Attachment 1

Hazards/Dangerous Condition	GDC Violation	How Condition Could Lead to or Exacerbate the Consequences of a Release, Causing Harm	Examples of Industry Standards of Care, Showing that (1) Hazard is Recognized by Owner/Operator's Industry, and (2) There are Way(s) to Eliminate or Reduce the Hazard
Condition 1 Duration: At least 12/1/12 – 4/1/2016 Lack of a hazard analysis that identified hazards posed by the System.	Failure to identify hazards which may result from accidental releases of extremely hazardous substances, using appropriate hazard assessment techniques.	Increases likelihood that a dangerous situation will not be recognized in time to prevent a release. Increases likelihood that any response to such a release will be less efficient and effective because the scenario was unanticipated and the response unplanned. Increased risk to emergency responders and increased potential for off-site impact.	The recommended industry practice and standard of care for ammonia refrigeration systems of this size would be to identify, analyze, and evaluate potential hazards using standard, industry-developed hazard identification checklists or more formalized techniques such as a "What-if" analysis. IIAR has developed checklists for this purpose *See, e.g.*, the International Institute of Ammonia Refrigeration's ("IIAR's") *Ammonia Refrigeration Management Program* (2005), Section 10 and Appendix 10.1; IIAR Bulletin No. 110, *Start-up, Inspection and Maintenance of Ammonia Mechanical Refrigerating Systems* (1993, rev. 2002) Section 5.2.1 (The owner shall confirm that a Process Hazard Analysis has been completed and that recommendations have been resolved or implemented.).
Condition 2 Duration: At least 12/1/12 – 4/1/2016 Inadequate documentation available about the technology and equipment in the process.	Failure to identify hazards which may result from accidental releases, using appropriate hazard	These documents provide operators and inspectors with essential understanding of the functioning and capacity of the system and the risks that the system	IIAR Bulletin No. 109 (1997), *Minimum Safety Criteria for a Safe Ammonia Refrigeration System*, (Safety Inspection Checklists); Section 4.3.1.2 (specifying name plate requirements for pressure vessels); IIAR Bulletin No. 110, *Start-up, Inspection and Maintenance of Ammonia Mechanical Refrigerating Systems*, Sections 4 (calling for readily available records, including but not limited to name plate data, relief system design and basis, pressure relief device types, set pressures, and dates of installation, and ventilation specifications, including air flow diagrams; "records shall contain a schematic refrigeration circuit or flow diagram for the

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For example, the Piping and Instrumentation Diagram (P&ID) posted in the ammonia machinery room and the P&ID later provided to EPA did not include some of the key equipment, such as emergency shutoff valves. Nor did the Facility have pressure relief vent calculations to verify that the vent header was appropriately sized. Also, several pressure vessels were missing information about whether those vessels were fit for service, for example some vessels were missing the American Society of Mechanical Engineers "U" or "UM" stamps, nameplates, or National Board numbers. In addition, the Facility did not have ventilation design records and calculations nor specification sheets or user manuals for the ventilation system to demonstrate that it provided sufficient ventilation for the space.	assessment techniques. Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases.	poses. They are also essential in ensuring the proper maintenance of the system. Releases are more likely, and their consequences more severe, when there is limited information available for hazard identification and minimization.	refrigerating system. Controls and valves which are most likely to be of importance in an emergency shall be clearly identified on the diagram which shall be updated when changes are made to the system.") and 6.4 (testing/information requirements to demonstrate that pressure vessels are fit for service); IIAR's *Ammonia Refrigeration Manual*, Section 3, including MSDS sheets, documentation of ammonia inventory at facility (e.g., documentation of ammonia charges, ammonia inventory during pump-out conditions, or detailed pipe-by-pipe/vessel-by-vessel inventory calculations); refrigeration flow diagrams; facility plan view (for use with fire department); equipment list for ammonia refrigeration equipment with detailed information about the equipment; desired system operating ranges (document desired system operating ranges for pressure, levels, and temperatures in the system); information regarding safety systems (e.g., alarms, compressor cut-outs, and ammonia detection systems); relief system design; ventilation system capacity; installation, operation, and maintenance manuals; and manufacturers data reports for all pressure vessels); ANSI/IIAR 2-2014, Sections 5.14.3 (Valves required for emergency shutdown of the system shall be clearly and uniquely identified at the valve itself and in the system schematic drawings); 15.3.7 (specifying that pressure relief devices shall have sufficient mass flow carrying capacity to limit the pressure rise in protected equipment to prevent catastrophic failure and setting out how to determine capacity of pressure relief devices for several different types of vessels including pressure vessels, oil separators, plate heat exchangers, shell and tube heat exchangers, product storage tanks); 15.5 (specifying how and where ammonia should be discharged through pressure relief devices — generally to the atmosphere with some exceptions, and how to calculate length of discharge pipe); 12.2.2 (specifying that pressure vessels exceeding 6 inches inside diameter must comply with the ASME Boiler and Pressure Vessel Code, Section VIII Division 1); 12.4.1 (specifying information that must be on pressure vessel nameplates, including manufacturer's name, maximum allowable working pressure information, minimum design metal temperature information, manufacturer's serial number, year of

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			manufacture, manufacturer's model number where applicable, and a stamp affixed to the equipment with the minimum design metal temperature that the equipment is operated at in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1); 5.14.4 (Requiring that equipment shall have a nameplate with minimum data that describes or defines the manufacturer's information and design limits and purpose as specified in Chapter 8 through Chapter 16, specifications regarding how the nameplates shall be affixed, and requirements for duplicate nameplates); 6.14.1 and 6.14.7 (requiring calculated minimum rates of ventilation); ANSI/IIAR 2-2008, Sections 9.3 (nameplate requirements for pressure vessels); 11.2.7 (specifying the required discharge capacity of a pressure relief device); and 11.3 ("The size of the discharge pipe from a pressure-relief device shall not be less than the outlet size of the pressure-relief device. The size and maximum equivalent length of common discharge piping downstream from each of two or more relief devices shall be governed by the sum of the discharge capacities of all the relief devices that are expected to discharge simultaneously, at the lowest pressure setting of any relief devices that discharging into the piping, with due allowance for the pressure drop in all downstream sections."); ANSI/ASHRAE 15-2013, Sections 9.7.5 (specifying minimum discharge capacities of pressure-relief device or fusible plugs for each pressure vessel), 9.7.6 (specifying how to determine the rated discharge capacity of a pressure relief device and specifying that all pipe and fittings between the pressure-relief valve and the parts of the system it protects shall have at least the area of the pressure-relief valve inlet area); 9.7.7 (formulas for determining rated discharge capacity); 9.3.2 (Pressure vessels having an inside diameter exceeding 6 inches and having an internal or external design pressure greater than 16 psig shall be directly marked, or marked on a nameplate, with a "U" or "UM" symbol signifying compliance with the rules of Section VIII of the AME Boiler and Pressure Code.); 9.4 (pressure relief protection); 8.11.4 and 8.11.5 (formulas for determining required mechanical ventilation capacity); and

