

C-67 Event Investigation Reports (Redacted) EIR-2023-037 (05/31/2023)

(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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WRPS

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Date

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Washington River Protection Solutions
EVENT SUMMARY

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

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

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

Project: Production Operations Date: May 31, 2023

Area/Building/Location: 242-A/AMU Approximate Time of Event: 0830 hours

AR Number: WRPS-AR-2023-1663 Responsible Manager: [REDACTED]

EIR Number: EIR-2023-037 Event Investigator: [REDACTED]

EVENT SUMMARY PART 2

Key Elements of the Investigation (Key investigation points):

To summarize the conclusions of the Industrial Hygiene Event Investigation Report, IHIR-00069 "TFC-OPS-OPER-C-67 Response 242A Evaporator AMU", although the odors could not be definitively identified, DRI monitoring performed during odor investigation and TFC-OPS-OPER-C-67 response actions did not indicate further actions were necessary with regard to a worker safety and health occupational exposure limit standpoint. The following considerations support the IHIR-00069 conclusion:

(1) Comments by the responding Production Operations-East IH indicated a 'Faint "rotten-egg odor was [perceived] upon arrival, but became [unnoticeable] quickly. Air dryer relief valve activated about 4 times during field response actions. Faint "rotten-egg" odor was [perceived] briefly every time the air dryer relief valve activated. A puddle was present under air compressor, but was not related to the described odor.'

(2) Comments by the responding POE Shift IHT- "There was no initial odor ... Checked the flammables cabinet... Shortly after that the pressure relief valve on the air dryer popped off and we could smell a sulfur smell immediately."

(3) A Direct Reading Instrument (DRI) equipped with sensors to monitor hydrogen sulfide, ammonia, and a volatile organic compound (VOC) 10.6 eV photoionization detector was utilized during the TFC-OPS-OPER-C-67 response. Peak readings were at or below background levels during the response.

Location	Ammonia	volatile organic compound	Hydrogen Sulfide
Glycol container	< 1 ppm	0.500 ppm	< 0.1 ppm
Flammable cabinet	< 1 ppm	0.420 ppm	< 0.1 ppm
Air dryer	< 1 ppm	0.010 ppm	< 0.1 ppm
Compressor	< 1 ppm	< 0.010 ppm	< 0.1 ppm

(4) Hydrogen sulfide gas has an offensive distinct rotten egg odor that is detectable at very low concentrations. The lower range of odor values for hydrogen sulfide as 40 ppt (or 0.04 ppb or 0.00004 ppm). While odors may be readily perceived, concentrations are still well below levels of worker exposure concern. Hydrogen sulfide, ammonia, and VOC gas production rate is a function of bacteria/organics concentrations, temperature, and dissolved oxygen. The limiting factor is relatively low bacterial levels associated with stagnant water. The resolution of DRI equipped with hydrogen sulfide (0.1 ppm) and ammonia (1 ppm) sensors are comparatively inadequate as a detection tool at the concentrations perceived by the human olfactory sense. While the resolution of the DRI equipped with these sensors are insufficient to detect concentrations at the lower range of odor threshold values, they are sufficient to detect hydrogen sulfide and ammonia at concentrations that approach their established occupational exposure limits (OELs).

DRI monitoring performed during response actions did not indicate further action was necessary to protect worker safety and health. As a result, the area was released from restricted access and work was allowed to continue. Odor descriptors provided by Affected Workers are consistent with stagnant water associated with the 242A Evaporator Room's KAESER air compressor and is an anticipated occurrence in the 242A AMU room.

Washington River Protection Solutions
EVENT SUMMARY (Continued)

Project: Production Operations Date: May 31, 2023

Area/Building/Location: 242-A/AMU Approximate Time of Event: 0830 hours

AR Number: WRPS-AR-2023-1663 Responsible Manager: [REDACTED]

EIR Number: EIR-2023-037 Event Investigator: [REDACTED]

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

N/A

Lessons Learned or Information That the Work Force Needs Immediately:

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

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

Basis for Determination:

This event does not require continuation of the event investigation process under TFC-OPS-OPER-C-14, "Event Investigation Process". The facts, findings, and comprehensive account captured under this Event Summary and the Industrial Hygiene Event Investigation Report, IHIR-00069 "TFC-OPS-OPER-C-67 Response 242A Evaporator AMU" form the basis that further investigation will provide no additional information or operational benefit.

Responsible Manager:

[REDACTED] [REDACTED] [REDACTED]
Print First and Last Name Signature / Date

CAS Manager:

[REDACTED] [REDACTED] [REDACTED]
Print First and Last Name Signature / Date

Washington River Protection Solutions
INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT

Event Title: <p style="text-align: center;">TFC-OPS-OPER-C-67 Response 242A Evaporator AMU</p>	PER Number: <p style="text-align: center;">N/A</p>
IHIR Number: <p style="text-align: center;">IHIR-00069</p>	

Date: 05/31/2023	Time: 0825	Location: 242A Evaporator AMU Room
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Event Summary and Timeline:

Event Summary:
 At approximately 0830 on 05/31/2023 two (2) Hanford Mission Integration Solutions (HMIS) Riggers encountered a stronger than normal "rotten egg" odor inside the 242A AMU Room near the compressor. Affected Workers were dressing out to make entry when they encountered the odor. Affected Workers indicated possible source was the air dryer for the compressor. No symptoms were reported, and both declined precautionary medical evaluation. Per HMIS procedure, Affected Workers were sent for precautionary medical evaluation.

Field Response Timeline:

- 0830 Central Shift Manager (CSM) notified of stronger than normal odors
- 0834 CSM notifies Production Operations-East (POE) Industrial Hygienist (IH)-1 of stronger than normal odors and TFC-OPS-OPER-C-67 response
- 0835 POE IH-1 notifies POE Shift Industrial Hygiene Technician (IHT) Supervisor and Level 3 POE Safety & Health (S&H) Manager of stronger than normal odors and TFC-OPS-OPER-C-67 response
- 0837 POE IH-1 notifies additional POE IHTs of stronger than normal odors and TFC-OPS-OPER-C-67 response
 - POE Shift IHT in route to Central Shift Office (CSO)
- 0841 Shift Office Event Notification (SOEN): "Initiating OPS-OPER-C-67 for odors inside 242-A AMU. Personnel stay clear of AMU room. CSM"
- 0842 POE IH-2 arrives at CSO
- 0842 POE Shift IHT and POE Shift IHT Supervisor arrive at CSO
- 0843 CSM contacts the 242A Evaporator Area Dayshift Manager (ADM) for additional information on the stronger than normal odors
 - Two HMIS Riggers inside the 242A Evaporator AMU Room encountered the odor
 - Affected Workers' Odor Descriptor: "Rotten egg"
 - Both Affected Workers declined precautionary medical surveillance
 - Odor/Vapor Response Cards are in process of being populated
 - 242A Evaporator ADM will return completed Odor/Vapor Response Cards to CSO
 - 242A Evaporator AMU Room has been posted Restricted Access
- 0845 POE IH-2 requests POE Shift IHT to have an additional Direct Reading Instrumentation (DRI) equipped with a Hydrogen Sulfide sensor
 - POE Shift IHT departs CSO to acquire instrumentation
- 0846 POE IH-3 arrives at CSO
- 0847 POE IH-3 contacts Hanford Meteorological Station to obtain weather information for Station #6 at 0830 on 05/31/2023:
 - Temperature: 63°F
 - Relative Humidity: 32%
 - Wind Speed: 15 mph with gusts up to 23 mph
 - Wind Direction: from West Northwest
 - Barometric Pressure: 29.20 inches of mercury and rising
- 0848 POE IHTs check Data Fusion Advisory System (DFAS), powered Smart Site™, for current weather details:
 - Wind Speed: 15.9 mph
 - Wind Direction: 312° (out of Northwest)
 - Mixing Height: 900 feet above grade
 - Stability Class: D (neutral conditions)
- 0850 POE Shift IHT Supervisor notifies POE Level 3 S&H Manager Affected Workers were HMIS employees

Field Response Timeline continued on next page.

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

Event Summary and Timeline:

Field Response Timeline (continued):

- 0850 CSM contacts the 242A Evaporator Area Dayshift Manager (ADM) for additional information on the stronger than normal odors
- Affected Workers were dressing out to make entry to perform work
 - Affected Workers' Likely Source: "Air-Dryer when pop-off valve released"
- 0854 POE IHs check Vapor Monitoring Detection System (VMDS) for current exhauster ammonia readings:
- POR518 (241-A): 2.581 ppm
 - POR519 (241-A): 0.890 ppm
 - 241-AN: N/A
 - 241-AP: N/A
 - 241-AW: 8.107 ppm
 - POR126 (241-AX): N/A
 - POR127 (241-AX): 0.429 ppm
 - 702AZ (241-AY/AZ): N/A
- All available readings << High Alarm set point
- 0907 POE Shift IHT Supervisor updates Level 1 Environmental, Safety, Health, & Quality (ESH&Q) Manager, Level 2 IH Manager, and POE Level 3 S&H Manager on stronger than normal odors and TFC-OPS-OPER-C-67 response
- Two HMIS workers (riggers) encountered a "rotten egg" odor when dressing out in AMU Room
 - Affected Workers indicated odor was coming from when the air dryer supporting the compressor released pressure
 - No symptoms experienced and both Affected Workers declined precautionary medical surveillance
- 0914 CSM and POE IH-2 contact 242A Evaporator ADM to inquire about the AMU Room air dryer and compressor system
- CSM/POE IH-2 → 242A Evaporator ADM: Source of air for the air dryer?
 - 242A Evaporator ADM → CSM/POE IH-2: Compressor on other side of the AMU Room
 - CSM/POE IH-2 → 242A Evaporator ADM: Air source contained within the AMU Room?
 - 242A Evaporator ADM → CSM/POE IH-2: Yes
- 0915 POE IH-1 arrives at Central Shift Office
- 0918 CSM attempts to contact Department of Energy (DOE) Facility Representative (Fac. Rep.) to notify about the stronger than normal odors and TFC-OPS-OPER-C-67 response
- CSM left message
 - CSM will follow-up with DOE Fac. Rep.
- 0922 CSM and POE IH-2 sign TFC-OPS-OPER-C-67 Attachment A Sheet 1 of 2, Response Plan
- 0924 CSM contacts Inter-Contractor Administrative Interface Agreement (AIA) Representative with an update on TFC-OPS-OPER-C-67
- Per HMIS procedure, Affected Workers will be sent for precautionary medical evaluation
- 0925 242A Evaporator ADM arrives at CSO with Affected Workers' Odor/Vapor Response Cards for 242A (A-6006-975)
- 0925 POE IHs review Affected Workers' Odor/Vapor Response Cards for 242A
- 0927 POE Shift IHT Supervisor updates Level 1 ESH&Q Manager, Level 2 IH Manager, and POE Level 3 S&H Manager
- HMIS AIA Representative directed the Affected Workers to go to the On-Site Medical Provider
- 0930 242A Evaporator ADM shows POE IHs location of the 242A Evaporator AMU Room air dryer (odor location) and compressor on the 242A Evaporator 3D Virtual Tour
- 0930 POE Shift IHT Supervisor contacts POE Shift IHT for status update
- POE Shift IHT in route to CSO with instrumentation
- 0934 POE Shift IHT arrives at CSO

Field Response Timeline continued on next page.

