odors Detected with (0) Immediate symptoms

- Notify immediate supervisor.
- Contact Event Shift Manager, [REDACTED] provide below bulleted information.
- Complete this, return to Central Shift Office as soon as practicable.

Odors Detected with Symptoms

- Notify immediate supervisor.
- Contact GSM, [REDACTED] complete below bulleted information and map.
 - Your name and the work you were performing
 - Your symptoms (if any)
 - Date and time odor was noticed
 - Location of odors (mark area on map and wind direction)
 - Describe the odor
 - Name of others in or near the affected area
 - Was an IRT present
 - Possible source
- Provide information on the back of card.
- Send this card immediately to the Central Shift Office.

Attachment 2: Industrial Hygiene Investigative Report (Cont.)

Washington River Protection Solutions TF-AOP-015 INDUSTRIAL HYGIENE INVESTIGATION REPORT	PER Number: #/3
Time/Date & Event location: 1215 12/07/2018 SX Farm Change Trailer	EIR Number: 2018-046

Odor Response Card

1. Contact CSM, [redacted] complete below bulleted information and map.

- Date and time odor was noticed: 12:30 12/7/18
- Your name and the work you were performing: [redacted]
- Location of odors (mark area on map and wind direction): South West
- Name of others in or near the affected area: _____
- Was an IHT present? NO
- Describe the odor: Sweet Sour Musty Harsh Metallic Rotten Gassy Other: Exhaust
- Possible source: _____
- Your symptoms (if any): Headache Dizziness/Light-headed Nausea Cough Itching/Redness/Weakness Irritation/Burning Throat Difficulty Breathing Irritated/Itched Eyes/Itchy with Vision Tingling/Numbness/Paralysis Rash/Itching Other: None

2. Send this card to the Control Shifts Office.

Odor Response Card

Odors Detected with **NO** immediate symptoms.

- Notify immediate Supervisor.
- Contact Control Shift Manager, [redacted] provide below bulleted information.
- Complete map, return to Control Shift Office as soon as possible.

Odors Detected with **IRRN** symptoms.

- Notify immediate Supervisor.
- Contact CSM, [redacted] provide below bulleted information and map.
 - Your name and the work you were performing
 - Your symptoms (if any)
 - Date and time odors were noticed
 - Location of odors (mark area on map and wind direction)
 - Describe the odor
 - Name of others in or near the affected area
 - Was an IHT present?
 - Possible source
- Provide information on the back of card.
- Send this card immediately to the Control Shift Office.

Attachment 2: Industrial Hygiene Investigative Report (Cont.)

Washington River Protection Solutions TF-AOP-015 INDUSTRIAL HYGIENE INVESTIGATION REPORT	PER Number: N/A
Time/Date & Event location: 1215 12/07/2018 SX Farm Change Trailer	EIR Number: 2018-046

Odor Response Card

1. Contact CDM [redacted] complete below bulleted information and map.

- Your name and the work you were performing: SNE FOR SX
- Your symptoms (if any): SLIGHT Nausea
- Time odor was noticed: 12:15
- Location of odors (mark area on map and wind direction): WAS FROM W East
- Describe the odor: SOOTY / BURNING
- Name of others in or near the affected area: [redacted]
- Was an OIT present? No
- Possible source: SOOTY / BURNING / 12:15 PM 12/07/18 SX FARM CHANGE TRAILER

1. Send this card to the Central Shift Office.

Odor Response Card

Always completed with OIT
 (Industrial Hygiene)

1. Notify immediate supervisor.
 2. Contact Central Shift Manager [redacted] provide below bulleted information.
 3. Complete card, return to Central Shift Office as soon as practicable.

Always completed with OIT
 (Industrial Hygiene)

4. Notify immediate supervisor.
 5. Contact CDM [redacted] complete below bulleted information and map.

- Your name and the work you were performing
- Your symptoms (if any)
- Time odor was noticed
- Location of odors (mark area on map and wind direction)
- Describe the odor
- Name of others in or near the affected area
- Was an OIT present?
- Possible source

6. Provide information on the back of card.

1. Send this card immediately to the Central Shift Office.

Attachment 2: Industrial Hygiene Investigative Report (Cont.)