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			National Board Inspection Code Part 2 — Inspection (regarding procedures to follow when nameplates are missing).
Condition 3 Duration: At least 12/1/2012 – 4/1/2016 Five of the oil separator pressure vessels were not protected by pressure-relief devices to safely relieve pressure buildup that could occur during fires or abnormal conditions	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases.	Failure to have pressure relief devices on pressure vessels can lead to catastrophic failure during fire or abnormal conditions, releasing ammonia.	ANSI/IIAR 2-2008, Section 11.2.1 ("Pressure vessels shall be provided with pressure relief protection in accordance with rules given in the governing edition of Section VIII, Division 1, ASME Boiler and Pressure Vessel Code."); 11.2.2 ("Pressure vessels containing liquid refrigerant that are capable of being isolated by stop valves from other parts of a closed-circuit ammonia refrigerating system shall be provided with overpressure protection."); ANSI/IIAR 2-2014, Sections 15.3.1 (requiring pressure vessels and other types of equipment built and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 to be provided with certified pressure relief protection.); ANSI/ASHRAE 15-2013, Section 9.4 (requiring pressure vessels to be protected with overpressure protection); IIAR Bulletin 109, Section 4.9.1 ("Single or dual safety pressure relief valves or other suitable relief devices shall be provided on all vessels, heat exchangers, oil pots, oil stills and elsewhere on the ammonia refrigerating system…."); and IIAR Bulletin 110 (1993), Section 6.8 ("In all instances, the removal of oil must be done very carefully. You must remember liquid ammonia can be present behind the oil, or that there may not be oil present, only liquid ammonia. The oil drain valve should be a rapid closing valve."…… "A pressure relief valve should be installed on all oil pots.").
Condition 4 Duration: 3/24/2016 – 4/1/2016	Failure to design and maintain a safe facility taking such steps as are necessary	Risks release of ammonia from pipes and/or system components if corrosion continues to point of failure.	The industry standard of care calls for a *preventative* maintenance program. *See, e.g.*, IIAR's *Ammonia Refrigeration Manual*, Section 5 and Appendix 5.1; IIAR Bulletin No. 110, *Startup, Inspection and Maintenance of Ammonia Mechanical Refrigerating Systems*, Section 4.3 (regarding inspection of equipment after being out of

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Excessive corrosion on refrigeration piping and other components in the ammonia machinery room. Also, on the roof, the inspectors observed several instances of rusted valves and piping around uninsulated valve manifolds.	to prevent releases.		use for, among other things, corrosion); Section 6.6 (Inspection and Maintenance — Valves and Sensing Devices) and Section 6.7 (Inspection and Maintenance — Piping). IIAR Bulletin No. 109, *IIAR Minimum Safety Criteria for a Safe Ammonia Refrigeration System*, Sections 4.7.4 and 4.7.5 and inspection checklists (4.7.4 -- Uninsulated refrigerant piping should be examined for signs of corrosion. If corrosion exists, the pipe should be cleaned down to bare metal and painted with a rust prevention paint. Badly corroded pipe should be replaced.) (4.7.5 — Insulated piping showing signs of vapor barrier failure should have the insulation removed and the pipe inspected….); (inspection checklists have corrosion monitoring question for pressure vessels, heat exchangers, evaporators, condensers, and piping.); FM Global Property Loss Prevention Data Sheet 12-61 *Mechanical Refrigeration*, Section 2.2.1.2 (Piping, heat exchangers and other system pressure vessels should be well supported and protected against mechanical and corrosion damage.); Section 53.3.1.1 of NFPA 1 (2012 ed.)[1] (Refrigeration systems shall be operated and maintained in a safe and operable condition, free from accumulations of oil, dirt, waste, excessive corrosion, other debris or leaks, and in accordance with ASHRAE 15 and the mechanical code.); IMC 2009, Section 1101.7 (Mechanical refrigeration systems shall be maintained in proper operating condition, free from accumulations of oil, dirt, waste, excessive corrosion, other debris and leaks.); and ANSI/IIAR 2-2014, Section 13.4.2 (requiring refrigerant piping to be isolated and supported to prevent damage from vibration, stress, corrosion, and physical impact).

[1] See 53.5.1 and 53.5.3 of NFPA 1 (2003 and 2006 edition). Citations in the 2012 edition changed considerably from earlier versions.

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Condition 5 Duration: 3/24/2016 – 4/1/2016 Damaged, stained, and missing insulation in multiple areas on ammonia piping and vessels in the ammonia machinery room, roof and in other areas containing ammonia piping. In addition, on the loading dock, the inspectors observed a section of ammonia piping wrapped in a type of insulation that retains moisture and liquid between the insulation and piping, increasing the likelihood of corrosion.	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases.	Vapor barriers protect pipes and vessels from moisture, which causes corrosion. Corroded pipes and vessels can break or succumb to pressure, causing an ammonia release.	IIAR Bulletin No. 109, *IIAR Minimum Safety Criteria for a Safe Ammonia Refrigeration System*, Section 4.7.5 (Insulated piping showing signs of vapor barrier failure should have the insulation removed and the pipe inspected….); IIAR Bulletin 110 -- 6.7.2 (Insulated Piping: Any mechanical damage to insulation should be repaired immediately and the vapor seal reinstated to prevent access of water or water vapor which will lead to breakdown of insulation and corrosion of the pipework.); 6.4.3 (Annual Inspection: "In the case of pressure vessels and heat exchangers covered by insulation, any effects of dampness or deterioration of the insulation which could lead to the eventual corrosion of the vessel or its connections shall be investigated. Surface treatment shall be applied to the vessels if required and the insulation shall be repaired within the shortest time."); and ANSI/IIAR 2-2014, Section 5.10.1 (piping and equipment surfaces not intended for heat exchange shall be insulated, treated, or otherwise protected to mitigate condensation and excessive frost buildup); See also Section 6.6.1 (piping and fittings shall be insulated as required by Section 5.10).
Condition 6 Duration: At least 3/24/2016 – 4/1/2016 The ammonia machinery room's mechanical air intake louvers are not the type that use power to close and otherwise spring open automatically and the louvers did not open during the Release; and the motor and louvers were not properly assembled together. During the first inspection, the emergency	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases. Failure to minimize the consequences of releases	Without adequate ventilation, vapors are more likely to build up to levels that are significant inhalation and dermal hazards or that risk causing fire or explosion. Also, where an exterior emergency ventilation on-	ANSI/ASHRAE 15-2013, *Safety Standard for Refrigeration System*, Section 8.11.4 ("Mechanical ventilation referred to in Section 8.11.3 shall be by one or more power-driven fans capable of exhausting air from the machinery room at least in the amount given in the formula in Section 8.11.5. Provision shall be made for inlet air to replace that being exhausted. Openings for inlet air shall be positioned to avoid recirculation…"); ANSI/IIAR 2-2008 (2012 ed.), *Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems*, Section 13.3.3.4 (If motorized dampers are utilized, they shall be of the power to close and spring to open type.); Section 13.3.8.1 (Normal mechanical ventilation design capacity shall be the greater of (a) 20 Air Changes per hour (20 ACH) based on the total gross volume of the machinery room, (b) The volume required to limit the room temperature to 104°F (40°C) taking into account