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INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT(Continued)

Field Response Timeline (continued):

- 0935 POE IH-2 provides POE Shift IHT briefing for response:
- Showed location of the 242A Evaporator AMU Room air dryer (odor location) and compressor on the 242A Evaporator 3D Virtual Tour
 - Monitor per IHSP-POE-MULTI-TFCOPSOPERC67:
 - DRI equipped with the following sensors:
 - Hydrogen Sulfide
 - Ammonia
 - Volatile Organic Compound (VOC) 10.6 eV photoionization detector (PID)
 - Survey around the air dryer
 - Survey around the compressor
 - General area inside 242A AMU Room
 - Respiratory Protection Equipment not required, Voluntary Use
 - Safety glasses
- 0937 Responding POE IH (POE IH-3) and POE Shift IHT depart CSO to initiate response actions
- 0943 Responding POE IH (POE IH-3) and POE Shift IHT check in with the 242A Evaporator Control Room
- 0947 Responding POE IH (POE IH-3) updates POE IHs, POE Level 3 S&H Manager, and POE Shift IHT Supervisor on response:
- Odor detectable by both responding personnel during release, at the air dryer
 - Hydrogen Sulfide- Less than detectable (< 0.1 ppm)
 - Ammonia- Less than detectable (< 1 ppm)
 - VOCs- Less than detectable (< 0.010 ppm)
- 0947 Responding POE IH (POE IH-3) updates POE IHs, POE Level 3 S&H Manager, and POE Shift IHT Supervisor on response:
- Hydrogen Sulfide- Less than detectable (< 0.1 ppm)
 - Ammonia- Less than detectable (< 1 ppm)
 - VOCs- 0.500 ppm at glycol container
 - VOCs- 0.240 ppm at flam cabinet
- 0959 Responding POE IH (POE IH-3) updates POE IHs, POE Level 3 S&H Manager, and POE Shift IHT Supervisor on response:
- POE Shift IHT in route to perform DRI post-use function test
- 1003 CSM contacts Performance Assurance (PA) regarding stronger than normal odors and TFC-OPS-OPER-C-67 response
- PA Point-of-Contact assigned for Event Investigation
- 1015 POE Shift IHT Supervisor notifies POE IHs and POE Level 3 S&H Manager that DRI have passed the post-use function test
- 1025 CSM notifies DOE Fac. Rep. of stronger than normal odors and TFC-OPS-OPER-C-67 response
- 1032 CSM contacts 242A Evaporator ADM
- Restoring access to 242A Evaporator AMU Room
- 1032 SOEN: "OPER-C-67 response at 242-A AMU is complete. IHT readings are at or below background levels. Access to the 242-A AMU is restored. CSM"
- 1039 CSM and POE IH-1 sign TFC-OPS-OPER-C-67 Attachment A Sheet 2 of 2, Response Plan

Field Response Timeline Acronyms:

ADM	Area Dayshift Manager	IH	Industrial Hygienist
AIA	Inter-Contractor Administrative Interface Agreement	IHT	Industrial Hygiene Technician
CSM	Central Shift Manager	mph	miles per hour
CSO	Central Shift Office	PA	Performance Assurance
DFAS	Data Fusion Advisorsy System	PID	photoionization detector
DOE	Department of Energy	POE	Production Operations-East
DRI	Direct Reading Instrumentation	ppm	parts per million
ESH&Q	Environmental, Safety, Health, & Quality	S&H	Safety & Health
eV	electron-volt	SOEN	Shift Office Event Notification
HMIS	Hanford Mission Integration Solutions	VMDS	Vapor Monitoring Detection System

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INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT(Continued)

Sampling/Monitoring Results:

DRI Monitoring Results:

- Monitoring performed in and around Affected Area
 - o Comments by Responding POE IH- 'Faint "rotten-egg odor was [perceived] upon arrival, but became [unnoticeable] quickly. Air dryer relief valve activated about 4 times during field response actions. Faint "rotten-egg" odor was [perceived] briefly every time the air dryer relief valve activated. Puddle was present under air compressor, but not related to described odor.'
 - o Comments by Responding POE Shift IHT- "IHT monitored their way into the room to the location of the [Affected Workers' like] source of the odors. There was no initial odor ... Checked the flammables cabinet... Shortly after that the pressure relief valve on the air dryer popped off and we could smell a sulfur smell immediately. [All readings at that time were below the detection limit]. We then moved to the compressor... then checked a glycol container in the corner of the room... We also checked a couple of drains that were located in the room..."
- Peak readings during response at or below background.

Location	Ammonia	VOCs	Hydrogen Sulfide
Glycol container	< 1 ppm	0.500 ppm	< 0.1 ppm
Flam cabinet	< 1 ppm	0.420 ppm	< 0.1 ppm
Air dryer	< 1 ppm	0.010 ppm	< 0.1 ppm
Compressor	< 1 ppm	< 0.010 ppm	< 0.1 ppm

Refer to IHIR-00069 Attachment A for SmartSite™ Summary, Response Map, and Response Pictures.

SWIHD References:

- Event Response Site Wide Industrial Hygiene Database Direct Reading Instrumentation (DRI) Survey:
- #23-03302 "TFC-OPS-OPER-C-67 Response 242A AMU"

Additional Information:

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

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

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

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.

Additional Information continued on next page.

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INDUSTRIAL HYGIENE EVENT INVESTIGATION REPORT(Continued)

Additional Information:

Review of the DFAS application, powered by SmartSite™, Weather Details dashboard for the approximate time of the Event:

05/31/2023 @ 0830 (weather data for approximate time of Initiating Event):

- Wind Speed: 15.9 mph
- Wind Direction: 311.90° (out of Northwest)
- Mixing Height: 900 feet above grade
- Stability Class: D (neutral 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:

05/31/2023 @ 0848 (current weather data for Response actions):

- Wind Speed: 15.9 mph
- Wind Direction: 312° (out of Northwest)
- Mixing Height: 900 feet above grade
- Stability Class: D (neutral conditions)

Meteorological information from the Hanford Weather Station for Station #6 on 05/31/2023 @ 0830:

- Temperature: 63°F
- Relative Humidity: 32%
- Wind Speed: 15 mph with gusts up to 23 mph
- Wind Direction: from West Northwest
- Barometric Pressure: 29.20 inches of mercury and rising

Vapor Monitoring Detection System (VMDS) exhauster ammonia readings on 05/11/2023 @ 1003:

- POR518 (241-A): 2.581 ppm
- POR519 (241-A): 0.890 ppm
- 241-AN: N/A
- 241-AP: N/A
- 241-AW: 8.107 ppm
- POR126 (241-AX): N/A
- POR127 (241-AX): 0.429 ppm
- 702AZ (241-AY/AZ): N/A

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

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

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

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

Additional Information continued on next page.

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

Additional Information (continued):

Vapor Monitoring Detection System (VMDS) 05/24/2023 @ 1542 to 05/31/2023 @ 1542:

Tank Farm	Exhauster	Minimum*	Maximum*
241-A	POR518/POR519	0.842 ppm	11.050 ppm
241-AN	Primary	-2.051 ppm	55.790 ppm
241-AW	Primary	0 ppm	11.767 ppm
241-AX	POR127	12.402 ppm	195.408 ppm
241-AY/AZ	702AZ	--	--

* Vapor Monitoring Detection System (VMDS) Alternative Real Time Monitoring performed 05/23/2023 to 05/30/2023 for 241-AP, 241-AW, 241-AX (POR126), and 241-AY/AZ (702AZ).

The 241-AP Primary Exhauster is not currently connected to Vapor Monitoring Detection System (VMDS). Readings are acquired in accordance with TF-OPS-IHT-037 when Stack Monitoring for Ammonia via the Vapor Monitoring Detection System (VMDS) is unavailable. Stack readings are required once per calendar day in accordance with ARP-T-041-00002.

Vapor Monitoring Detection System (VMDS) Alternate Monitoring 05/03/2023 to 05/10/2023:

Tank Farm	Exhauster	Minimum	Maximum
241-AP	Primary	0 ppm	4 ppm
241-AW	Primary	0 ppm	4 ppm
241-AX	POR126	0 ppm	1 ppm
241-AY/AZ	702AZ	4 ppm	7 ppm

Based on the odor descriptor "rotten eggs", monitoring for hydrogen sulfide vapors was performed:

- "Rotten Eggs": The American Industrial Hygiene Association (AIHA) Odor Threshold for Chemicals with Established Health Standards, 2nd Edition, lists hydrogen sulfide with this odor character. Therefore, direct reading instrument equipped with a hydrogen sulfide sensor was selected.
- Refer to TOC-IH-58956 for more detail on the monitoring strategy for response to odors.

RPP-RPT-60381, Facility Design Description for 242-A Evaporator Systems and Buildings-

The function of the Aqueous Makeup Unit (AMU) room is receipt (or makeup), storage, and transfer of anti-foam and decontamination solutions. It also serves as an operating area for the bridge crane. The principal systems and components in the AMU room include the Compressed Air System, the exhaust fan (K2-5-2), Fire Protection System components, Electrical Distribution System components, and three chemical storage tanks.

The AMU room is 27' by 24', and 22' from floor to ceiling. The AMU room shares a common wall with the loading room, loadout and hot equipment storage room, pump room, and the associated crane gallery. That portion of the wall common with the pump room and loadout and hot equipment storage room is 1'10"-thick concrete. All other walls are 1'-thick concrete.

The 242A Evaporator's K2 Ventilation System provides heating, ventilation, and air conditioning (HVAC) to the 242A Evaporator Building Office Areas, AMU Room, HVAC Room, Change Rooms, Cleaned and Soiled Clothes Storage Room, and building corridors. The supply fan (K2-5-1) supplies a maximum of 13,010 CFM of outside air. Additional air is recirculated from the HVAC room. Air is exhausted directly to the atmosphere via exhaust fans, power wall ventilators, and gravity dampers.

Contaminated water is collected in the 242A Building at various locations within the facility, including the AMU Room floor drains. The collected water gravity drains from the AMU Room to the Condenser Room. From the Condenser Room, the collected water gravity drains to the evaporator feed tank (TK-241-AW-102) via three penetrations in the 242A Building for the Evaporator Drain System. The three drain penetrations are double-contained pipe.

Additional Information continued on next page.

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

Additional Information (continued):

The 242A Evaporator AMU Room KAESER Air Compressors-

Affected Workers' likely source was the "Air-Dryer [DR-E-1] when pop-off valve released". The air-dryer is part of the compressed air supply system in the 242A Evaporator AMU Room, which consists of two KAESER rotary screw air compressor units (CP-E-1 and CP-E-2). The units are from the product line ASD 30T, with the specific model number ABT 57. These units are set to provide a nominal 100 SCFM at 100 psig. The compressor units draw a maximum of 60 amps from the electrical supply system and discharge into the compressed air system receiver (R-E-1), which has a relief valve set at a pressure of 125 psig (WRPS Engineering, 2019).

The KAESER KAD115-C Air Dryer System consists of a regenerative desiccant dryer (DR-E-1) with a dry air receiver (ECN-715202, RPP-RPT-62735). The air dryer (DR-E-1) is a dual tank air dryer that dries the air in one desiccant tank by adsorbing moisture on the desiccant, while the other tank's desiccant is regenerating utilizing purge air to evaporate the water on the desiccant. The Air Dryer System is set to cycle between these tanks every 10 minutes (KAESER Compressors®, n.d.; PMID-BAS-5606). The air dryer (DR-E-1) is a pressure-swing regenerative desiccant compressed air dryer, with a working pressure range of 60-150 psig (RPP-RPT-62735). The Air Dryer System supplies the 242-A building with pressurized dry air which is needed to support various Evaporator building equipment (PMID-BAS-5606).

The 242A Evaporator AMU Room KAESER Air Compressors References-

- Engineering Change Notice (ECN-715202), 242A Evaporator Air Dryer Replacement.
- H-2-99001, Piping & Instrumentation Diagram (P&ID) Process & Inst Air System.
- Kaeser Compressors® (n.d.). Regenerative Desiccant Dryers: KAD, KED, and KBD Series. Retrieved from <https://us.kaeser.com/download.ashx?id=tcm:46-37609>
- RPP-RPT-62735, Spare Parts List for the 242-A Air Dryer.
- PMID-BAS-5605, Technical Basis for the Preventative Maintenance of the Air Dryer System in 242-A.
- WRPS Engineering (2019). Engineering Evaluation of 242-A Air Compressor Automatically After Outage (Response to PER WRPS-PER-2019-0753).

Stagnant Water Odors-

Transient odors are associated with stagnant water and is an anticipated occurrence in the 242A AMU Room. Low levels of hydrogen sulfide gas (consistent with Affected Workers' odor description), ammonia, and various VOCs may be produced by the stagnant water when its within a confined area for an extended period. While odors may be readily perceived, concentrations are still well below levels of worker exposure concern due to a combination of factors:

1. Not a continuous emission source
2. Large air dilution coefficient inside the 242A Evaporator AMU Room (ventilated space)
3. Minimal source volume (i.e., Air Supply System has a finite volume upstream of, and inside, the Air Dryer)

The factors listed above indicate that gas dispersion is transient in nature and undergoes significant dilution. Low levels of hydrogen sulfide, ammonia, and VOCs may be produced when water, low airflow, and sulfur seeking bacteria stagnate within a confined area for an extended period. This is primarily the result of natural decay of organic material through biological decomposition. The biological decomposition process produces a great number of odors from decomposition of organic material into simpler intermediate chemical compounds which can be re-introduced into the environment in the form of solids (particulates), liquids (volatile organic compounds such as alcohols, organic acids), and gases (hydrogen sulfide, sulfur dioxide, ammonia, methane) (Silva, 2002; Texas A&M, 2009).

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

Additional Info. cont. on next page.