Washington River Protection Solutions TF-AOP-015 INDUSTRIAL HYGIENE INVESTIGATION REPORT		PER Number: N/A
Time/Date & Event location: 1215 12/07/2018 SX Farm Change Trailer		EIR Number: 2018-046

Order Response Card

1. Contact OSM, [redacted] complete below indicated information and sign.

- Your name and the work you were performing: [redacted] 1215 12/07/18
- Your symptoms (if any): none
- Time order was notified: 12:20
- Location of order (mark area on map and wind direction): _____
- Describe the order: Wet Fish
- Name of address in or near the affected area: X in map
- Was an OIT present? No
- Possible cause: SX Admin

2. Send this card to the Central Wash Office.

Order Response Card

(Send this card to the Central Wash Office.)

1. Notify immediate supervisor.
 2. Contact OSM/OSHA.
 Always [redacted] provide below indicated information.
 3. Complete this card, return to Central Wash Office as soon as practicable.

(Send this card to the Central Wash Office.)

4. Notify immediate supervisor.
 5. Contact OSM/OSHA. [redacted] complete below indicated information and sign.

- Your name and the work you were performing
- Your symptoms (if any)
- Time order was notified
- Location of order (mark area on map and wind direction)
- Describe the order
- Name of address in or near the affected area
- Was an OIT present?
- Possible cause

6. Provide information to the back of card.

7. Send this card to the Central Wash Office.

Attachment 2: Industrial Hygiene Investigative Report (Cont.)

Washington River Protection Solutions TF-AOP-015 INDUSTRIAL HYGIENE INVESTIGATION REPORT	PER Number: N/A
Time/Date & Event location: 1215 12/07/2018 SX Farm Change Trailer	EIR Number: 2018-046

Odor Response Card

1. Complete ERM [redacted] completely below indicated information and map.

- Your name and the work you were performing: [redacted] 12-7-18
- Your symptoms (if any): None
- Time odor was noticed: 12:15
- Location of odor (mark area on map and wind direction): _____
- Describe the odor: Smoky odor
- Name of others in or near the affected area: [redacted]
- Was an HVT present? No
- Possible cause: ?

* Please fill out in the Central Mill Office.

Odor Response Card

Please fill out with the following information:

1. Notify immediate supervisor.
2. Contact Central Mill manager: [redacted] provide name below information.
3. Complete map related to Central Mill Office as shown provided.

Please fill out with the following information:

4. Notify immediate supervisor.
5. Complete ERM [redacted] completely below indicated information and map:
 - Your name and the work you were performing
 - Your symptoms (if any)
 - Time odor was noticed
 - Location of odor (mark area on map and wind direction)
 - Describe the odor
 - Name of others in or near the affected area
 - Was an HVT present?
 - Possible cause
6. Provide information on the back of card.

* Please fill out in the Central Mill Office.

Attachment 2: Industrial Hygiene Investigative Report (Cont.)

Washington River Protection Solutions TF-AOP-015 INDUSTRIAL HYGIENE INVESTIGATION REPORT	PER Number: N/A
Time/Date & Event location: 1215 12/07/2018 SX Farm Change Trailer	EIR Number: 2018-046

Odor Response Card 017/19

1. Contact ESM [redacted] complete below bulleted information and map.

- Your name and the work you were performing [redacted] at SX
- Your symptoms (if any) head sensitivity
- Time odor was noticed 11:30 am
- Location of odors (mark area on map and wind direction) marked a map (11:30 am)
- Describe the odor Fresh odor/like a hot air
- Name of address in or near the affected area [redacted]
- Was an OIT present? No
- Possible source SX 1st floor location of a vent off a tank

2. Send this card to the Control Room Office.

Odor Response Card

Return Response with 24 hours maximum

1. Notify immediate supervisor.
2. Contact Control Room Manager [redacted] Provide below bulleted information.
3. Complete map, return to Control Room Office as soon as possible.

Return Response with 24 hours maximum

4. Notify immediate supervisor.
5. Contact ESM [redacted] complete below bulleted information and map.
 - Your name and the work you were performing
 - Your symptoms (if any)
 - Time odor was noticed
 - Location of odors (mark area on map and wind direction)
 - Describe the odors
 - Name of address in or near the affected area
 - Was an OIT present?
 - Possible source
6. Provide information on the back of card.

2. Send this card to the Control Room Office.

Attachment 2: Industrial Hygiene Investigative Report (Cont.)