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ventilation was turned on, but the louvers did not open. They also were in the closed position when power to that room was turned completely off. Duration: At least 12/1/2012 – 4/1/2016 The Facility was not doing any regular testing to ensure the ventilation system was in working order.	which do occur.	switch is lacking or not functioning, the buildup of dangerous levels of toxic/flammable vapors in a machinery room can delay the entry of emergency response personnel to shut off the system, resulting in a prolonged release.	the ambient heating effect of all machinery in the room and with the ventilation air entering the room at a 1% ASHRAE design….); Section 13.3.9.1 (Emergency mechanical ventilation systems shall be capable of providing at least one air change every two minutes, which is 30 air changes per hour (30 ACH) based on the gross machinery room volume.); Section 13.3.9.2 (Emergency mechanical ventilation shall be actuated by (a) A refrigerant detector at a level not exceeding 1,000 ppm; (b) Manual controls.); Section 13.3.12 (The facility shall establish a time schedule for testing of the mechanical ventilation systems and the alarm system. The manufacturer's recommendations shall be followed or modified based on documented experience. Where no recommendations are provided, these devices shall be scheduled for functional tests on an annual basis.); ANSI/IIAR 2-2014, Section 6.14.5 (Inlet Air), specifically 6.14.5.1 (Outside air shall be provided to replace air being exhausted and shall maintain negative pressure in the machinery room); Section 6.14.5.5 (Intakes for makeup air to the machinery room shall serve only the machinery room.); Section 6.14.5.6 (Motorized louvers or dampers, where utilized, shall fail to the open position upon loss of power.); Section 6.14.7.2 (Emergency mechanical ventilation shall be activated by both an ammonia leak detection and a manual control switch.); App. K (alternative ventilation calculation methods); Section 6.14.8 (A schedule for testing the mechanical ventilation system shall be established based on manufacturers' recommendations, unless modified based on documented experience. . . . Where manufacturers' recommendations are not provided, the mechanical ventilation system shall be tested at least twice per year.); Section 53.3.2.2 of NFPA 1 (2012 ed.) (regarding ventilation systems)[2] requires periodic testing of fans and associated equipment intended to operate emergency purge ventilation systems; Section 53.3.2.4 requires that a written record of required testing shall be maintained on the premises; and

[2] Sections 53.10.4 and 53.10.5 of NFPA 1 (2006 edition).

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			IMC 2009, Sections 1105.6 (Machinery rooms shall be mechanically ventilated to the outdoors. Mechanical ventilation shall be capable of exhausting the minimum quantity of air (as further required by this section) both at normal operating and emergency conditions), 1105.4 (Periodic tests of the mechanical ventilating system shall be performed in accordance with manufacturer's specifications and as required by the code official.), and 1106.5.2 (A clearly identified switch of the break-glass type shall provide on-only control of the machinery room ventilation fans.).
Condition 7 Duration: At least 12/1/2012 – 4/1/2016 Lack of functioning audio/visual alarms: There were no visual and audible alarms in the ammonia machinery room. Nor were there audio/visual alarms outside other rooms containing ammonia refrigeration equipment and piping. Outside the primary entrance to the ammonia machinery room was an inadequately labeled visual alarm, but no audio alarm was present. There were no audio or visual alarms near the second-floor doors of the ammonia machinery room should someone attempt to enter the	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases. Failure to minimize the consequences of releases which do occur.	Ammonia detectors and alarms provide early warning that a release is taking place, enabling quick response and protecting workers, emergency responders, and the public from a larger release.	ANSI/IIAR 2-2008 (Add. B, 2012 ed.), *Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems*, Section 13.2 (Each refrigerating machinery room shall contain at least two refrigerant detectors that activate an alarm and mechanical ventilation.); Section 13.2.1.2 (The detectors shall activate visual and audible alarms inside the refrigerating machinery room and outside each entrance to the refrigerating machinery room.); ANSI/IIAR 2-2014, Sections 6.13.1 and 17.7 (The machinery room shall have at least one ammonia detector that activates an alarm that reports to monitored location at concentration of 25 ppm or higher; audible and visual alarms shall be provided inside machinery room to warn that access restricted to authorized personnel and emergency responders when alarm activated; additional audible and visual alarms shall be located outside each entrance to machinery room.); 6.13.2.3 (Detection of ammonia equal to or exceeding 150 ppm shall activate visual indicators and audible alarm and activate emergency ventilation; emergency ventilation shall continue to operate until manually reset by a switch located in the machinery room.); 6.13.2.4 (Detection of ammonia concentration that exceeds detector's upper detection limit or 40,000 ppm (25% LFL), whichever is lower, shall activate visual indicators and audible alarm and emergency ventilation; ventilation will continue to operate until manually reset; refrigerant compressors, refrigerant pumps, and normally closed automatic refrigerant valves not part of emergency control system will be automatically de-energized.); 7.2.(Requirements for Non machinery Room Spaces, specifically 7.2.3 which provides — with key exceptions — that Level 1 detection and alarm shall be provided in

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room from the outside (e.g., by ladder or fire truck). Moreover, the M&M system printout indicated that, although the vapor detector in the ammonia machinery room was functioning to detect levels of ammonia during the March 23 incident, the safety interlocks between this detector and the alarm/shutdown system had been manually disabled prior to the Release. (The interlock between this detector, the ventilation system, and the compressors also was disabled.)			accordance with 17.7.1 and that the detection/alarm system shall comply with Chapter 17; 17.4 (detectors shall be mounted in position where ammonia from a leak is expected to accumulate); 17.7.3 (additional requirement that level 3 alarm shall activate system to close control valves and de-energize refrigerant pumps, nonemergency fans and other motors); 17.5 (audible alarms shall provide sound pressure level of 15 decibels (dBA) above average ambient sound level and 5 dBA above maximum sound level of the area); ANSI/ASHRAE 15-2013, *Safety Standard for Refrigeration System*, Section 8.11.2.1 (Each refrigerating machinery room shall contain a detector located in an area where refrigerant from a leak will concentrate that activates an alarm and mechanical ventilation….The alarm shall annunciate visual and audible alarms inside the refrigerating machinery room and outside each entrance to the refrigerating machinery room.); NFPA 1 (2012 ed.) Section 53.2.3.1 (requirement for vapor detectors, monitors and alarm system); Section 8.12.h (When ammonia is used, the machinery room is not required to meet Class 1, Division 2 of the National Electric Code provided (a) the mechanical ventilation system in the machinery room is run continuously and failure of the mechanical ventilation system actuates an alarm or (b) the machinery room is equipped with a detector, conforming to Section 8.11.2.1, except the detector shall alarm at 1000 ppm.); and IIAR's Ammonia Refrigeration Manual (2005), Appendix 10.1, item 9.2 at A10-36.
<u>Condition 8</u> Duration: At least 12/1/2012 – 4/1/2016 The ammonia detectors in the machinery room, cooler rooms, freezer room, and loading dock near	Failure to design and maintain a safe facility taking such steps as are necessary	Properly functioning ammonia detectors provide early warning that a release is taking place, enabling quick response and protecting workers,	Hansen Bulletin A100 (Feb. 2008), indicating that bump tests should be completed at least once every six months and calibration of the sensors should be completed annually at a minimum; ANSI/IIAR 2-2014, Section 17.3 (Testing requirements for ammonia detection and alarms, specifying that a schedule for testing shall be established based on manufacturer's recommendations unless modified based on documented experience.