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

Additional Information (continued):

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

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

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

Stagnant Water Odor References-

- American Conference of Governmental Industrial Hygienists (2016). TLVs® and BEIs® Based on the Documentation of the Threshold Limit Values for Chemicals Substances and Physical Agents & Biological Exposure Indices. Cincinnati, OH: Signature Publications.
- American Industrial Hygiene Association (2013). Odor Thresholds for Chemicals with Established Health Standards, 2nd Edition.
- Silva, D.P. (2002). The chemical logic behind... Fermentation and Respiration. Retrieved from <https://aggie-horticulture.tamu.edu/earthkind/landscape/dont-bag-it/chapter-1-the-decomposition-process/>
- Texas A&M (2009). Earth-Kind Landscaping: Chapter 1, The Decomposition Process. Retrieved from <https://web.archive.org/web/20080917123419/http://www2.ufp.pt/~pedros/bq/respi.htm>

Additional Information Acronyms:

ACGIH	American Conference of Governmental Industrial Hygienist		
AIHA	American Industrial Hygiene Association	ppb	parts per billion
AMU	Aqueous Makeup Unit	ppm	parts per million
COPC	Chemical of Potential Concern	ppt	parts per trillion
CFM	cubic feet per minute	psig	pounds per square inch gauge
HVAC	Heating, Ventilation, and Air Conditioning	QRA	Quantitative Risk Assessment
IDLH	Immediately Dangerous to Life or Health	SCFM	standard cubic feet per minute
mph	miles per hour	STEL	Short-Term Exposure Limit
NIOSH	National Institute for Occupational Safety & Health	TLV	Threshold Limit Value
OEL	Occupational Exposure Limit	TWA	Time-Weighted Average
OSHA	Occupational Safety & Health Administration	VMDS	Vapor Monitoring Detection System
PEL	Permissible Exposure Limit	VOC	Volatile Organic Compound

The event response DRI results were less than detectable in the Affected Area for ammonia and hydrogen sulfide. The event response DRI results were at or below background for VOCs. These results along with the review of the atmospheric conditions (DFAS application, powered by SmartSite™, and those provided by On-Duty Forecaster) outside of Affected Area around the reported time of the event indicate the cause of the odor is unlikely to be from Tank Farm emissions. The Atmospheric Stability Class at 0830 was neutral conditions. The Atmospheric Mixing Height was 900 feet above grade.

Refer to IHIR-00069 Attachment A for SmartSite™ Summary, Response Map, and Response Pictures.

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

Recommendations/Conclusions:

Recommendations:

N/A

Conclusions:

Direct Reading Instrumentation monitoring performed during response actions did not indicate further action was necessary to protect worker safety and health. As a result the area was released from restricted access and work was allowed to continue. Odor descriptors provided by Affected Workers are consistent with stagnant water associated with the 242A Evaporator AMU Room's KAESER Air Compressors, and is an anticipated occurrence in the 242A AMU Room. The odor was also perceived by Responding Personnel, under the same conditions as the Affected Workers, when the Air-Dryer (DR-E-1) purge valve released. The odor may emanate from the purge valve, or from released air disturbing the water surface inside the drains located throughout the 242A Evaporator AMU Room. Although known nearby sources exist, monitoring performed to support response actions did not readily identify a source, as readings indicated that further response action was not necessary.

Other:

- No symptoms reported and both Affected Workers declined precautionary medical surveillance.
 - Per HMIS procedure, Affected Workers were sent for a precautionary medical surveillance.
- Event Investigation Report (EIR) #2023-037.

Industrial Hygienist:

Print First and Last Name

Signature / Date

Industrial Hygiene Level 2 Manager:

Print First and Last Name

Signature / Date

IHIR-00069 Attachment A: SmartSite™ Summary, Response Map, and Response Pictures



Figure 1. 200-East Area (with 241-AW, 241-AP, 241-AN, 241-AY/AZ, 241-AX, 241-A Farm projected plume models) at 0825 05/31/2023 from Data Fusion and Advisory System (DFAS) application, powered by SmartSite™

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

IHIR-00069 Attachment A: SmartSite™ Summary, Response Map, and Response Pictures

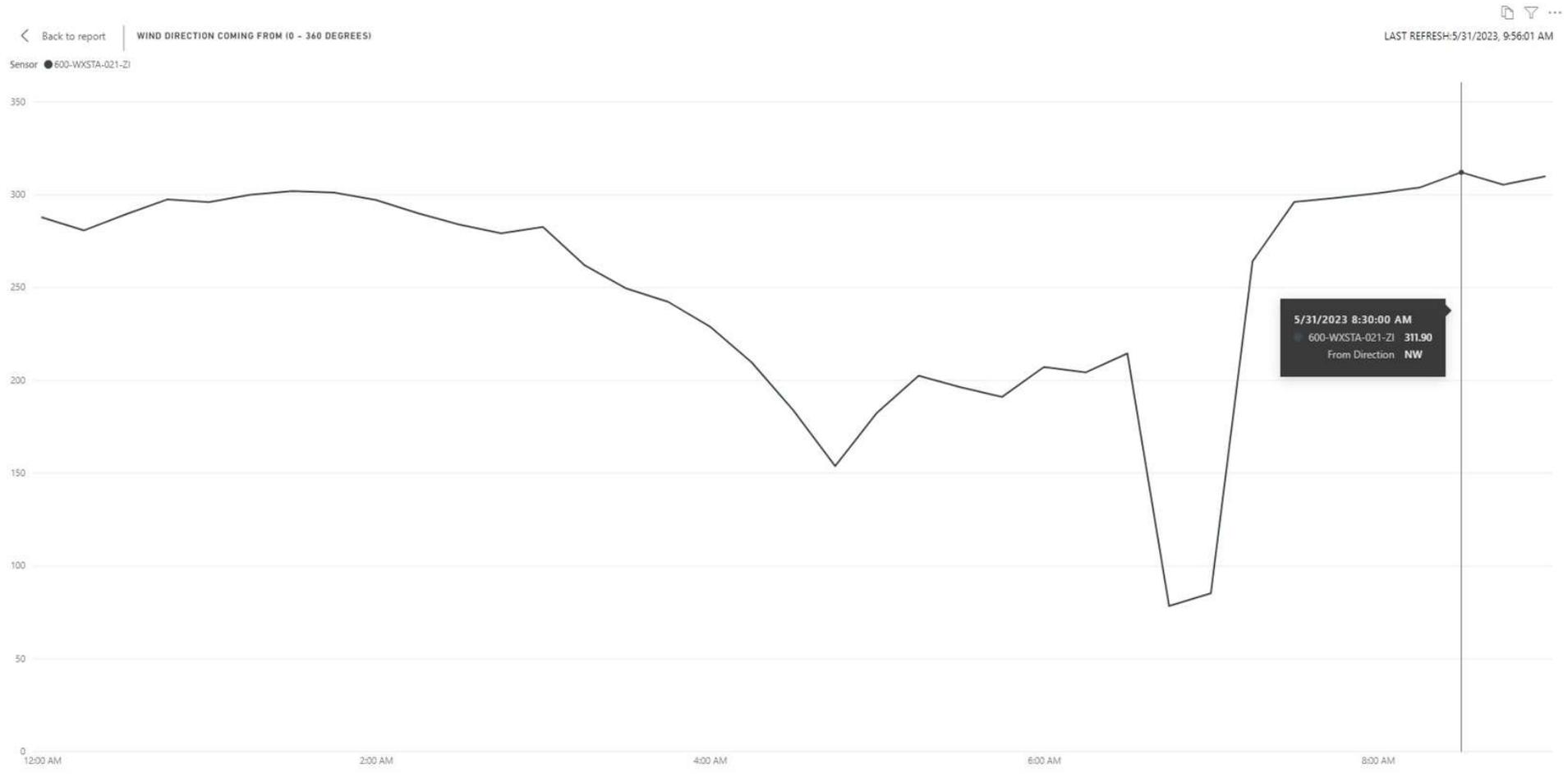


Figure 2. DFAS application, powered by SmartSite™ Weather Data (wind direction) from 0830 05/31/2023.

IHIR-00069 Attachment A: SmartSite™ Summary, Response Map, and Response Pictures



Figure 3. DFAS application, powered powered by SmartSite™ Weather Data (wind speed) from 0830 05/31/2023.

IHIR-00069 Attachment A: SmartSite™ Summary, Response Map, and Response Pictures

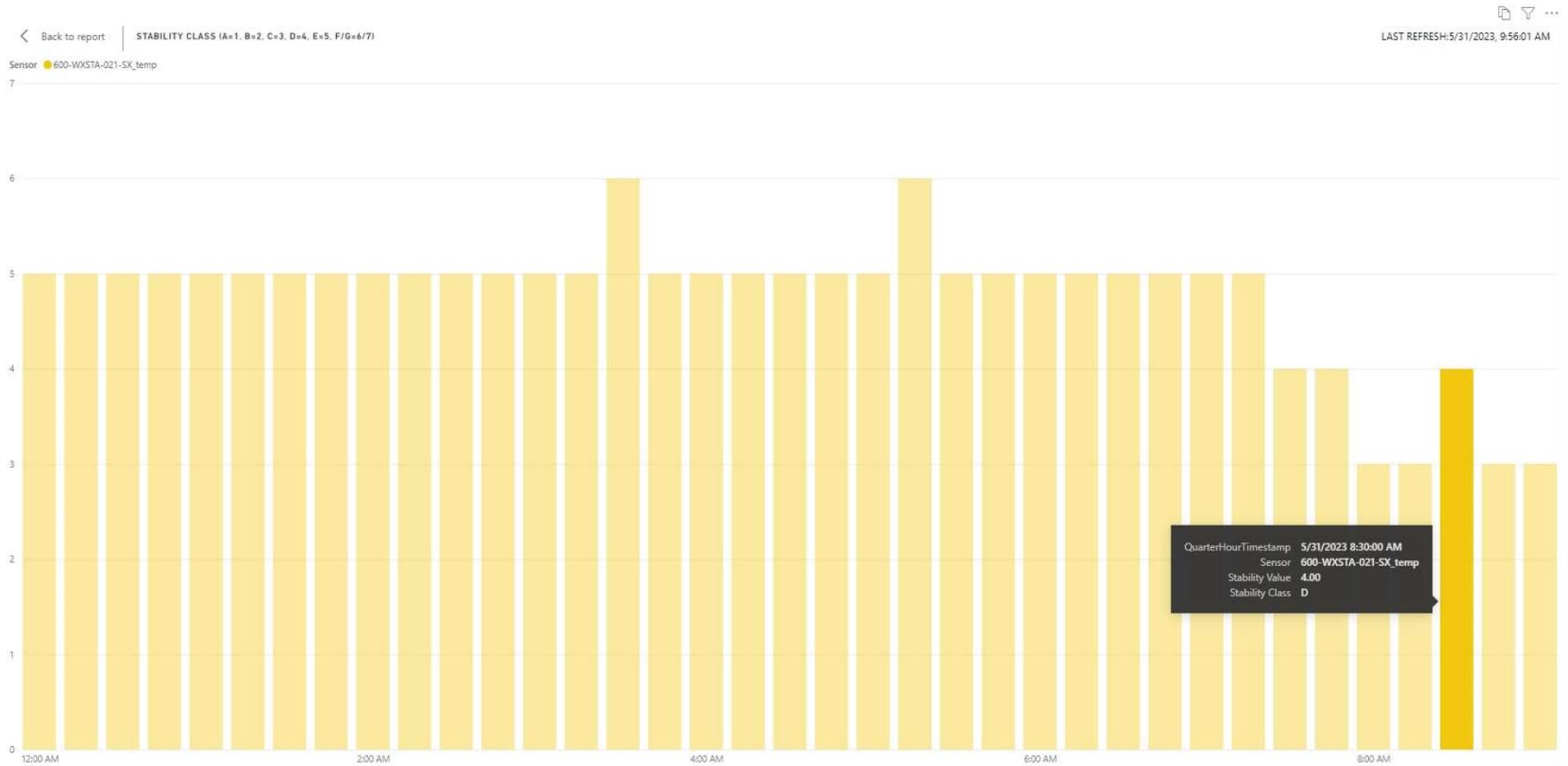


Figure 4. DFAS application, powered by SmartSite™ Weather Data (stability class) from 0830 05/31/2023.