Washington River Protection Solutions		PER Number: N/A
TF-AOP-015 INDUSTRIAL HYGIENE INVESTIGATION REPORT		
Time/Date & Event location: 1215 12/07/2018 SX Farm Change Trailer		EIR Number: 2018-046
<p>• Summary of IH Monitoring and Sampling Data:</p> <p>a. Monitoring:</p> <p>Event Response (TF-OPS-OPER-C-87): 18-10382 NH3: 0 ppm VOC: 0 ppb</p> <p>Event Response (TF-AOP-015): 18-10313 NH3: 0 ppm VOC: 160 ppb inside of SX change trailer "most likely due to rubber matting"</p> <p>SY Farm Sweep (TF-AOP-021): 18-10314 Hg: 3 ng/m³ NH3: 0 ppm VOC: 0 ppb</p> <p>b. Sampling: N/A</p> <p>4. <u>Summary of Employee Reported Information (e.g., symptoms)</u> One employee reported a "slight headache"</p> <p>5. <u>Recommendations/Conclusions:</u> Identification of Source of the Concern: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No No recommendations at this time.</p> <p>6. Other: N/A</p> <p>S&H Program Management:</p> <div style="border: 1px solid black; height: 20px; width: 100%; background-color: black; margin-bottom: 5px;"></div> <div style="display: flex; justify-content: space-between;"> Print First and Last Name Signature Phone No. </div> <div style="text-align: right; margin-top: 10px;"> 12/12/18 Date </div>		

Attachment 3: APGEMS – TF Plume Modeling for December 7, 2018 AOP-015 Event¹

An AOP-015 event was reported on December 7, 2018 near the SX tank farm. Eight workers were in the MO-2194 building just outside the SW corner of the SX farm and reported a fish or musty smell at 12:39 PM. Workers were relocated to MO-298 near the northwest corner of the SX farm at 2:10 PM, and the odor was reportedly even stronger at that time and location. See Figure 1 for these locations on a map.



Figure 1. The location of the original odor event (top panel) and the secondary odor event (bottom panel) are identified by light green circles.

APGEMS-TF Modeling Results Conclusions:

The APGEMS Tank Farm plume model was used to support investigation of the AOP-15 event and evaluate nearby sources as potential culprits. Results of the modeling are summarized as follows:

- **Tank waste vapors were not the likely source of the AOP-15 odors.** AOP-15 locations were downwind from the SX, SY and S-Farms, but estimated vapor concentrations at these locations were several orders of magnitude below odor detection thresholds and occupational exposure limits.
- **The newly opened 200W Area sewage lagoon was not the likely source of the AOP-15 odors.** Odor locations were not in the path of vapor plumes emanating from the sewage aeration lagoon.

¹ This information was provided via email from the Chemical Vapors Modeling Team.

**Attachment 3: APGEMS – TF Plume Modeling for December 7, 2018 AOP-015 Event
(Cont.)**

- **Herbicide application in SY-Farm was not the likely source of the AOP-15 odors.** Theoretical vapor plumes from herbicide application in SY-Farm would have touched the AOP-15 odor locations, but the herbicide used (active ingredient 2-4D) is reported to have little odor.
- **None of the modeled sources were likely culprits of the AOP-15 event, but the model suggests likely sources to be NNE of the AOP-15 locations.** Large dumpsters exist in this direction near building 272S and MO296, and may be potential sources for investigation.

Selection of Sources to be Modeled:

Investigation of work activities in the area just prior and during the AOP-15 event indicated no waste disturbing activities, although the SY exhauster was down at the time resulting in emissions from the SY-Farm passive breather filters (PBFs) and an herbicide (granular Dibro 2+2) application was made in SY-Farm two-days prior to the event. Investigation of nearby septic tanks and dumpsters indicated a sewer system to the East of 222-S and a large dumpster (near MO-2193) to the South of the AOP-15 locations, neither of which were upwind of the observed odor locations. Based on this, the modeled sources were selected to include SX-Farm, SY-Farm and S-Farm passive breather filters (quiescent waste conditions), herbicide in SY-Farm and newly operated large sewage treatment settling ponds at the Northeast end of 200W Area.

APGEMS-TF Modeling:

The APGEMS-TF model generates a 3-D wind field utilizing meteorological data from 30 weather stations on the Hanford site. The model then utilizes measured mixing heights and stability classes to estimate mixing and dispersion of contaminants within the wind field. The model estimates dispersion of chemical contaminants from a source and estimated concentrations downwind of the source, but does not estimate a source location based on a receptor location.