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the ceiling were not calibrated annually, nor were bump tests (This is a qualitative function check in which a challenge gas is passed over the sensor(s) at a concentration and exposure time sufficient to activate all alarm settings) conducted every six months, as recommended by the manufacturer, Hansen Technologies.	to prevent releases. Failure to minimize the consequences of releases which do occur.	emergency responders, and the public from a larger release.	Where manufacturer's recommendations are not provided, they shall be tested at least annually.); IIAR Bulletin 110, Section 6.6.4 (Specifies that manufacturer's instructions should be followed for inspecting, testing, calibrating and overhauling the following equipment: sensing devices, monitoring devices, sensors, alarms, interlocks, and emergency shutdown systems); ANSI/ASHRAE 15-2013, *Safety Standard for Refrigeration System*, Section 11.6.3 ("Detector(s), alarm(s) and mechanical ventilating systems shall be tested in accordance with manufacturers' specifications..."); and NFPA 1 (2012 ed.) Sections 53.2.3.1.7, 53.3.2.2, 53.3.2.3 and 53.3.2.4.
<u>Condition 9</u> Duration: At least 12/1/2012 – 4/1/2016 Problems with remote controls for activating ventilation and shutting down refrigeration equipment: There was a remote emergency shutdown control and ventilation switch outside the machinery room door, but these controls lacked clear signage about their function and were not easily accessible to emergency responders, due to a missing key.	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases. Failure to minimize the consequences of releases which do occur.	Creates risk of harm to workers and emergency responders who cannot quickly shut down or properly ventilate machinery room without entering the room, which could contain dangerous levels of vapors. The delay could also contribute to a longer ammonia release time, increasing risks to workers, emergency	ANSI/ASHRAE 15-2013, *Safety Standard for Refrigeration Systems*, Section 8.12.i (Remote control of the mechanical equipment in the refrigerating machinery room shall be provided immediately outside the machinery room door solely for the purpose of shutting down the equipment in an emergency. Ventilation fans shall be on a separate electrical circuit and have a control switch located immediately outside the machinery room door.); ANSI/IIAR 2-2008 (Add. B, 2012 ed.), *Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems*, Section 13.1.13.2 (A remote emergency shutdown control for refrigerant compressors, refrigerant pumps, and normally closed automatic refrigerant valves within the machinery room, shall be provided immediately outside the designated principle exterior machinery room door...); Section 13.3.1 (….The mechanical ventilation systems shall be powered independently of the machine room machinery and shall not be subject to emergency shutdown controls.).; Section 13.3.11 (Ventilation Remote Controls, specifically 13.3.11.1 specifies that emergency remote controls for the emergency mechanical ventilation systems shall be provided and be located immediately outside the designated principle exterior machinery room door.); Section 13.3.11.2 (specifies that the function of the

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Moreover, the existing remote controls would have been difficult for a person working in the machinery room to access in an emergency, given that the machinery room was upstairs from the remote controls, with no separate door or remote controls upstairs. Also, the emergency ventilation system was not working on the day of EPA's March 24 inspection; the emergency ventilation was turned on but the air intake louvers were closed. The emergency shut-off switch did not turn off all electrical power to the machinery room, risking ignition of ammonia vapors during a release; an air compressor (which was not part of the refrigeration system) came on during the March 24 inspection, even though the emergency shut-off for the refrigeration system compressors was activated.		responders, and people off-site.	emergency remote controls shall be clearly marked by signage near the controls); Section 13.3.11.3 (specifies that there must be an "on/auto" override for emergency ventilation immediately outside the designated principle exterior machinery room door); and Section 13.3.11.4 (specifies that there should be a "on/off/auto" override for normal and emergency ventilation at a secured remote location."); ANSI/IIAR 2-2014, Section 15.15 (Directions for emergency shutdown should be provided at a location readily accessible to trained refrigeration system staff and trained emergency responders; schematic drawings or signage should include details/steps for shutting down the system in an emergency; contact names and telephone numbers for refrigeration system operating, maintenance and management staff, emergency responders, and safety personnel; contact names and telephone numbers of corporate, local, state and federal agencies to be contacted in event of reportable incident; quantity of ammonia in the system, type and quantity of refrigerant in system; and the field test pressures applied); Section 6.12.1 (Emergency Stop Switch. A clearly identified emergency shut-off switch with a tamper resistant cover shall be located outside and adjacent to the designated principal machinery room door. The switch shall provide off-only control of refrigerant compressors, refrigerant pumps, and normally closed automatic refrigerant valves located in the machinery room. The function of the switch shall be clearly marked by signage near the controls.); 6.12.2 (Emergency Ventilation Control Switch. A clearly identified control switch for emergency ventilation with a tamper-resistant cover shall be located outside the machinery room and adjacent to primary machinery room door. The switch shall provide "ON/AUTO" override capability for emergency ventilation. The function of the switch shall be clearly marked by signage near the controls.); Section 6.14.7.3 (Emergency ventilation shall be powered independently of machine room equipment and continue to operate regardless of whether emergency shutdown controls have been activated.); and NFPA 1 (2012 ed.) Section 53.2.3.1.4 (emergency shut-off interface requirements, requiring vapor detectors to automatically turn off electrical power at concentrations at or above 25% of LFL); 53.2.3.3.1 (requiring emergency ventilation switch right outside

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			machinery room door).[3] Also, see Sections 53.2.3.4.5 (shutoffs for refrigeration machinery) and 53.2.3.3.1 (ventilation switch).
Condition 10 Duration: At least 12/1/2012 – 4/1/2016 The ammonia machinery room pressure relief vent line is located less than 7.25 feet above the cooler room B roof level. All of the high pressure relief vent lines and the emergency exhaust fan discharged less than 20 feet from the property line.	Failure to minimize releases that do occur	Improperly placed discharge reliefs and exhaust fans can result in ammonia being sprayed on people during a release, further exacerbating the consequences of a release.	ANSI/IIAR 2-2008 (Add. B., 2012 ed.), Sections 11.3.6.3 (requirement for pressure relief to discharge at least 20 feet from window, ventilation intake or personnel exit) and 11.3.6.4 (requirement to discharge to atmosphere at least 15 feet above adjacent roof level); ANSI/IIAR 2-2014, Section 15.5 (pressure relief device discharge piping must discharge at least: 7.25 feet above the roof, adjacent roof line or platform surface; 15 feet above grade and at least 20 feet from windows, ventilation intakes, or exits, and discharge shall be directed upward and arranged to avoid spraying ammonia on persons in the vicinity); 6.14.3.4 (Machinery room exhaust shall vent to the outdoors no fewer than 20 feet from a property line or openings into the buildings.); ANSI/ASHRAE 15 (2013) Section 9.7.8 (Requires discharge to atmosphere 15 feet above adjoining ground level and not less than 20 feet from window, ventilation opening, or exit. Discharge shall terminate in a manner that will prevent discharged refrigerant from being sprayed on people.); NFPA 1 (2012 ed.) Section 53.2.2.1.2 (15 feet discharge to atmosphere requirement plus some other discharge options for ammonia flaring and diffusion systems).[4] See also, Section 53.2.3.3.12 (exhaust must discharge at least 20 feet from the property line or openings into the building); and IMC 2009, Sections 1105.7 (Pressure relief devices, fusible plugs and purge systems located within the machinery room shall terminate outside of the structure at a location not less than 15 feet above the adjoining grade level and not less than 20 feet from any window, ventilation opening or exit.); 1105.6.1 (Exhaust from mechanical ventilation

[3] Sections 53.11, 53.10.2, 53.10.9, and 5.10.5 of NFPA-1 2006 edition.

[4] Section 53.8.3.2 of NFPA 1-2006 edition.

