Air Products and Chemicals, Inc.
3700 W. 190th Place
Torrance, CA 90504
November 18, 2023 - Incident Investigation Report
U24 Ammonia Release

Introduction

Air Products and Chemicals, Inc. (APC) has prepared this incident investigation report at the request of the Torrance Fire Department (TFD) in response to an incident with occurred on November 18, 2023 involving Unit 24 at the hydrogen plant operated by APC at the Pbf Refinery in Torrance, California at the above-referenced address. APC understands that TFD has characterized the incident, which involved a limited release of a small quantity of anhydrous ammonia as a "major incident" as that term is defined in section 2735.3(ii) of Title 19 of the California Code of Regulations (19 CCR section 2735.3(ii)). While APC respectfully disagrees with that characterization, the company accepts TFD's exercise of its discretion to construe the regulatory definition and has prepared this report in general conformity to the provisions of 19 CCR section 2762.9(i).

Date and Time of the Incident.

The incident occurred on November 18, 2023 at 1540 PST.

Date and Time the Investigation Began.

The investigation began immediately after the November 18, 2023 event.

Detailed Description of the Incident.

The incident occurred following a scheduled maintenance event at the APC Unit 24 outage, Ammonia Tank 24C-27 was being put into service. At approximately 1535 PST, a third-party vendor began refilling the tank with liquid anhydrous ammonia to allow the tank to return to normal operations. Within five minutes after the filling was completed, site personnel visually observed frosting on the vent line from Process Safety Valve (PSV) PSV215, also referred to as a relief device, indicating ammonia was leaking.

When the ammonia leak was observed, APC immediately ordered an evacuation and muster from the Unit 24 area. Onsite emergency first responders and Torrance Fire Department (TFD) were promptly notified, and the deluge system was turned on as a precaution to limit any potential personnel exposure by capturing any ammonia released in water. After the release was mitigated and contained, the ammonia delivery service vendor was engaged to start a de-inventory process of Tank 24C-27. Onsite emergency first responders installed a tarp on the ammonia tank vent line to minimize dissipation of any vapors which had been released. By 1645 PST, there was no visual leak, and the responders demobilized at 1705 PST.

There were no injuries to personnel, damage to equipment or offsite environmental impacts. The total amount of ammonia released within the one hour during which the incident occurred was calculated to be 91 pounds which is less than the reportable quantity (RQ) threshold for ammonia.

Incident Timeline.

- Morning of 11/18: Nitrogen (N_2) and vapor ammonia leak checks performed on Tank 24C-27

- 1535 PST – Ammonia delivery by service vendor commences
- 1540 PST – Ammonia leak from PSV215 initially observed (i.e., PSV 215 body, flanges, and outlet piping frosted indicating ammonia flow) and immediate area was secured
- 1605 PST – Deluge system turned on, evacuation/muster ordered for personnel in the area around Unit 24 directly after leakage was observed
- 1612 PST – Onsite emergency first responders turn on fire monitor
- 1630 PST – Ammonia delivery service vendor engaged to schedule equipment to de-inventory tank
- 1645 PST – No visual leak observed and absence of further leakage confirmed by portable sniffer with ammonia sensor
- 1650 PST – Vaporizer isolated
- 1700 PST – Onsite emergency first responders install tarp on ammonia tank vent line to minimize vapor dissipation
- 1705 PST – Leak no longer active, onsite first responders demobilized
- 1730-1930 PST – Tank pressure holding, confirmed no active leak during this time using portable sniffer (eagle) with ammonia sensor. No trace ammonia detected
- 2100-2300 PST – Ammonia evacuated from tank. Tank left at 0 psig. Contractors given approval to return to work

Incident Investigation Team.

Once the leak was determined to no longer be active and contractors were approved to return to work (i.e. 1705 PST on November 18, 2023), APC commenced its investigation. To do so, the company assembled an incident investigation team which included:

- A Root Cause Analysis (RCA) facilitator,
- The Turnaround (TAR) Team supervisor,
- Plant Management,
- Process Engineering,
- A Process Safety Representative,
- An Environmental Representative,
- Project Team Lead and Members,
- an Operations Specialist, and
- a Relief Device Specialist.

The PSV215 relief device service vendor was also included in the investigation as an interviewed party.

Factors that Caused/Contributed to the Incident.

The direct cause of the leakage on the date of the incident was improper assembly of the PSV215 relief device by the device vendor. Following completion of the Tank 24C-27 replacement project, APC re-installed PSV215 without the knowledge that it was improperly assembled by the relief device vendor.

Although APC performed several integrity verification checks in the interval between receiving PSV215 from the vendor and installing it on the ammonia tank, those inspections did not indicate that PSV215 was not fit for service.