Modeling of SX-Farm, S-Farm and SY-Farm Passive Breather Filters as Potential Sources:

Winds for the AOP-15 period were relatively light and variable. At 12:30 PM on 12/07/18, the Hanford meteorological tower located at the 200W area had a wind speed of 2 mph and wind direction from NNE (30 deg from north); and at 2:30 PM the wind was 1 mph out of the W (260 deg from north). The stability class was neutral, so one would expect relatively low levels of mixing due to the low winds, but plume widths would be relatively large due to meandering wind direction. APGEMS-TF modeling indicated that AOP-15 locations were downwind from the SX, S and SY-Farm PBFs, but concentrations at these locations were several orders of magnitude below odor thresholds and occupational exposure limit (OEL) concentrations. Figure 2 shows the pyridine plume (most prominent fish smelling COPC in S-Farm complex) from the combined simultaneous emissions from the 15 SX, 12 S-Farm and 3 SY-Farm PBFs at time of the AOP-15 odor events (12:30 PM and 2:30 PM). At 12:30 PM, the location of the observed odors (MO-2194) was in the centerline of the plume from the S-Farm complex PBFs. At 2:30 PM, the location of the observed odors (MO-298) was near the plume. Model results indicate the maximum concentration of fish odor COPCs from the tank waste (pyridine and ethylamine) exposed to the workers was ~ 1-10 ppt (3 orders of magnitude below the odor thresholds).¹ A review of non-COPC chemicals in the S-Farm complex tanks indicated an additional three fish smelling compounds (pyrimidine, pyrazine and 2-methylaziridine) all with similar maximum concentrations to pyridine.

**Attachment 3: APGEMS – TF Plume Modeling for December 7, 2018 AOP-015 Event
(Cont.)**

If the odors are considered to be additive, the modeled concentration of the combined fish odor chemicals at the receptor sites were still 2.5 orders of magnitude below odor thresholds.



Figure 2. APGEMS-TF plume estimates from 12:30 (upper panel) and 2:30 (lower panel) assuming conservatively high releases of pyridine from each of the SX, S and SY-Farm PBFs. AOP-15 locations identified with light green stars.

**Attachment 3: APGEMS – TF Plume Modeling for December 7, 2018 AOP-015 Event
(Cont.)**

Modeling of Sewage Lagoon at Northeast end of 200W Area:

Modeling indicated that AOP-15 odor locations were not in the path of vapor plumes emanating from the sewage aeration lagoon located in the northeast corner of the 200W area nearly 2.5 miles away from the MO-2194 building. Figure 3 presents APGEMS-TF plumes from the two AOP-15 time periods. At 12:30 PM, the plume from the lagoon, oriented toward the southwest, passed over the T tank farm, approximately 1.5 miles (2.5 km) north of the MO-2194 building. The plume was longer and was shifted slightly toward the south at 2:30 PM compared with 12:30 PM. Neither of these plumes would indicate the wastewater lagoon as the source of the December 7, 2018 AOP-015 event.