Hazards/Dangerous Condition	GDC Violation	How Condition Could Lead to or Exacerbate the Consequences of a Release, Causing Harm	Examples of Industry Standards of Care, Showing that (1) Hazard is Recognized by Owner/Operator's Industry, and (2) There are Way(s) to Eliminate or Reduce the Hazard
			systems shall be discharged not less than 20 feet from a property line or openings into buildings.).
Condition 11 Duration: 3/24/2016 – 4/1/2016 Fire Hazards: Open electrical junction boxes, loose wiring, and light sockets without bulbs were present in the maintenance room and in the ammonia machinery room. The electrical switchgear room inside of the expansion ammonia machinery room contained an electrical conduit that was dripping water from a fitting, indicating that water was present inside the conduit and presenting an electrical hazard. There were also combustible materials in areas that were not separated from the ammonia machinery room (*e.g.*, wooden stairs, flammable items stored on first floor).	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases. Failure to minimize the consequences of releases which do occur.	Exacerbates risk of fire or explosion. Ammonia is flammable at certain concentrations.	ANSI/IIAR 2-2008 (Add. B., 2012 ed.), *Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems*, Section 13.1.3.1 (Flammable and combustible materials shall not be stored in machinery rooms.); Section 13.1.7 Electrical Safety (requires wiring to be installed in accordance with the National Electrical Code); NFPA 1 (2012 ed.), Section 53.3.1.3.1 (Flammable and combustible materials shall not be stored in the refrigeration machinery rooms except for incidental materials necessary for the safe and proper operation and maintenance of the system.)[5]; 53.2.3.4 and 11.1 (Electrical equipment and electrical installations in refrigeration machinery room shall comply with Section 11.1.); IIAR Bulletin 109 *Minimum Safety Criteria for a Safe Refrigeration System*, General Safety checklist, item (x) (Covers should be fastened to all electrical panels and junction boxes.); 29 C.F.R. § 1910.303(g)(2) (guarding of live parts); and NFPA 70 (National Electric Code) (2011), Section 110-27 (guarding of live parts).

[5] Section 53.10.7, 53.12, and 53.10.8.2 of NFPA-1 (2006 edition). Note that NFPA 1 (2006 ed.) has different provisions than the 2012 edition for electrical safety, but the restriction on storage of flammable or combustible materials is the same as in the 2012 edition.

Hazards/Dangerous Condition	**GDC Violation**	**How Condition Could Lead to or Exacerbate the Consequences of a Release, Causing Harm**	**Examples of Industry Standards of Care, Showing that (1) Hazard is Recognized by Owner/Operator's Industry, and (2) There are Way(s) to Eliminate or Reduce the Hazard**
Heaters on the loading dock, which were not interlocked with the ammonia detection system yet were located near the evaporator units and ammonia piping, were a potential ignition source and fire hazard in the event of an ammonia release.			
Condition 12 Duration: 3/24/2016 – 4/1/2016 The machinery room door was not adequately labeled to: o warn of the hazards of entering a room with ammonia-containing machinery; o restrict access to authorized personnel; o provide appropriate information about alarms; o and provide information about emergency procedures.	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases. Failure to minimize the consequences of releases which do occur.	Increases the chance of inadvertent exposure to ammonia releases and could frustrate effort to react quickly and properly during an ammonia release. Signs and posted information provide a level of protection in addition to worker training and operating procedures.	ANSI/IIAR 2-2008 (Add. B., 2012 ed.), *Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems*, Section 13.1.10.4: There is a requirement in the section entitled, "Entrances and Exits," that refrigerating systems shall be provided with approved informative signs, emergency signs, charts and labels in accordance with NFPA 704. Hazard signs shall be in accordance with International Mechanical Code. (Refers to Appendix L). Also see Section 13.1.2.4 (signs restricting entry to authorized personnel), Section 13.2.4.1 (signs with meaning of alarms near the visual and audible alarms); and Appendix L (examples of recommended machinery room door signage); ANSI/IIAR 2-2014, Sections 6.3.4 and 6.15 (requires that access to machinery room be restricted to authorized personnel and that machinery room doors shall have restricted access, signage, alarm signage and NFPA 704 placards); Sections 6.15.2 and 17.6 (use of signage to identify ammonia leak detection alarms); Appendix J (examples of recommended machinery room door signage); ANSI/ASHRAE 15-2013, *Safety Standard for Refrigeration Systems*, Sections 8.11.2.1 (signs with meaning of alarms); 8.11.8 (signs restricting entry to authorized personnel); 11.2.4 (same); 11.7 (posted emergency shutdown procedures); NFPA 704 (re. readability of signs); and

Hazards/Dangerous Condition	**GDC Violation**	**How Condition Could Lead to or Exacerbate the Consequences of a Release, Causing Harm**	**Examples of Industry Standards of Care, Showing that (1) Hazard is Recognized by Owner/Operator's Industry, and (2) There are Way(s) to Eliminate or Reduce the Hazard**
			IIAR's Ammonia Refrigeration Manual (2005), Appendix 10.1, item 11.3 at A10-40 ("Is access to the machinery room(s) restricted to authorized personnel?").
Condition 13 Duration: At least 12/1/2012 – 4/1/2016 There were no emergency shutdown instructions, diagrams, or procedures posted in the Facility, nor were adequate written emergency instructions available elsewhere at the Facility.	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases. Failure to minimize the consequences of releases which do occur.	Increases the chance of exposure to ammonia releases and could frustrate effort to react quickly and properly during an ammonia release. Signs and posted information provide a level of protection in addition to worker training and operating procedures. Proper emergency procedures can also prevent larger releases.	IIAR Bulletin 109, Section 4.10.5 (A sign or signs should be posted in a conspicuous location providing emergency instructions and phone numbers of emergency safety and operating personnel.); ANSI/AHSRAE 15-2013, Section 11.7 (Responsibility for Operation and Emergency Shutdown: …..Emergency shutdown procedures, including precautions to be observed in case of a breakdown or leak, shall be displayed on a conspicuous card located as near as possible to the refrigerant compressor. These precautions shall address (a) instructions for shutting down the system in case of an emergency; (b) the name, address, and day and night telephone numbers for obtaining service; (c) the names, addresses and telephone numbers of all corporate, local, state, and federal agencies to be contacted in the event of a reportable incident. When a refrigerating machinery room is used, the emergency procedures shall be posted outside the room, immediately adjacent to each door. The emergency procedures shall forbid entry into the refrigerating machinery room when the refrigerant alarm required by Section 8.11.2.1 has been activated except by persons provided with the appropriate respiratory and other protective equipment and trained in accordance with jurisdictional requirements.); ANSI/IIAR 2-2014, Section 5.15 (Emergency Shutdown Documentation. It shall be the duty of the person in charge of the premises at which the refrigeration system is installed to provide directions for the emergency shutdown of the system at a location that is readily accessible to trained refrigeration system staff and trained emergency responders. Schematic drawings or signage shall include the following: (1) instructions with details and steps for shutting down the system in an emergency; (2) the name and telephone numbers of the refrigeration operating, maintenance, and management staff, emergency responders, and safety personnel; (3) the names and telephone numbers of all corporate, local, state, and federal agencies to be contacted as required in the event of a reportable