IHIR-00069 Attachment A: SmartSite™ Summary, Response Map, and Response Pictures

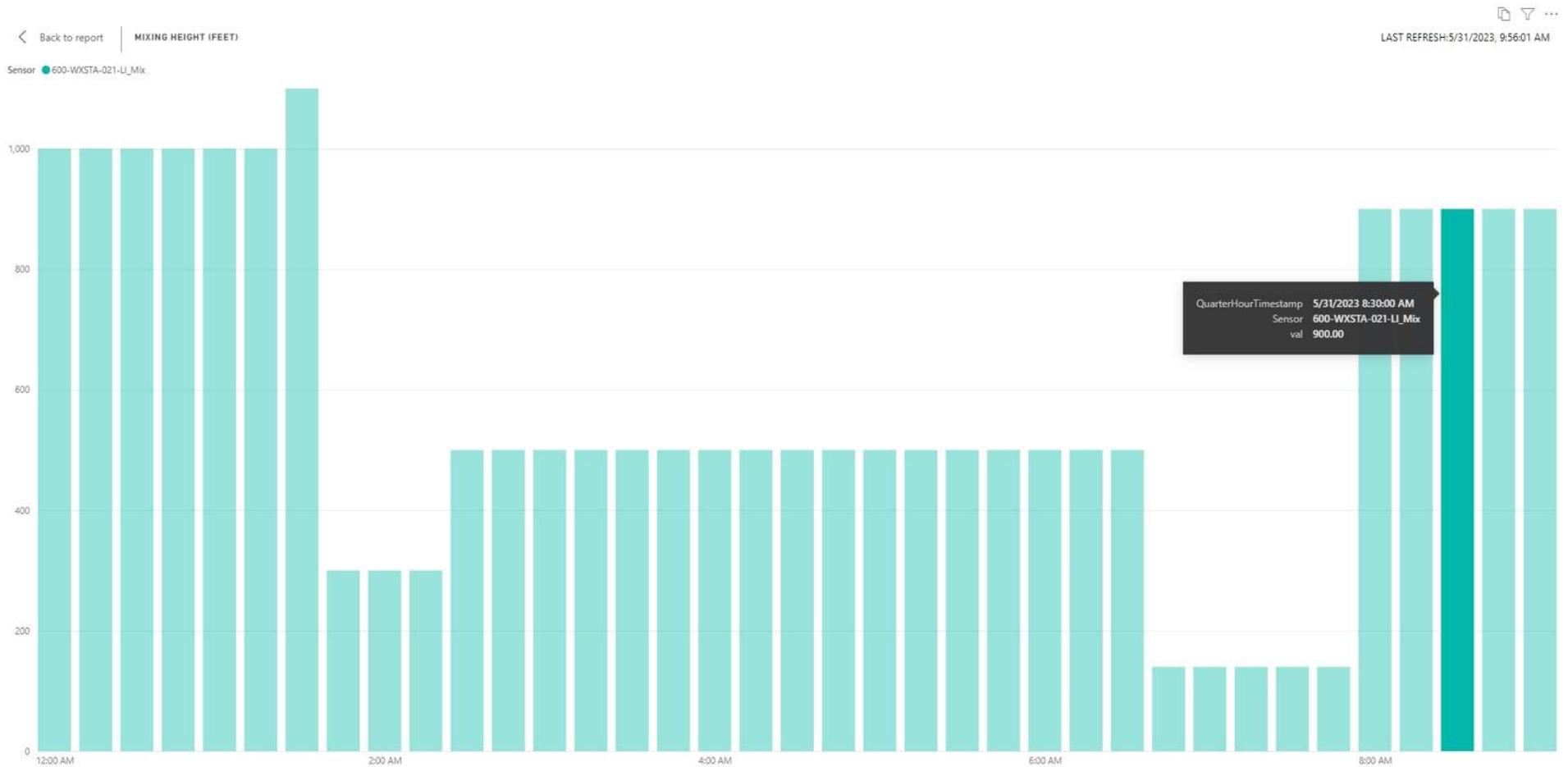


Figure 5. DFAS application, powered by SmartSite™ Weather Data (mixing height) from 0830 05/31/2023.

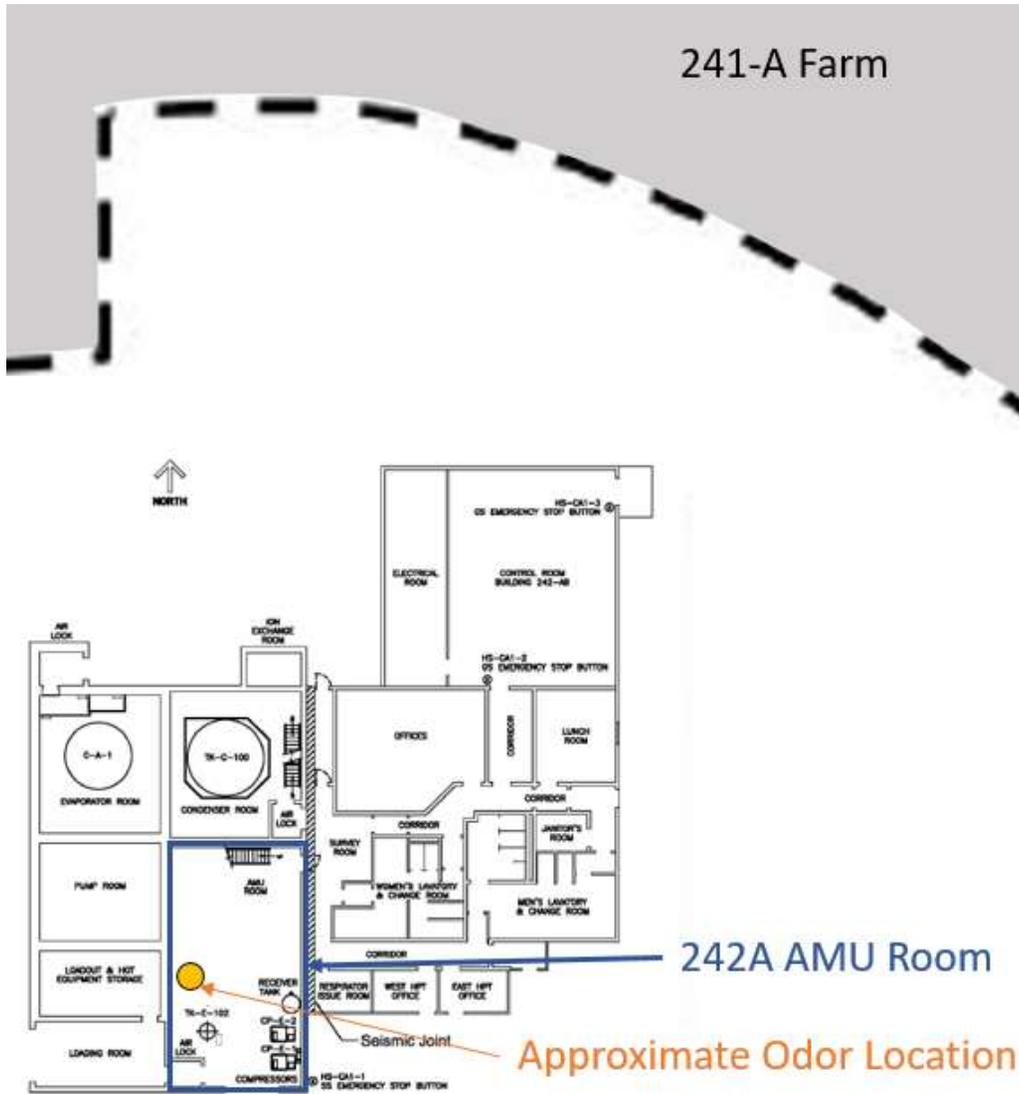


Figure 6. 242A 1st Floor Map

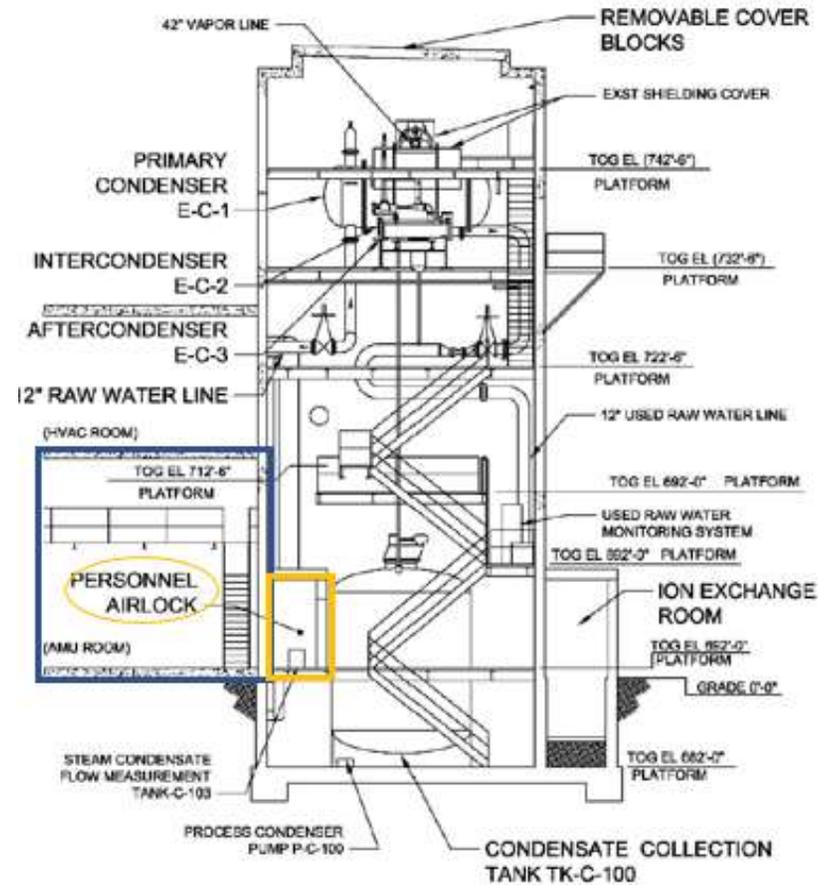


Figure 7. 242A Evaporator Facility Condenser Room (East Elevation).

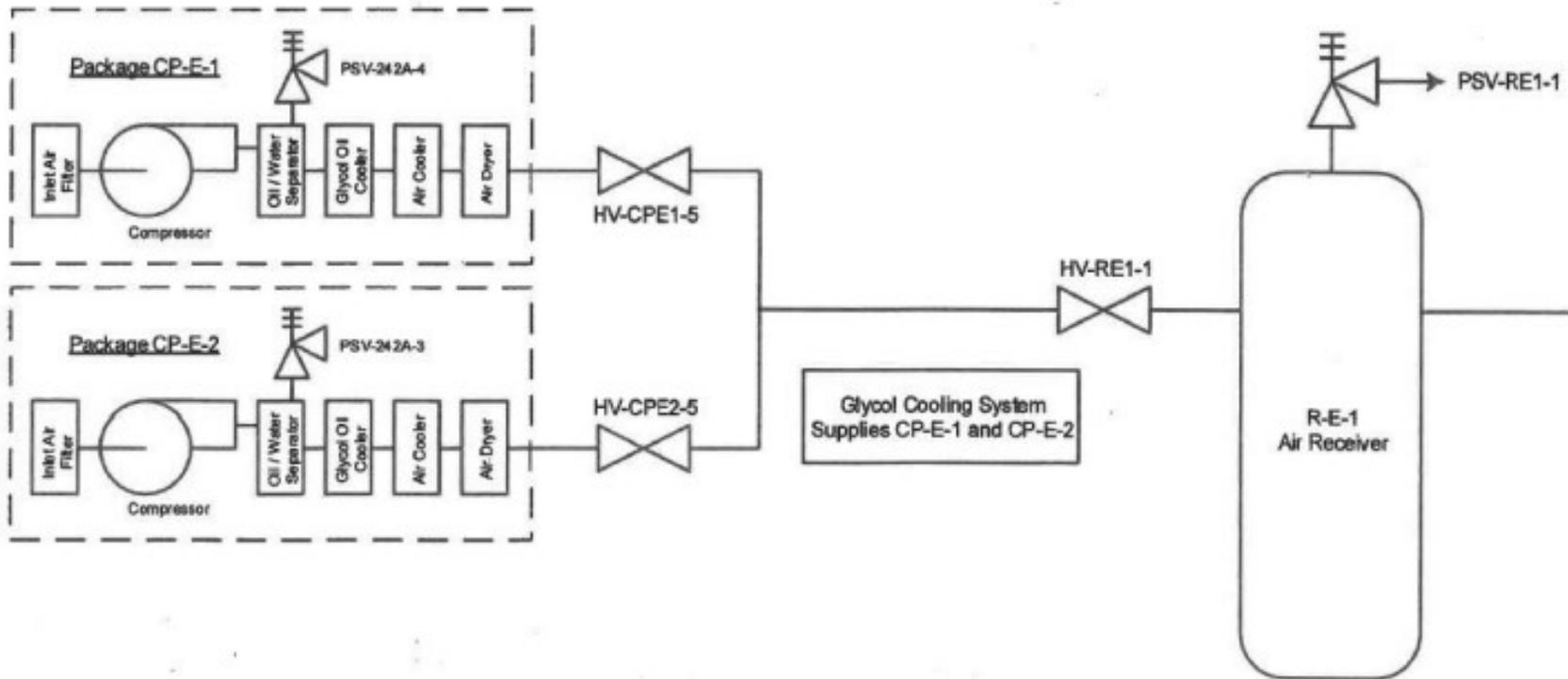


Figure 8. Simplified Schematic Showing the Air Compressors Connection to the Compressed Air System