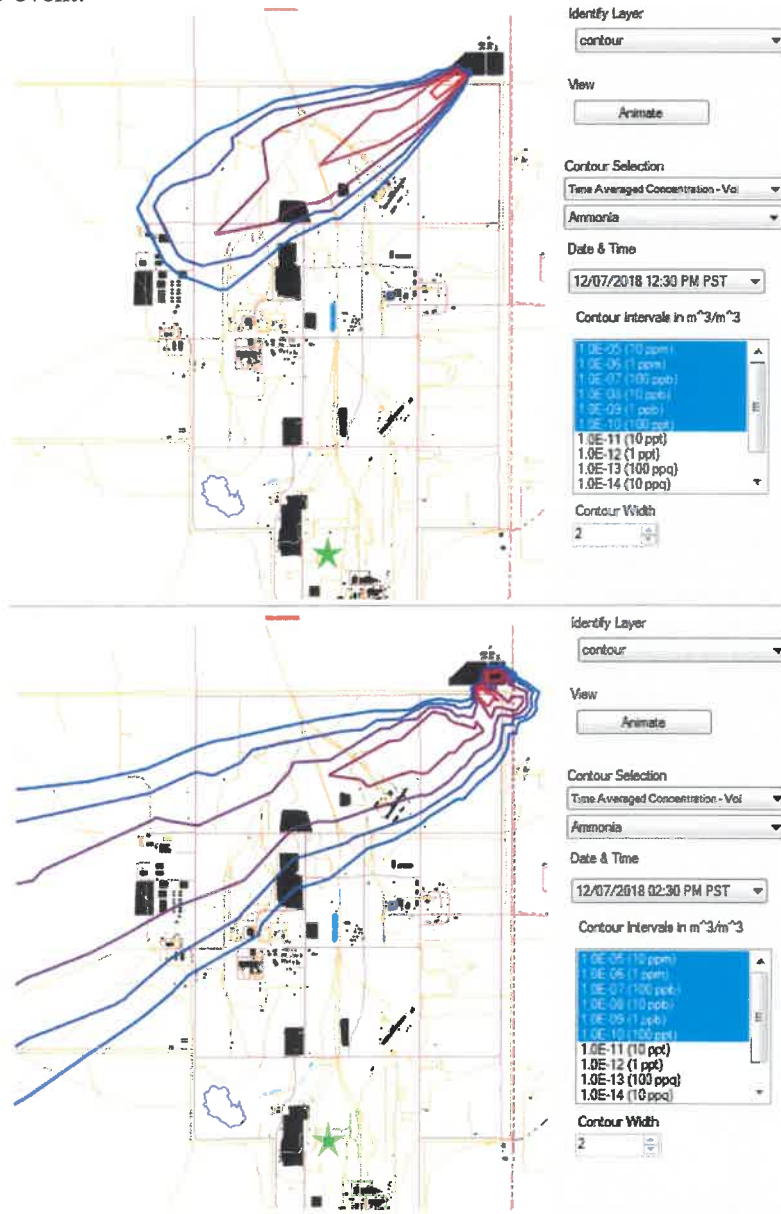


Figure 3. APGEMS-TF plume estimates from 12:30 (upper panel) and 2:30 (lower panel) assuming a unit release of ammonia from the wastewater lagoon (1 g ammonia/s). AOP-15 locations identified with light green stars.

**Attachment 3: APGEMS – TF Plume Modeling for December 7, 2018 AOP-015 Event
(Cont.)**

Modeling of Herbicide Application in SY-Farm on 12/05/18:

A source near the center of SY-Farm was modeled to evaluate the possibility of the culprit source being the SY-Farm herbicide application. Per Figure 4, the plume tends to pass to the north of the MO-2194 at 12:30 PM and to the south of MO-298 at 2:30 PMⁱⁱ. The herbicide applied to SY-Farm was Dibro 2+2, which is in a granular form (94% crystalline silica) with active ingredients Diuron and Bromacil, collectively reported to have little odor (digitalmsds.com). The herbicide application is therefore unlikely to be the source for this AOP-015 event.