Hazards/Dangerous Condition	GDC Violation	How Condition Could Lead to or Exacerbate the Consequences of a Release, Causing Harm	Examples of Industry Standards of Care, Showing that (1) Hazard is Recognized by Owner/Operator's Industry, and (2) There are Way(s) to Eliminate or Reduce the Hazard
			incident; (4) quantity of ammonia in the system; (5) type and quantity of refrigerant oild in the system; (6) field test pressures applied.; and IIAR's *Ammonia Refrigeration Manual*, Section 4.2, recommending that emergency shutdown procedures be written.
Condition 14 Duration: 3/24/2016 – 4/1/2016 Failure to have a legible, permanent sign securely attached and easily accessible in any location on the ammonia refrigeration system displaying the following information: a) Name and address of the installer; b) The refrigerant number and the amount of refrigerant in the system; c) The lubricant identity and amount; and d) The field test pressure(s) applied	Failure to design and maintain a safe facility	Information provides critical information to those who are maintaining system.	IIAR Bulletin 109, Section 4.10.4; IIAR Bulletin 109, general safety checklist item (i); ANSI/ASHRAE 15-2013, Section 11.2.1; NFPA 1-2012, Section 53.2.4.1 (signage requirements include all of the information listed under Condition 14 except for c) lubricant identity and amount);[6] and ANSI/IIAR 2-2014, Section 5.15 (among other emergency shutdown schematic drawings or signage, must have information on quantity of ammonia in system, type and quantity of refrigerant oil in the system, and field test pressures applied).
Condition 15 Duration: At least 12/1/2012 – 4/1/2016 The doors into the ammonia machinery room on the first and second floors were not tight-fitting	Failure to minimize the consequences of releases which do occur.	In the event of an ammonia release inside the machinery room, the failure to have a tight-fitting and self-closing door risks the spread	ANSI/IIAR 2-2008 (Add. B., 2012 ed.), *Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems*, Section 13.1.10.1 (Each refrigerating machinery room shall have a tight-fitting door or doors opening outward, self-closing if they open into the building, and adequate in number to ensure freedom for persons to escape in an emergency.) 13.1.10.3 (The refrigerating machinery room shall have a door that opens directly to the outside air or through a vestibule equipped with self-closing, tight-fitting doors equipped with panic-type hardware.);

[6] Section 53.14 in NFPA 1 (2006 ed.).

Hazards/Dangerous Condition	**GDC Violation**	**How Condition Could Lead to or Exacerbate the Consequences of a Release, Causing Harm**	**Examples of Industry Standards of Care, Showing that (1) Hazard is Recognized by Owner/Operator's Industry, and (2) There are Way(s) to Eliminate or Reduce the Hazard**
and self-closing.		of ammonia vapors outside the room. Also, it is more difficult for employees to escape the room when the door opens into the room rather than out.	ANSI/IIAR 2-2014, Section 6.10.2 (machinery doors shall be self-closing and tight fitting); ANSI/ASHRAE 15-2013, *Safety Standard for Refrigeration System*, Section 8.12.d. (The refrigerating machinery room shall have a door that opens directly to the outdoors or through a vestibule equipped with self-closing, tight-fitting doors.); 8.11.2 (Each refrigeration machinery room door shall have a tight-fitting door or doors opening outward, self-closing if they open to the building and adequate in number to ensure freedom for persons to escape in an emergency. With the exception of access doors and panels in air ducts and air handling units…there shall be no openings that will permit passage of escaping refrigerant to other parts of the building.); Section 8.12.b (Doors communicating with the building shall be approved, self-closing, tight-fitting doors.); and IIAR's *Ammonia Refrigeration Manual*, Appendix 10.1, item 11.14-11.18 at A10-42 (including questions about whether the doors are tight-fitting).
<u>Condition 16</u> Duration: At least 12/1/2012 – 4/1/2016 The machinery room walls and floor contained holes and gaps for piping and conduit that were not sealed from other spaces in the building.	Failure to minimize the consequences of releases which do occur.	Allows release of ammonia inside the machinery room to spread to other parts of the building, putting employees and responders at risk.	ANSI/ASHRAE-15(2013), Sections 8.11.2 (…With the exception of access doors and panels in air ducts and air handling units…there shall be no openings that will permit passage of escaping refrigerant to other parts of the building.); 8.11.7 (There shall be no air flow to or from an occupied space through a machinery room unless the air is ducted and sealed in a manner to prevent any refrigerant leakage from entering the airstream); and 8.12(f) (All pipes piercing the interior walls, ceiling, or floor of such rooms shall be tightly sealed to the walls, ceiling, or floors through which they pass.); ANSI/IIAR 2-2008 (Add. B, 2012 ed.), Section 13.1.1.3 (Walls, floor, and ceiling shall be tight and of non-combustible construction — with exception from non-combustible construction requirement for buildings equipped with automatic sprinkler system); Section 13.1.5.2 (All pipes piercing the interior walls, ceiling, or floor of machinery rooms shall be tightly sealed to the walls, ceiling, or floors through which they pass.); ANSI/IIAR 2-2014, Section 6.6.2 (Pipes penetrating the machinery room separation shall be sealed to the walls, ceiling, or floor through which they pass); 6.2.5 (Airflow from

Hazards/Dangerous Condition	GDC Violation	How Condition Could Lead to or Exacerbate the Consequences of a Release, Causing Harm	Examples of Industry Standards of Care, Showing that (1) Hazard is Recognized by Owner/Operator's Industry, and (2) There are Way(s) to Eliminate or Reduce the Hazard
			Occupied Spaces. Air shall not flow to or from any portion of a premises that is routinely accessible to or occupied by people on a part time or full-time basis through a machinery room unless the air is ducted and sealed to prevent ammonia leakage from entering the airstream. Access doors and panels in ductwork and air handling units located in a machinery room shall be gasketed and tight-fitting.); and IIAR's *Ammonia Refrigeration Manual*, Appendix 10.1, item 11.28 ("Are all pipes piercing the exterior walls, ceiling or floor of the machinery room(s) tightly sealed….?").
Condition 17 Duration: 3/24/2016 – 4/1/2016 The inspectors observed a significant amount of piping and equipment in the ammonia machinery room, roof, and other ammonia-containing areas that was inadequately labeled or missing labeling indicating contents, physical state, and direction of flow. For example, the accumulators in the ammonia machinery room were inadequately labeled.	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases. Failure to minimize the consequences of releases which do occur.	Makes it more difficult to: properly maintain system, operate correct valves, warn workers and emergency responders about hazards posed by system, reduce risk of human error in operating the system, and respond quickly in the event of a release. The risk was exacerbated at this Facility by the co-location of some	IIAR Bulletin No. 109, *IIAR Minimum Safety Criteria for a Safe Ammonia Refrigeration System*, Section 4.7.6 (All ammonia piping should have appropriate pipe markers attached to indicate the use of the pipe and arrows to indicate the direction of flow, such as in IIAR Bulletin No. 114…); IIAR Bulletin No. 114, *Identification of Ammonia Refrigeration Piping and System Components*; Sections 4.1 (Piping Markers: Piping markers shall be designed to identify the refrigerant, the physical state of the refrigerant, the relative pressure level of the refrigerant and the direction of flow); 4.2 (Component Markers: Component markers will bear the name of the equipment they identify, e.g., RECEIVER, ACCUMULATOR, RECIRCULATOR and provide a pressure level designation.); ANSI/IIAR 2-2008 (Add. B, 2012 ed.), *Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems*, Section 10.6 (All piping mains, headers and branches shall be identified as to the physical state of the refrigerant (that is, vapor, liquid, etc.), the relative pressure level of the refrigerant, and the direction of flow. The identification system used shall either be one established as a standard by a recognized code or standards body or one described and documented by the facility owner.);[7] ANSI/IIAR 2-2014, Sections 5.14.2 (Refrigeration machinery shall be provided with labels); 5.14.3 (Emergency shutdown valves shall be clearly and uniquely identified at

[7] This particular requirement was in Section 10.5 of the 2010 edition.