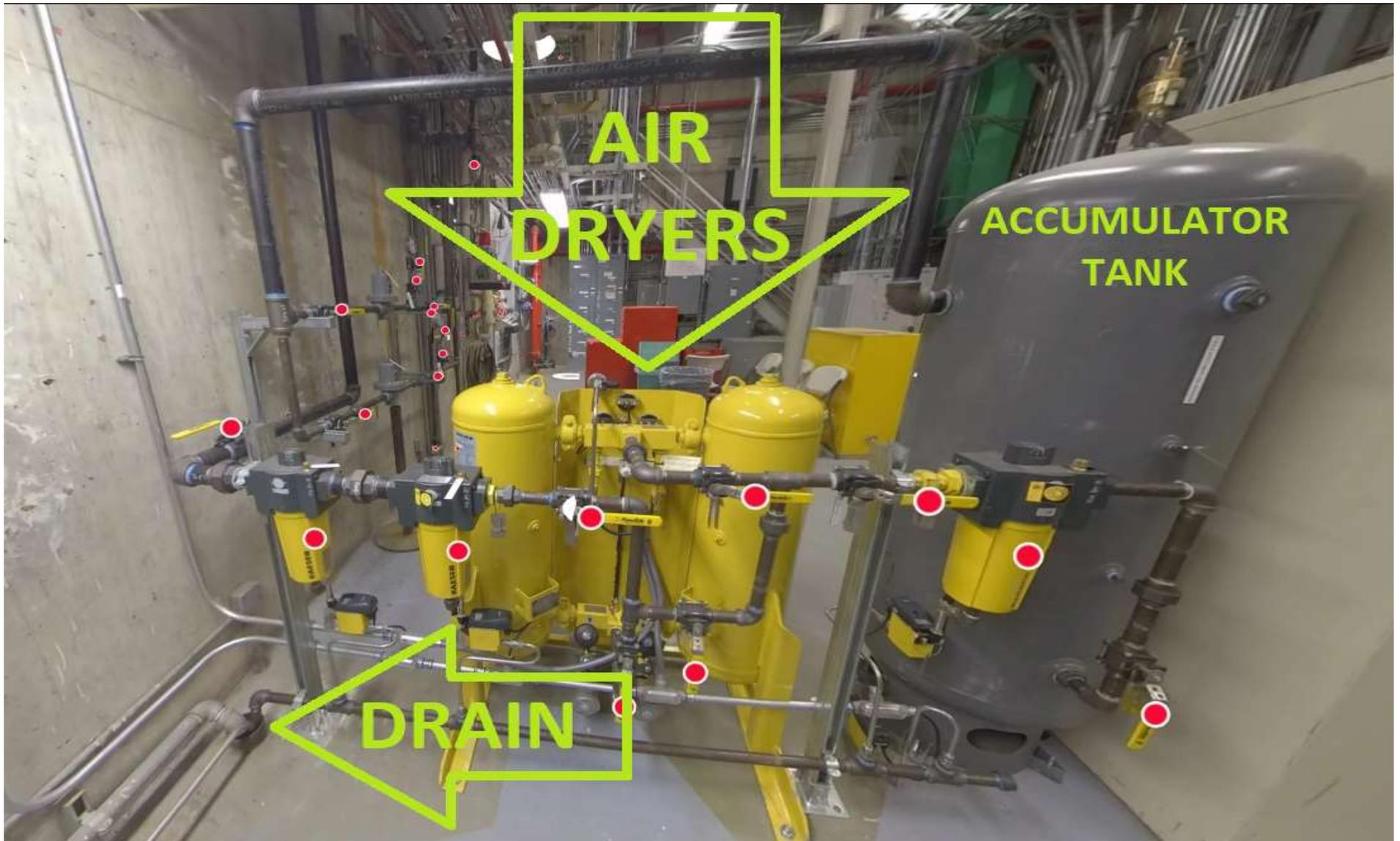
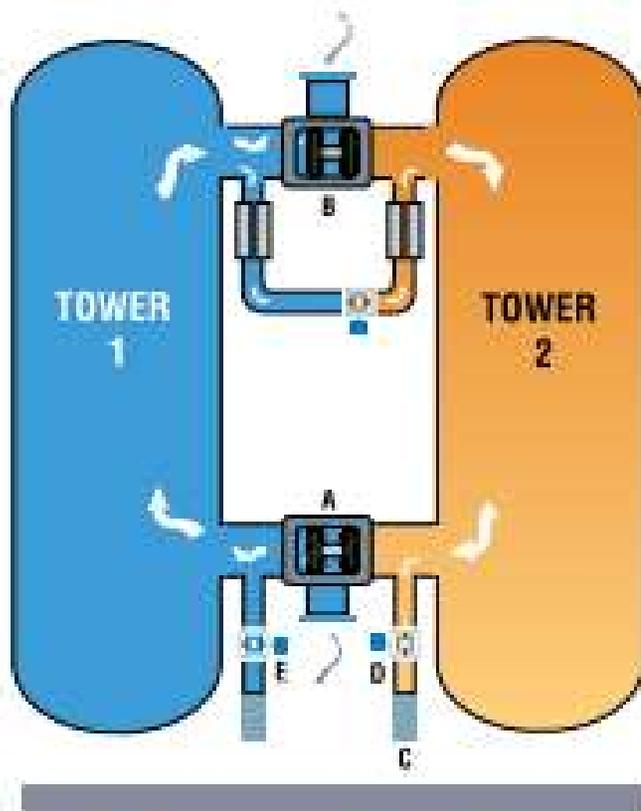


Figure 9. 242-A Service Air Dryer System Overview



- A Inlet valve
- B Outlet valve
- C Muffler
- D & E Purge valves

Figure 10. KAESER Compressors® Desiccant Dryer Diagram

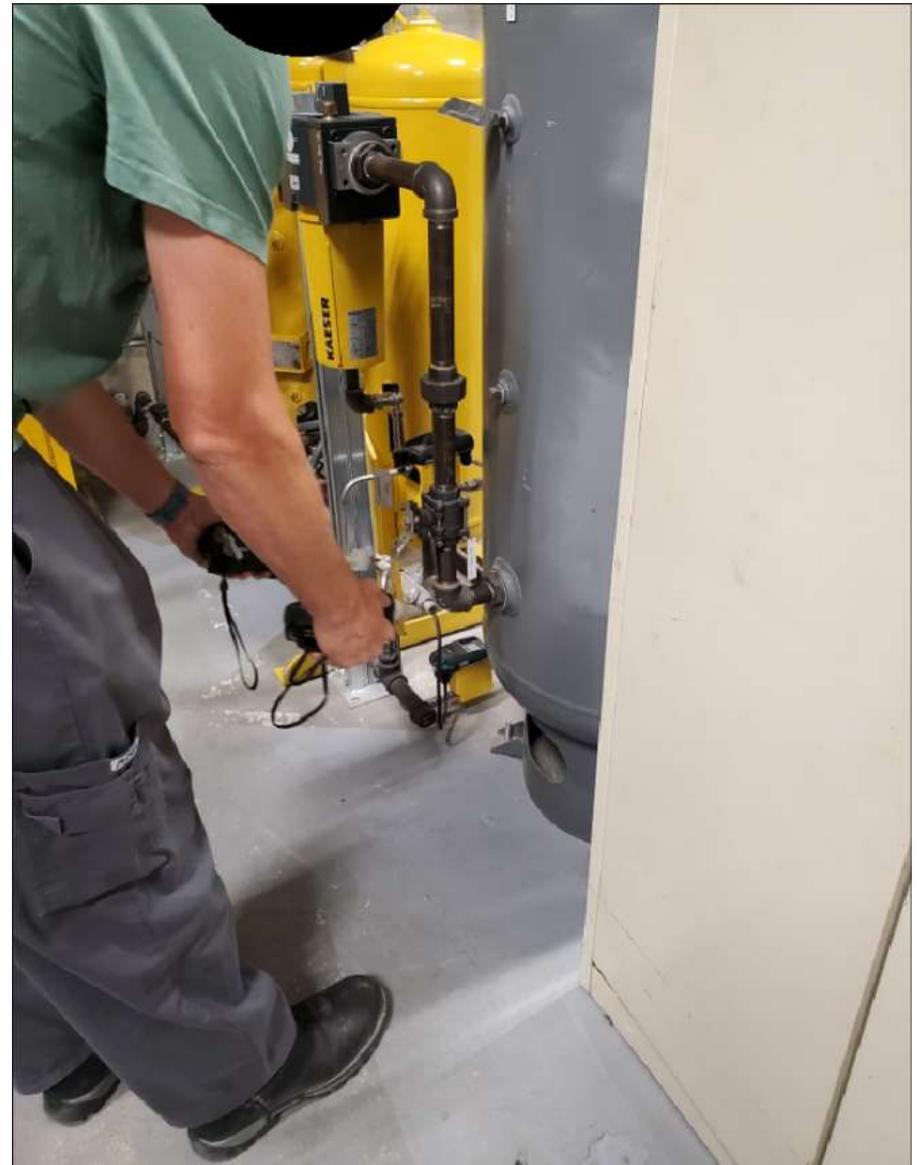


Figure 11. IHT Monitoring Air Dryer System Connections.



Figure 12. IHT Monitoring Air Dryer System Drain.

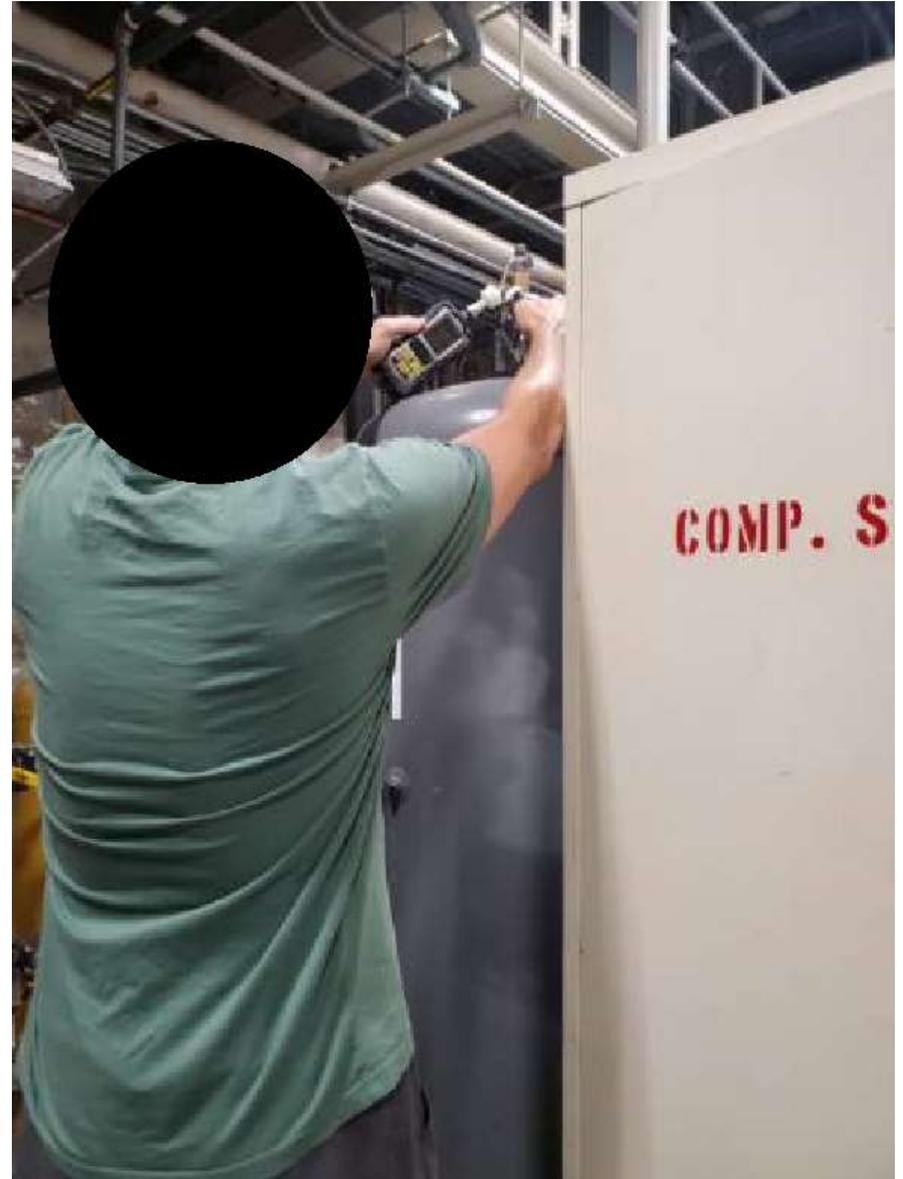


Figure 13. IHT Monitoring Accumulator Tank PRV.