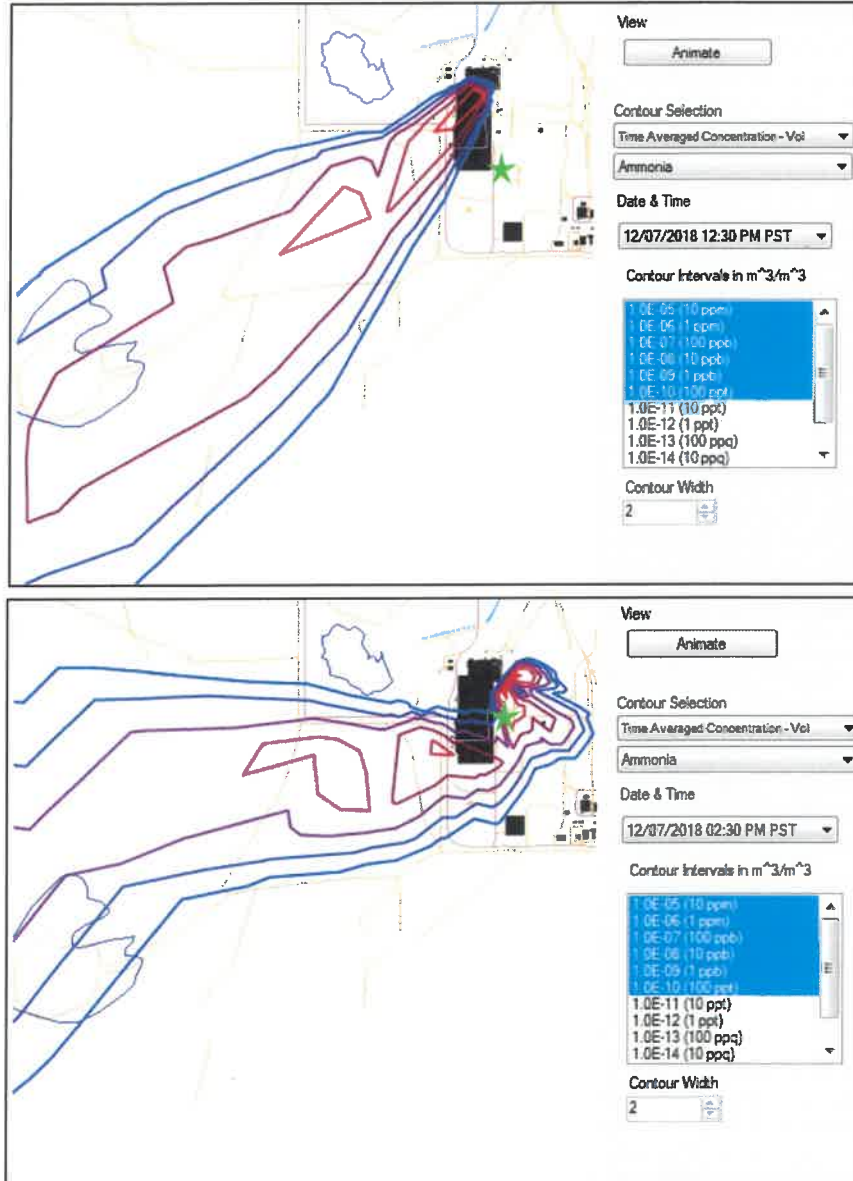


Figure 4. APGEMS-TF plume estimates from 12:30 (upper panel) and 2:30 (lower panel) assuming a unit release of ammonia from near the center of the SY Farm (1 g ammonia/s). AOP-15 locations identified with light green stars.

**Attachment 3: APGEMS – TF Plume Modeling for December 7, 2018 AOP-015 Event
 (Cont.)**

References

Nune, SK, CK Clayton J Liu, CJ Freeman, TM Brouns, LA Mahoney. 2018a. Analysis of Air Purifying Respirator (APR) Cartridge Performance Testing on Hanford Tanks SX-101 and SX-104: Volume 1. PNNL-27568 Vol 1 Rev A. Pacific Northwest National Laboratory, Richland Washington.

Nune, SK, CK Clayton J Liu, CJ Freeman, TM Brouns, LA Mahoney. 2018b. Analysis of Powered Air-Purifying Respirator (PAPR) Cartridge Performance Testing on Hanford Tanks SX-101 and SX-104: Volume 1. PNNL-27558 Vol 1 Rev A. Pacific Northwest National Laboratory, Richland Washington.

ⁱ Modelling inputs for the APGEMS-TF modeling of pyridine were as follows:

Tank	Source Conc. (ppb pyridine)	Reference	Tank	Source (ppb pyridine)	Reference
SX-101	0.4	Cartridge testing	S-101	1.5	Max value in S-Farm
SX-102	40	Max value in SX-Farm	S-102	1.5	Max value in S-Farm
SX-103	40	Max value in TWINS	S-103	1.5	Max value in S-Farm
SX-104	2	Max value in SWIDS	S-104	1.5	Max value in S-Farm
SX-105	40	Max value in SX-Farm	S-105	1.5	Max value in S-Farm
SX-106	29	Max value in TWINS	S-106	1.5	Max value in S-Farm
SX-107	40	Max value in SX-Farm	S-107	1.5	Max value in S-Farm
SX-108	40	Max value in SX-Farm	S-108	1.5	Max value in SWIDS
SX-109	40	Max value in SX-Farm	S-109	1.5	Max value in S-Farm
SX-110	40	Max value in SX-Farm	S-110	1.5	Max value in S-Farm
SX-111	40	Max value in SX-Farm	S-111	1.5	Max value in S-Farm
SX-112	40	Max value in SX-Farm	S-112	1.5	Max value in S-Farm
SX-113	40	Max value in SX-Farm	SY-101	10.5	Max value in SWIDS
SX-114	40	Max value in SX-Farm	SY-102	10.5	Max value in SWIDS
SX-115	40	Max value in SX-Farm	SY-103	10.5	Max value in SWIDS
PBF emissions rate = 10 cfm/pbf					
Odor threshold for most sensitive noses = 4 ppb, link on IH Fact Sheet Odor Thresholds on the Vapors Webpage					

ⁱⁱ A unit release of ammonia (i.e., 1 g/s) was used in modeling to generate a normalized emission that can be easily be converted to other source chemicals based on ratios of their release rate. A fish smell is not

expected from ammonia, but its plume shape is representative of any other source chemical (including fish smelling compounds) and its concentration contours can be converted to other known source chemicals.