Hazards/Dangerous Condition	**GDC Violation**	**How Condition Could Lead to or Exacerbate the Consequences of a Release, Causing Harm**	**Examples of Industry Standards of Care, Showing that (1) Hazard is Recognized by Owner/Operator's Industry, and (2) There are Way(s) to Eliminate or Reduce the Hazard**
		unmarked natural gas lines, some of which were confusingly painted the same color as the ammonia pipes.	the valve itself and in the system schematic drawings); 5.14.5 (Ammonia piping mains, headers, and branches shall be identified with the following information: (1) "AMMONIA;" (2) physical state of the ammonia; (3) relative pressure level of ammonia, being low or high as applicable; (4) pipe service (can be abbreviated); and (5) direction of flow. The marking system shall either be one established by a recognized model code or standard or one described and documented by facility owner.); ANSI/ASHRAE 15-2013, Section 11.2.2 (Systems containing more than 110 lbs of refrigerant shall be provided with durable signs…designating (a) valves or switches for controlling the refrigerant flow, the ventilation, and the refrigeration compressor(s); and (b) the kind of refrigerant or secondary coolant contained in exposed piping outside the machinery room. Valves or piping adjacent to valves shall be identified in accordance with *ANSI 13.1, Scheme for Identification of Piping Systems*.); IIAR's *Ammonia Refrigeration Manual*, Section 4.2 (recommends labeling in accordance with Bulletin 114 as part of the facility's Standard Operating Procedure program); and ASME 13.1 (2007), specifying conventions for labeling piping.
<u>Condition 18</u> Duration: 3/24/2016 – 4/1/2016 Main shut-off valves (king valves) were not identified with a prominent sign.	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases. Failure to minimize the consequences of releases	See above re: labeling of valves. Also, the king valve can be used to quickly shut off flow of ammonia from the ammonia receiver to the rest of the system. Any impediment to its use can lengthen the time of a release, endangering	IIAR Bulletin No. 109, *IIAR Minimum Safety Criteria for a Safe Ammonia Refrigeration System*, Section 4.10.3 (The main shut-off valve(s) (king valve(s)), hot gas defrost line main shut-off valve, and NH_3 pump liquid main shut-off valve(s) and/or disconnects of the ammonia system should be readily accessible and identified with a prominent sign having letters sufficiently large to be easily read.); See also General Safety Checklist items (d) and (e); ANSI/ASHRAE 15-2013, *Safety Standard for Refrigeration Systems*, Section 11.2.2 (Systems containing more than 110 lbs of refrigerant shall be provided with durable signs…designating (a) valves or switches for controlling the refrigerant flow, the ventilation, and the refrigeration compressor(s).); ANSI/IIAR 2-2014, Sections 5.14.2 (Refrigeration machinery shall be provided with labels.); 5.14.3 (Emergency shutdown valves shall be clearly and uniquely identified at

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	which do occur.	workers, emergency responders, and people off-site. Indeed, finding and accessing the king valves at this Facility was an issue in the emergency response for this incident.	the valve itself and in the system schematic drawings.); and NFPA 2-2012 Section 53.2.4.2 (Systems containing more than 110 lbs of refrigerant must have signs for main shutoff to each vessel, electrical controls, remote control valve, pressure limiting device.).
Condition 19 Duration: At least 12/1/2012 – 4/1/2016 The company did not have tags or labelling on pressure relief valves (PRVs) showing date of installation and when they had been last inspected. When the company later provided information on the date of installation of existing PRVs, it indicated that three existing PRVs had been used for almost four years after they had expired.	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases.	Makes it very difficult to judge whether valves are still functional. Pressure relief valves should be replaced or recalibrated every five years to ensure that they will function properly. Old pressure relief valves can leak ammonia.	ANSI/ASHRAE-15 (2013), Sections 10.1.1 and 10.2 (testing and declaration of test procedures applicable after complete installation and before operation); IIAR Bulletin 109, Section 4.9.7 (Pressure relief valves discharging to atmosphere should be replaced every five years of service.); IIAR Bulletin 110 (June 19, 2007 revision of 6.6.3 regarding replacement and recalibration of pressure relief valves); and National Board Inspection Code Part 2 — Inspection (inspection requirements for pressure relief valves).

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Condition 20 Duration: At least 12/1/2012 – 4/1/2016 Access to and egress from Ammonia machinery room and Ammonia Equipment: Failure to provide a clear and unobstructed approach to refrigeration machinery for inspection, service, and emergency shutdown with adequate clearances for maintenance of equipment. For example, the Pilot Receiver pipe that broke in the March 23 release was in the way of the oil change point for the accumulator located behind the pilot receiver. Also, the Facility lacked safe access to ammonia-containing equipment on the roof, because the roof could only be accessed by an unsecured ladder placed precariously near the wooden steps leading downstairs. Also, at least one isolation valve on the Control Pressure receiver was located approximately eight to ten feet above ground level with no	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases. Failure to minimize the consequences of releases which do occur.	Makes it very difficult to access machinery for proper preventative maintenance, risking an ammonia release from improperly-maintained equipment. Given the configuration of equipment and lack of support under oil drain pipes, these conditions could also lead to inadvertent breakage of these pipes. Likewise, emergency responders would have a difficult time accessing equipment, which could increase the duration of a release. Also, the access/egress deficiencies put	ANSI/IIAR 2-2008 (Add. B, 2012 ed.), Section 13.1.2.2 (Requires a clear and unobstructed approach and space to refrigeration machinery for inspection, service, and emergency shutdown with adequate clearances for maintenance of equipment.); ANSI/IIAR 2-2014, Sections 6.3.1 (Machinery room equipment shall be located in such a manner as to allow egress from any part of the room in the event of an emergency and provide clearances required for maintenance, operation, and inspection according to manufacturer's instructions.); 6.3.3.1 (Manually operated valves inaccessible from floor level shall be operable from portable platforms, ladders, or shall be chain operated.); 6.3.3.2 (Manually operated isolation valves that are part of system emergency shutdown procedure shall be directly operable from floor or chain operated from a permanent work surface.); 6.11 (Machinery rooms shall be equipped with light fixtures delivering a minimum of 30 foot-candles (320 lumens/m^2) at the working level, 36 in. (0.91 m) above a floor or platform and manual control for illumination sources shall be provided.); ANSI/ASHRAE 15 (2013), Sections 8.3 (A clear and unobstructed approach and space shall be provided for inspection, service and emergency shutdown of condensing units, compressor units, condensers, stop valves, and other serviceable components of refrigerating machinery.), Section 9.12.1 (All serviceable components of refrigerating systems shall be provided with safe access.); IIAR Bulletin 109, Section 4.10.3 (The main shut-off valve(s) should be readily accessible….) and General Safety checklist, item e.; IIAR's *Ammonia Refrigeration Manual*, Appendix 10.1, items 7.6 (accessibility of main valves), 11.5 (availability of platforms, ladders or chains for inaccessible valves), 11.33 (lighting) ; and IMC 2009, Section 306.1 (Appliances shall be accessible for inspection, service, repair and replacement without disabling the function of a fire-resistance-rated assembly or