Figure 14. IHT Monitoring Air Dryer Filter Connections.

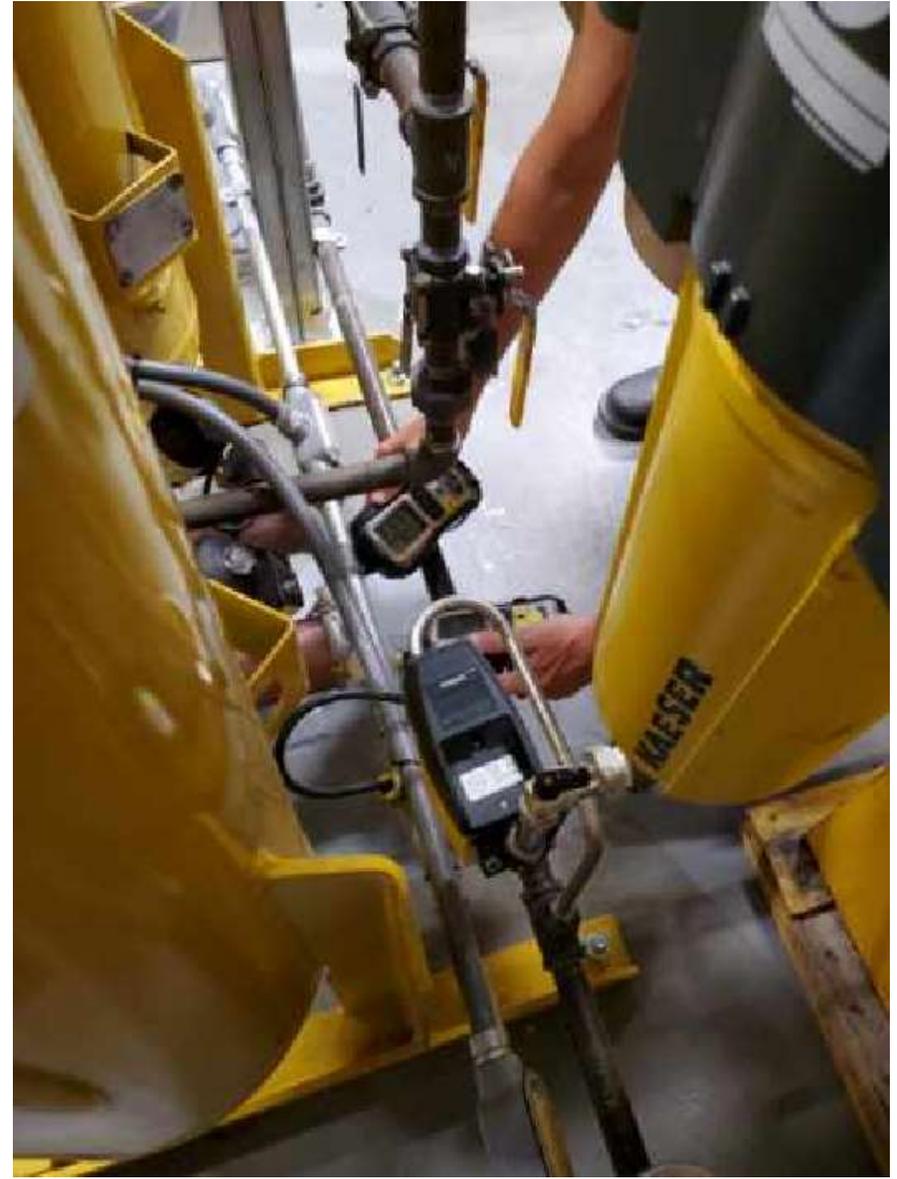


Figure 15. IHT Monitoring Air Dryer System Connections.



Figure 16. IHT Monitoring Air Dryer System Connections.

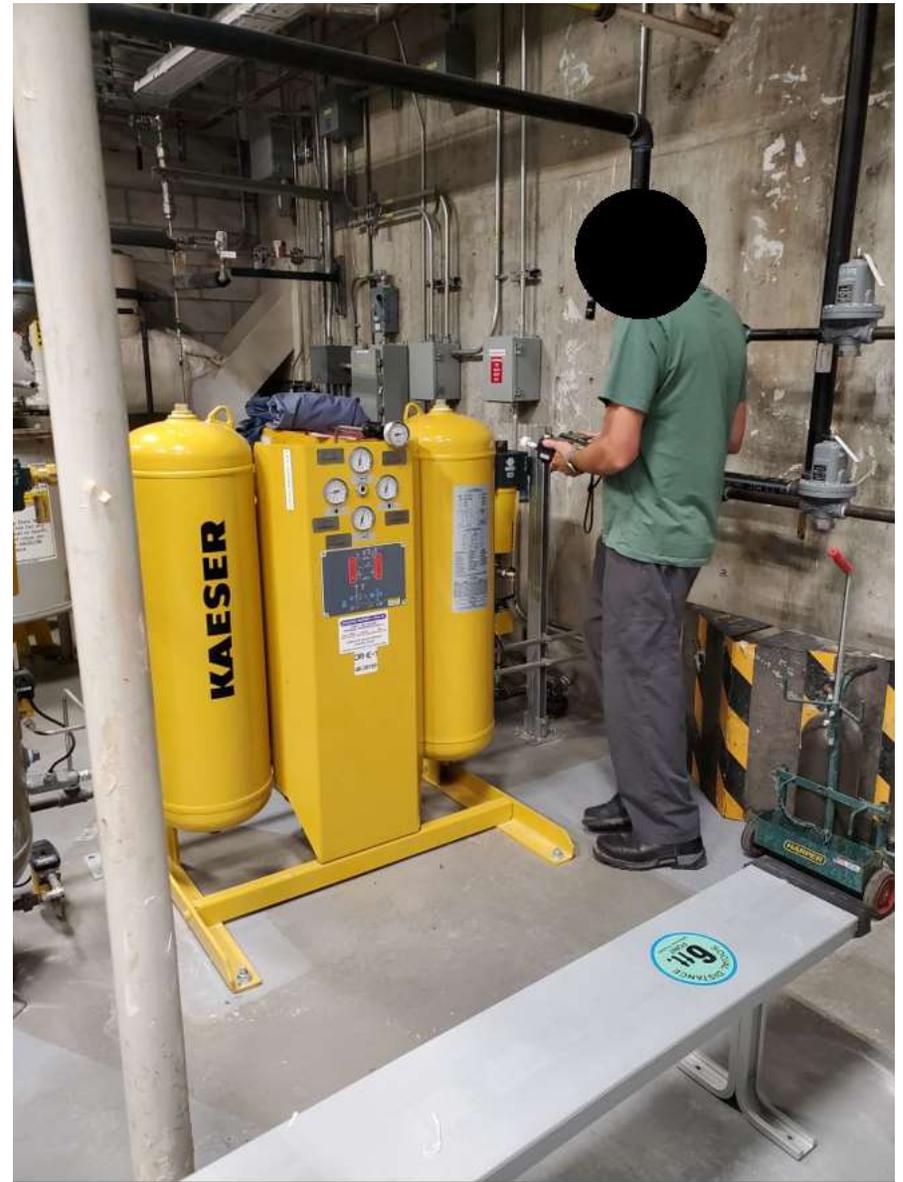


Figure 17. IHT Monitoring Air Dryer System Connections.



Figure 18. IHT Monitoring Air Compressor.



Figure 19. IHT Monitoring Air Compressor.



Figure 20. IHT Monitoring Air Compressor.

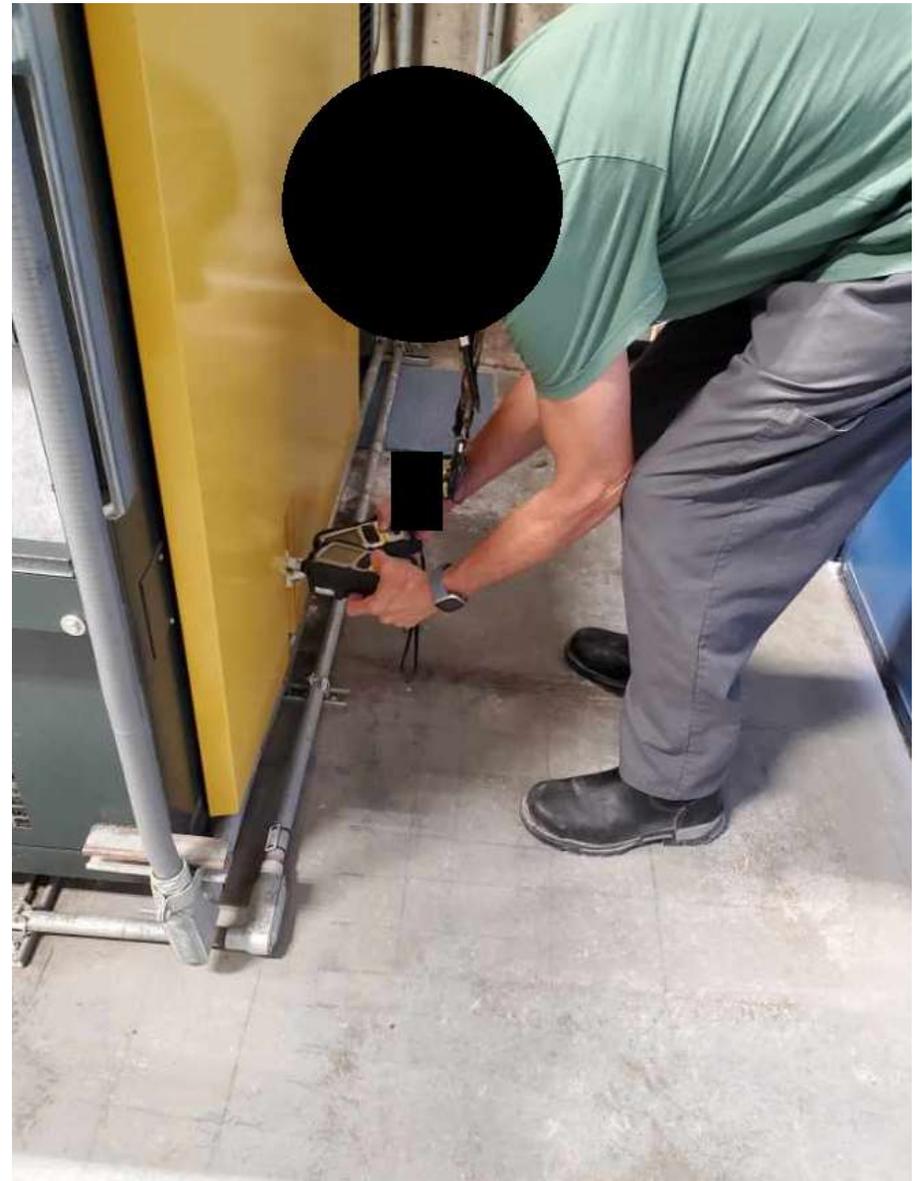


Figure 21. IHTs Monitoring Air Compressor.