The ammonia delivery on the date of the incident was the initial tank fill following the planned maintenance event which included replacing the ammonia tank and piping components. The existing relief device PSV215 (ammonia vaporizer PSV) was temporarily removed to execute the replacement scope. PSV215 was not among the components to be replaced nor was it due to be overhauled as part of its four-year reservice frequency until 2025 as it was last overhauled in 2021. While performing other work, the relief device vendor accidentally picked up PSV215 and brought the device to their shop.

Upon learning that PSV215 was incorrectly transported to the relief device vendor shop, APC informed the vendor that the device was not due for replacement or for an overhaul. APC requested the vendor to perform a functional test to ensure there was no damage to the valve during transport before returning it to the plant. During APC's investigation, the vendor acknowledged that its personnel misinterpreted this request thinking that the device was being permanently removed from service. PSV215 failed the functional test per the vendor's standard criteria. After the test failed, the vendor disassembled PSV215 for inspection. Assuming that the device was being permanently removed from service, the vendor only partially reassembled it. The vendor did not inform APC that PSV215 failed the test, was then disassembled, and only partially reassembled so as to render it unsuitable for service.

APC Products received PSV215 from the vendor and performed the following pre-startup inspections and verification testing:

- Visual inspections – Normal inspections were made when PSV215 was received, but these inspections are limited to ensuring the valve is upright, and not meant to physically inspect every component of the relief device. APC relies on the vendor for the proper assembly of PSV's.
- Pre-Startup Safety Review (PSSR) Pressure Hydrotest – Pressure hydrotesting was performed on the new Ammonia system; however, this test is not designed to detect an issue with a leaking relief device as those devices are not included in the test (cannot achieve high enough pressure during these tests).
- Nitrogen leak check – A field pressure decay test was performed at 120 psig which is used to identify gross leaks, with the source N2 isolated and tank holding pressure for 20 minutes. The PSV215 set point is 250 psig and the operating pressure of the tank is around 60-120 psig. No leaks were observed during this test.
- Ammonia vapor leak test – An ammonia vapor leak test was performed at 60 psig, where litmus paper was used around the system to detect possible leaks. Minor leaks were detected and promptly addressed and checked; however, no leaks were found on PSV215 itself.

The pre-startup inspection and integrity verification tests above were all passed and did not indicate any integrity issues with the system. The filling of refrigerated liquid ammonia then commenced. The investigation team suspects that the cold liquid caused contraction of the PSV215 relief device components, creating an unintended flow path.

The PSV215 leaking condition was confirmed on 11/19/2023 when the tank was pressurized to 145 psig N2 after the tank had been evacuated and purged. Soap bubble tests detected leaks at PSV215 in multiple locations.

Conclusions.

The incident investigation team has determined with respect to the incident that:

- The failure mode of the limited ammonia release was leakage from the body of PSV215 due to the device having not been properly reassembled by the relief device vendor. APC installed the relief device after it had been returned by the vendor assuming it was being returned for service, based on its instruction to the relief device vendor, and had been properly assembled for installation.
- The vendor mistakenly believed the relief device was being removed from service despite a written request from APC that it was being put back into service.
    - The relief device vendor failed to notify APC that PSV215 failed a function test and was being sent back not assembled for service.
    - APC relies heavily on this vendor to follow its instructions particularly for relief device assembly.
- A contributing factor to the incident was the accidental retrieval of PSV215 by the vendor to its shop although PSV215 was not due to be reserviced.
- APC inspections and integrity verification tests were performed and passed but failed to detect that the vendor had improperly assembled or only partially assembled PSV215.
- Given the short duration during which the release occurred and the small quantity of ammonia release, there were no injuries or exposure to personnel during this event.

Recommendations.

Description of Recommendation	Anticipated Date of Completion
Rebuild, assemble for service, and install PSV215	Completed
Perform N2 leak test/soap bubble check once newly assembled device is installed.	Completed
Vendor Management Improvement – Existing written APC relief device standard states that notification from vendor to APC is required when a relief device fails a functional test or if other signs of failure are found during the inspection and testing process. APC will perform an audit at the vendor site involved in this incident. Communication with the vendor will reiterate the requirements of the APC standard.	3/29/24
Verify that all other relief devices sent to vendor's shop during the scheduled downtime preceding this event were property tested and sent back fit for service.	Completed

APC to review and update existing PSV standard and checklist to provide for more consistent inspections of relief devices coming back from vendor during plant turnaround.	8/30/24
APC to give additional training to Turnaround workers responsible for managing relief devices which training will focus on interpretation of report data and completing inspections according to the current APC standard.	12/31/24