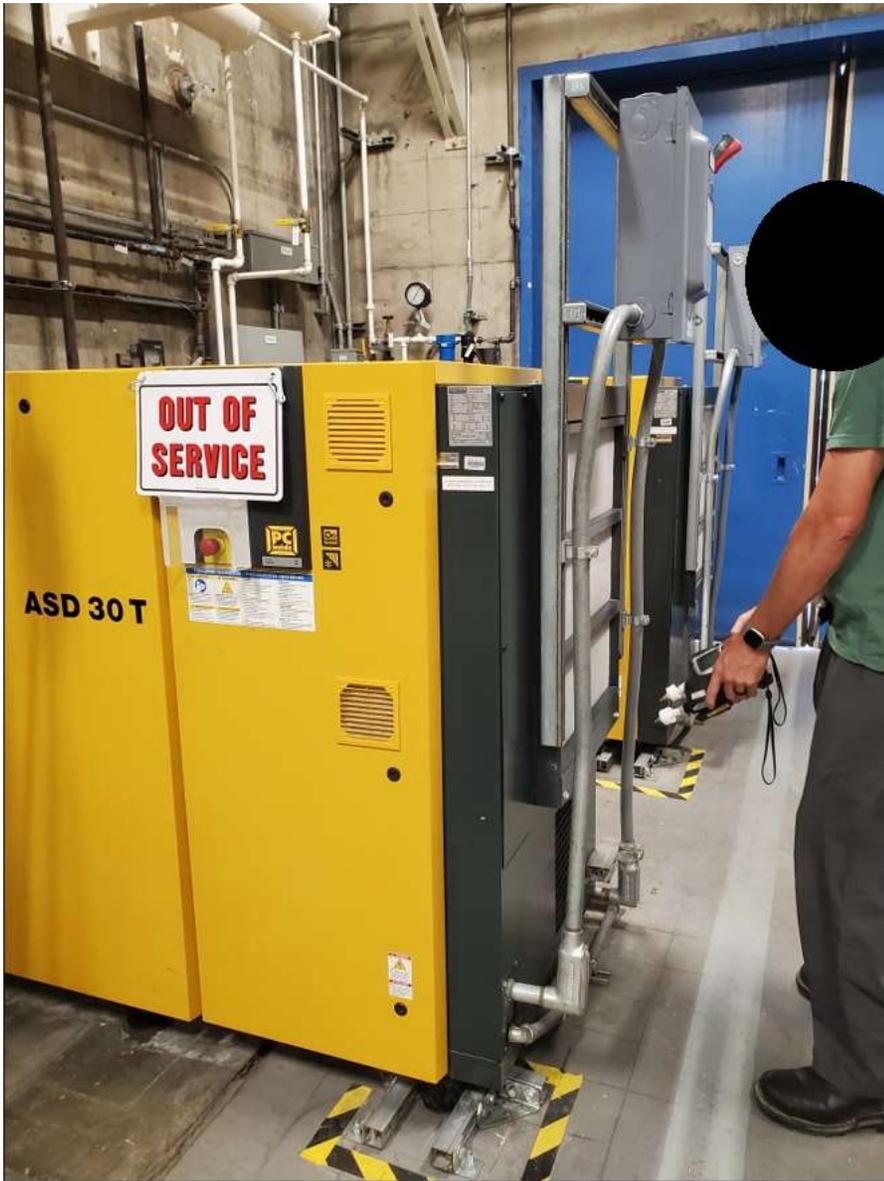


Figure 22. IHTs Monitoring Air Compressor.

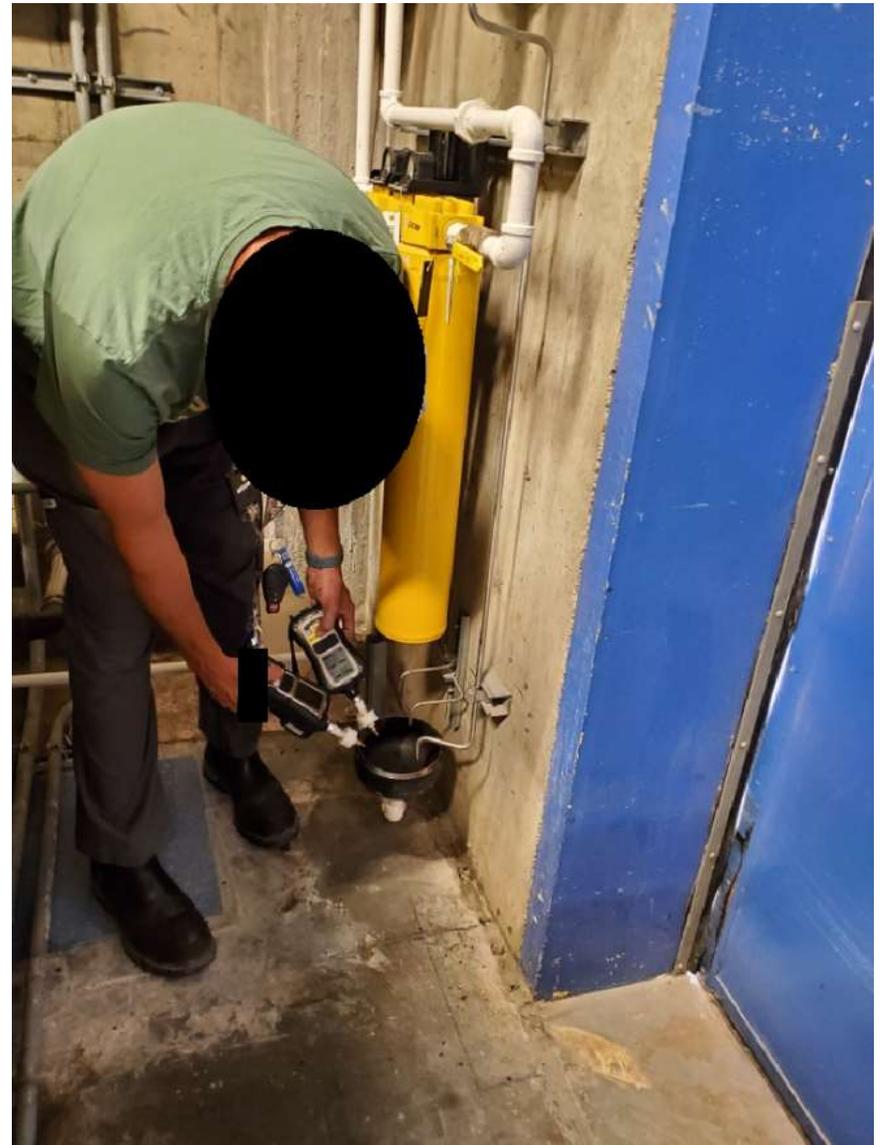


Figure 23. IHT Monitoring Instrument Air System Condensate Drain.



Figure 24. IHT Monitoring Instrument Air System Condensate Drain.



Figure 25. IHT Monitoring Instrument Air System Accumulator Tank.



Figure 26. IHT Monitoring at Flammable Material Cabinet Threshold.



Figure 27. IHT Monitoring Hazardous Material Cabinet Threshold.



Figure 28. IHT Monitoring at Anti-Foam Tank.



Figure 29. IHT Monitoring at Coolant Overflow Container.



Figure 30. Coolant Overflow Container.

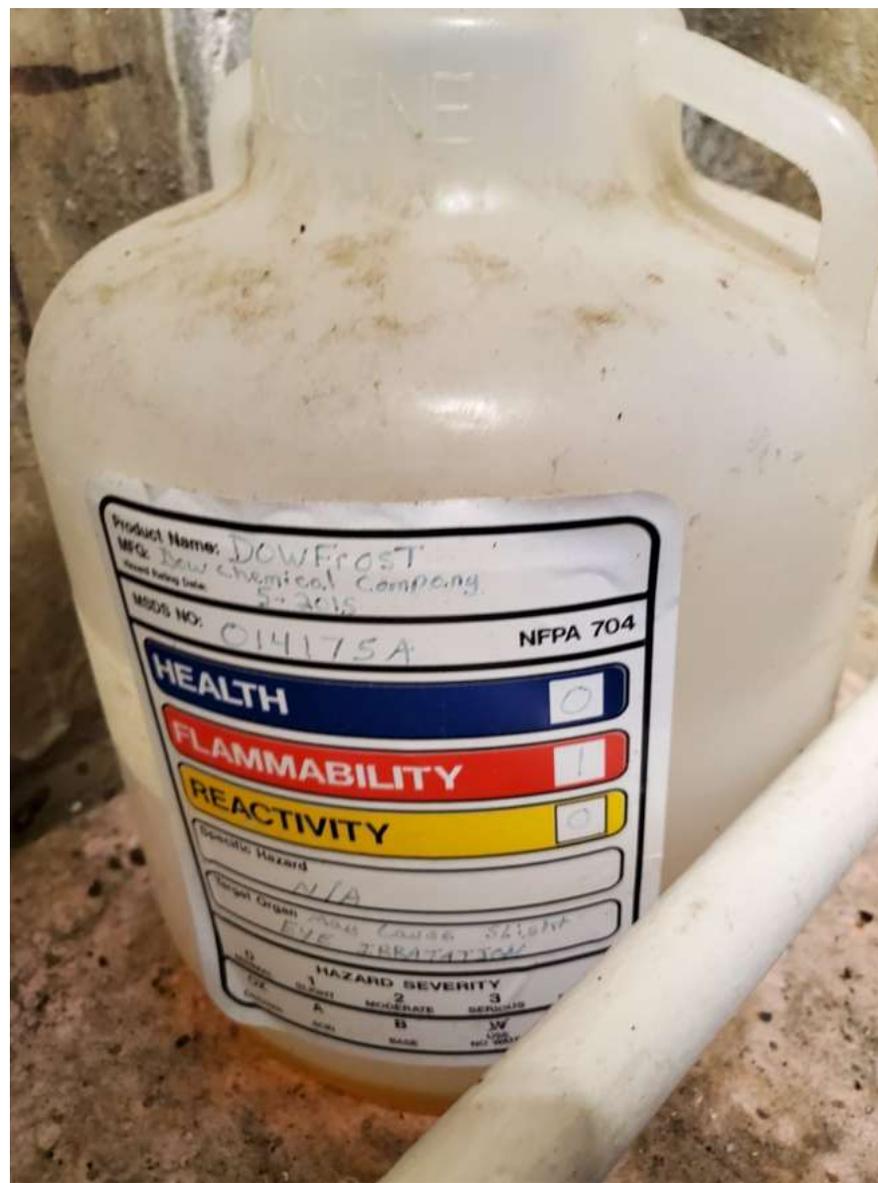


Figure 31. Coolant Overflow Container Secondary Container Label.



Figure 32. Puddle and Absorbent Mats Under Air Compressor.



Figure 33. Puddle under Air Compressor.



Figure 34. Puddle under Air Compressor.



Figure 35. Wall Residue.

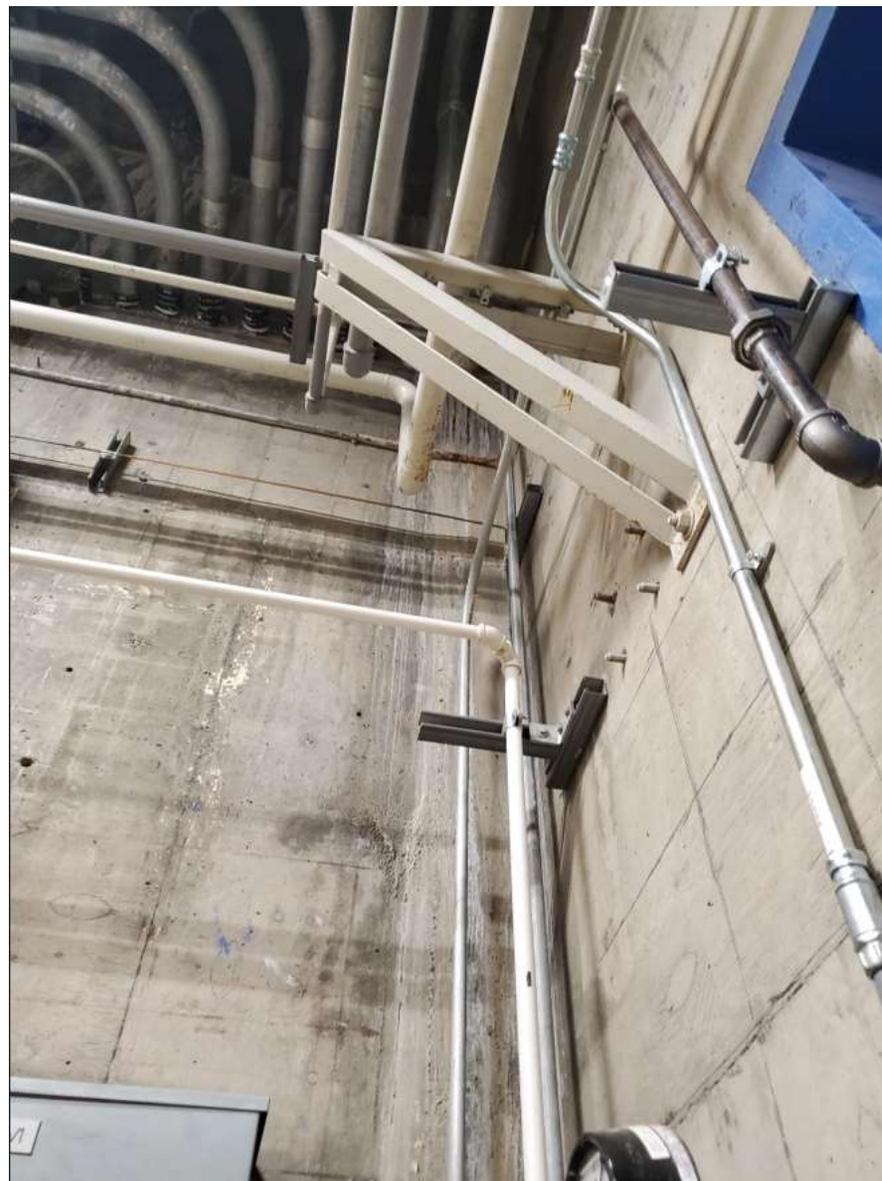


Figure 36. Wall Residue.



Figure 37. Air Dryer EIN.



Figure 38. Air Dryer EIN and information.



Figure 39. DRI Readings at Flammable Materials Cabinet Threshold.

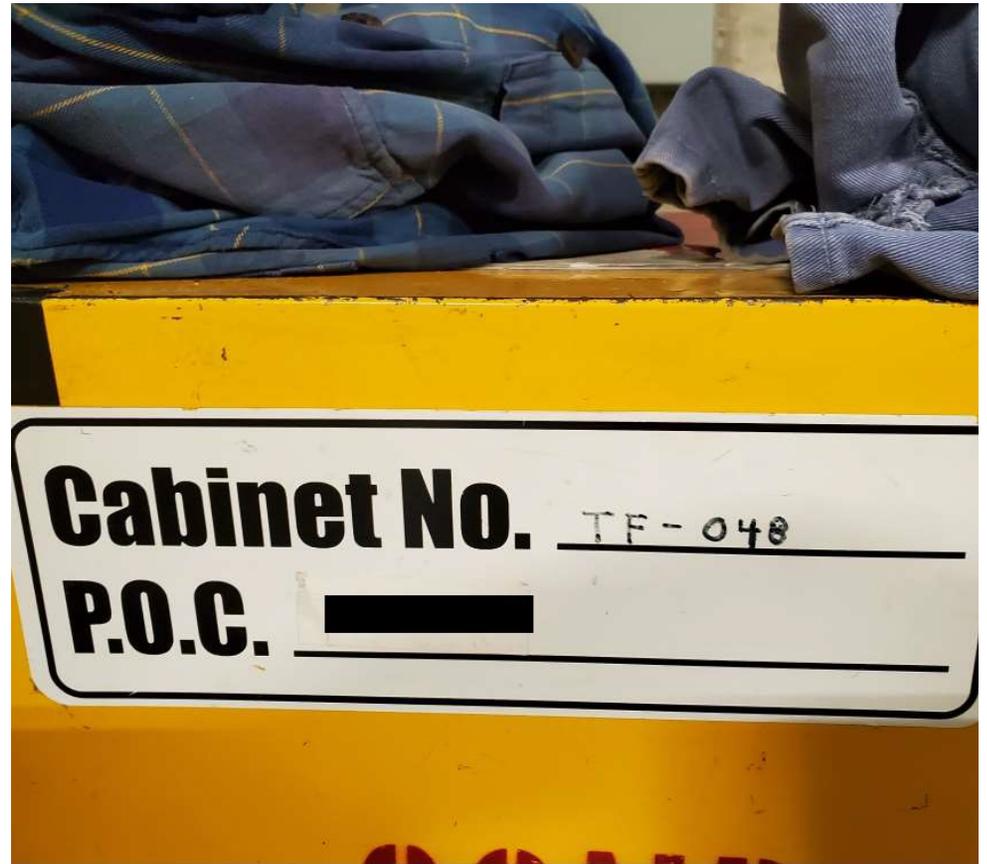


Figure 40. Flammable Cabinet Labeling.

IHIR-00069 Attachment A: SmartSite™ Summary, Response Map, and Response Pictures

SDS-MSDS (rl.gov)

INVENTORY

Product Name/Manufacturer (As listed on primary container)	SDS Number/Revision Date		Last Inspection Date:
			5/17/2023
			Quantity
INVERT-A-CAP MARKING PAINT	019771	07/01/2021	(1) 17-Ounces
LOCTITE SF 7471 (bottles)	054605	05/27/2020	(2) 1.75-Ounces
LOCTITE 518 (tube)	071081	03/01/2011	(1) 1.69-Ounces
3M NITRILE RUBBER AND GASKET ADHESIVE	069597	06/04/2019	(2) 5-Ounces
CHEVRON/TEXACO REGAL R&O 220	013818	07/03/2003	(1) 5-Gallon, (1) 2-Gallon - Container, (1) Pint - Container
TURBINE OIL 68	012614	01/27/2000	(1) 2-Gallon, (1) Pint
DOWFROST HEAT TRANSFER FLUID	014175	06/07/2018	(1) 5-Gallon
MOBIL 600 SUPER CYLINDER OIL	036182	05/08/2017	(1) 5-gallon, (2) Pints - Container
RIGID NUCLEAR THREAD CUTTING OIL	012716	05/02/2018	(1) Pint Can W/Spout
A57 UNION OIL/UNAX 68	077583	01/08/2008	(2) Pint Cans W/Spout
CHEVRON GEAR COMPOUND	018349	02/02/2009	(1) Quart - Container
PT PF SOLVENT/LPS PF SOLVENT	020906	05/25/2017	(2) Quarts
SIGMA S-460	04814,30830, 08071	TBD	(2) 5-GALLON-(1) QUART

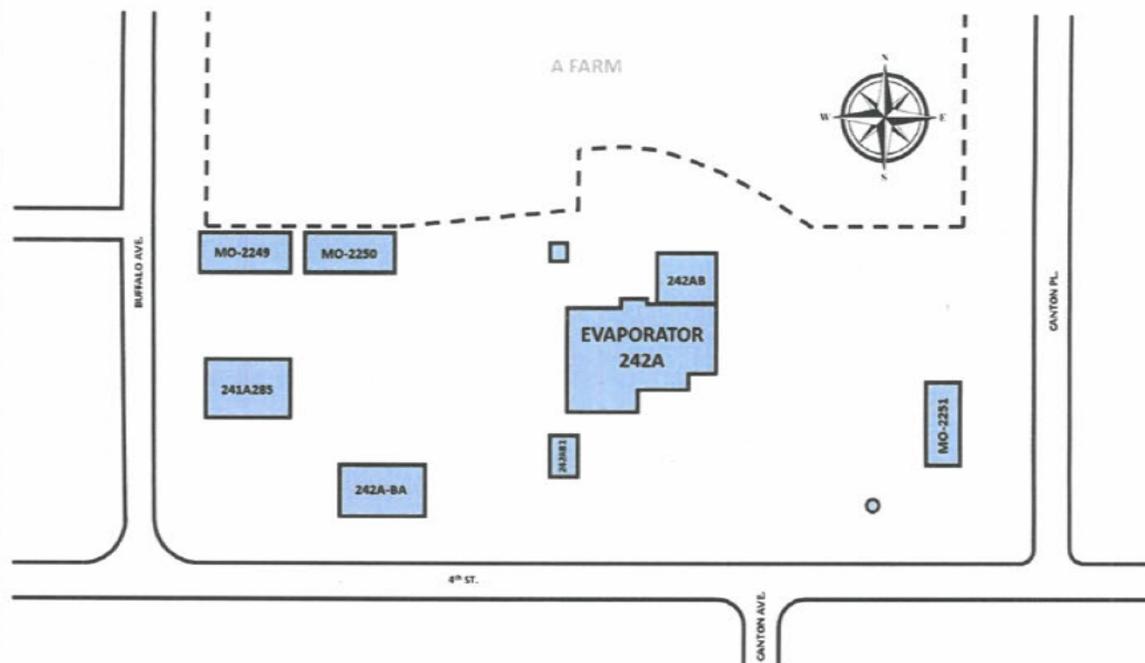
Figure 41. Flammable Materials Storage Cabinet GHS-SDS List.

ODOR/VAPOR RESPONSE CARD - 242 A

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.



ODOR/VAPOR RESPONSE CARD - 242 A

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

- Date and time of event: 5-31-23 0825
- Check Applicable:
 - Odor Ammonia Alarm (6 ppm) Ammonia Alarm (12 ppm) Alarm (other - describe): _____
- Your name and the work you were performing:
- Other Work Underway? Describe:
Five Systems piping repair
- Location of event (mark area on map and wind direction):
AMU Room 242-A
- 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): Bad Eggs Smell
- Is source known/likely? Describe:
Air Dryer when pop-off valve released
- Your symptoms? None
 - Headache Dizziness Nausea Cough Fatigue
 - Weakness Sore Throat Difficulty Breathing Eye Irritation Rash
 - Itch Tingling Numbness Taste
 - Other (describe): _____

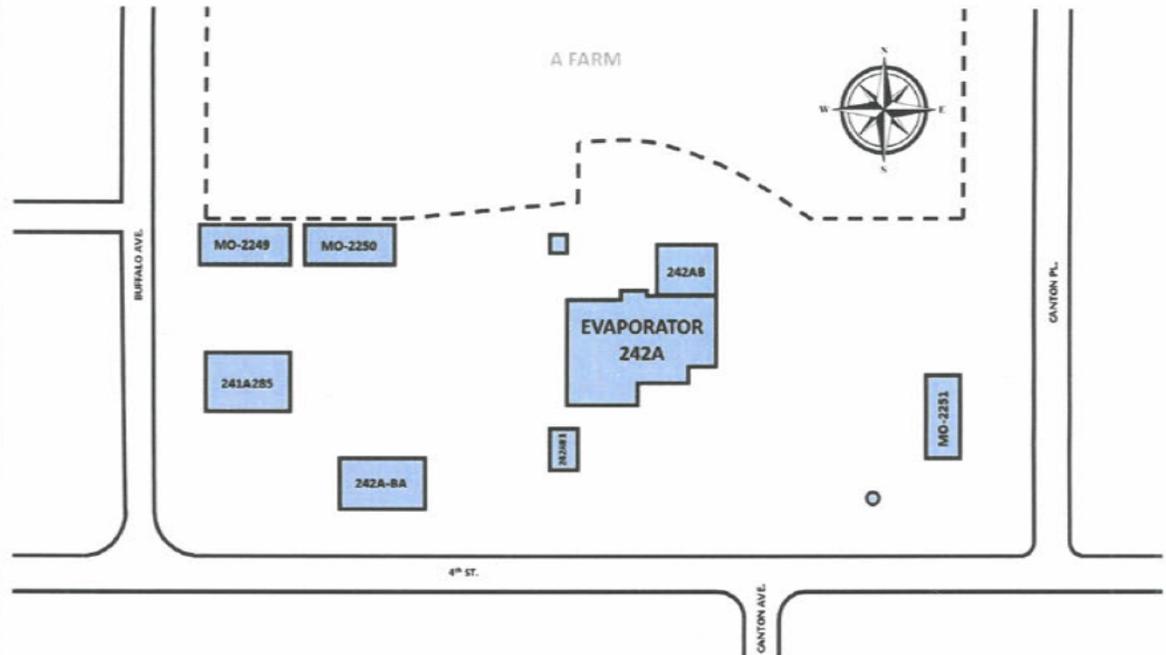
2. Provide this completed card (Page 1 & 2) to Supervisor, Industrial Hygiene, your Union Safety Representative or the CSM. If received by Supervisor/IH/U-SR, Supervisor/IH/U-SR will ensure card is provided to the CSM.

ODOR/VAPOR RESPONSE CARD - 242 A

Instructions:

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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;
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ODOR/VAPOR RESPONSE CARD - 242 A

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

• Date and time of event: 5-31-23 0825

• 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: _____

FSM piping repair

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

AMU Room 242-A

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

• Was Industrial Hygiene present, who? _____

No

• Describe the odor:

Sweet Sour Smoky Septic/Sewer Musty Rotten
 Metallic Onion Earthy Ammonia Citrus Solvent
 Other (describe): Bad Egg Smell

• Is source known/likely? Describe: _____

Air Dryer when pop off valve

• 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.