Hazards/Dangerous Condition	GDC Violation	How Condition Could Lead to or Exacerbate the Consequences of a Release, Causing Harm	Examples of Industry Standards of Care, Showing that (1) Hazard is Recognized by Owner/Operator's Industry, and (2) There are Way(s) to Eliminate or Reduce the Hazard
permanent platform or ladder or chain for operation to access the valve in the case of an emergency. Also, the ammonia machinery room was very dark, making it difficult to see, inspect, and move around equipment. Finally, access to and egress from the ammonia machinery room itself was unsafe. The only access and egress was up wooden, combustible stairs, and the upstairs door leading to open air had no steps or adequate protection to prevent someone from falling to the ground.		workers at risk in the event of an ammonia release.	removing permanent construction, other appliances, venting systems or any other piping or ducts not connected to the appliance being inspected, serviced, repaired or replaced.).
Condition 21 Duration: 3/24/2016 – 4/1/2016 There was excessive ice buildup on refrigeration piping, the control pressure receiver, and valves in the ammonia machinery room	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases.	Ice buildup can obscure valves and weigh down components, risking collapse and ammonia release and making it difficult to turn off components. It also exposes pipes to moisture, which can cause corrosion and pipe failure.	ANSI/IIAR 2-2008 (Add. B, 2012 ed.), Section 10.4.1 (Piping hangars and supports shall carry the weight of the piping, as well as any other anticipated loads, e.g. refrigerant weight, insulation, frost/ice, seismic/wind loads, personnel, etc.); ANSI/IIAR 2-2014, Sections 13.4.1 & App. F (Piping hangars shall carry the weight of the piping and any additional expected loads; maximum hangar rod loading tables); App. A, A.13.4.1 (examples of loads include ammonia weight, insulation, frost, ice, seismic, wind, and thermal); 5.10.1 (Piping and equipment surfaces not constructed of corrosion-resistant materials or protected with corrosion-resistant treatment and not intended for heat exchange shall be insulated, treated, or otherwise protected to mitigate condensation and excessive frost buildup; piping and fittings constructed of corrosion-resistant materials or protected with a corrosion-resistant treatment must be routinely defrosted or

Hazards/Dangerous Condition	GDC Violation	How Condition Could Lead to or Exacerbate the Consequences of a Release, Causing Harm	Examples of Industry Standards of Care, Showing that (1) Hazard is Recognized by Owner/Operator's Industry, and (2) There are Way(s) to Eliminate or Reduce the Hazard
			otherwise managed to limit ice accumulation if not insulated; if defrost method of ice control used then must provide means to control and drain condensate); IIAR Bulletin 109, Section 4.10.7 (Ice formations that could endanger refrigerant piping or other components should be removed and the condition(s) that caused the ice build-up corrected.); General safety checklist (item (s): System is free of abnormal ice formations?"); ANSI/ASHRAE 15 (2013), Section 11.6 (Refrigerating systems shall be maintained by the user in a clean condition, free from accumulations of oily dirt, waste, and other debris, and shall be kept accessible at all times.); and IIAR Bulletin 110, Section 6.7 (re. piping maintenance).
Condition 22 Duration: At least 12/1/2012 – 4/1/2016 Failure to adequately safeguard piping, valves, and other system components adequately from accidental damage or rupture by external sources. For example, in the ammonia machinery room, drain lines extending from tanks into walkways were not supported or protected from physical impact. Moreover, no step protection or other support	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases.	Risks ammonia release from accidental damage to system components.	ANSI/ASHRAE 15 (2013), Section 11.1 (Means shall be taken to adequately safeguard piping, controls and other refrigeration equipment to minimize possible accidental damage or rupture due to external sources.); ANSI/IIAR 2-2014, Sections 5.17.1 (Guarding or barricading shall be provided for ammonia-containing equipment installed in a location subject to physical damage.); 13.4.2 (Refrigerant piping shall be isolated and supported to prevent damage from vibration, stress, corrosion, and physical impact.); IIAR Bulletin 109, Section 7 Inspection Checklists for evaporators, item g (adequate protection against traffic hazards?), item b (piping); Ammonia Refrigeration Manual, Appendix 10.1, item 8.10 ("Is all piping protected from traffic hazards such as fork lifts?"); and

Hazards/Dangerous Condition	GDC Violation	How Condition Could Lead to or Exacerbate the Consequences of a Release, Causing Harm	Examples of Industry Standards of Care, Showing that (1) Hazard is Recognized by Owner/Operator's Industry, and (2) There are Way(s) to Eliminate or Reduce the Hazard
was provided to protect the pipe at the base of the Pilot Receiver (which failed, resulting in the ammonia release) from physical impact. In cooler room A, the inspectors observed pallet racks installed near the ceiling and directly underneath ammonia piping and evaporator units. The inspectors observed a damaged drainage pan under one of the cooler room A evaporators, indicating that a forklift or other equipment had run into the pan. The inspectors also observed a low, unprotected liquid trap on ammonia piping running above one of the loading dock bays. The temporary refrigeration piping and electrical cords running across the floor in the loading dock area presented a trip hazard for employees working in the area.			IMC 2009, Section 1107.2 (Refrigerant piping that crosses an open space that affords passageway in any building shall be not less than 7 feet 3 inches above the floor unless the piping is located against the ceiling of such space.).
<u>Condition 23</u> Duration: 3/24/2016 – 4/1/2016	Failure to design and maintain a safe facility taking	This computerized system was intended to provide an extra measure of safety to	IIAR Bulletin 109, IIAR Minimum Criteria for a Safe Ammonia Refrigeration System, Section 4.10.1 (All installed instruments should be in working order. Inaccurate or broken instruments should be replaced.); and

Hazards/Dangerous Condition	**GDC Violation**	**How Condition Could Lead to or Exacerbate the Consequences of a Release, Causing Harm**	**Examples of Industry Standards of Care, Showing that (1) Hazard is Recognized by Owner/Operator's Industry, and (2) There are Way(s) to Eliminate or Reduce the Hazard**
The Facility had a computerized panel to help monitor and control the refrigeration system (the "M&M System"), but it appeared not to be properly calibrated, as it read out the wrong time. Duration: 10/7/2015 – 10/14/2015; 11/12/2015 – 1/16/2016; 1/28/2016 – 2/23/2016; and 3/4/2016 – 3/28/2016 The interlocks triggered by the ammonia detector had been manually disabled, such that a detection of high ammonia levels would not automatically turn on ventilation, activate alarms, or shut off machinery.	such steps as are necessary to prevent releases. Failure to minimize the consequences of releases which do occur.	monitor performance of the system and, in the case of an ammonia leak, turn on ventilation, activate alarms and shut down compressors.	IIAR Bulletin No. 110 *Startup, Inspection and Maintenance of Ammonia Mechanical Refrigerating Systems*, Section 6.6.4 (Sensing Devices, Monitoring Devices, Sensors, Alarms, Interlocks, and Emergency Shutdown Systems: These devices or systems may take the form of pressure, temperature or level-operated switches or controls, Bourdon tube pressure gauges, or ammonia vapor detectors. It also includes remote level indicators, data collection systems, annunciators, or other automatic devices connected to these other devices. Manufacturer's instructions for inspection, testing, calibration, and overhaul shall be followed. At least annually, safety cutouts shall be tested. Pressure gauges used in the testing of any safety cutouts shall be calibrated.).
<u>Condition 24</u> Duration: At least 12/1/2012 – 4/1/2016 Inadequate eyewash and lack of safety showers inside or immediately outside the maintenance/ ammonia machinery room.	Failure to minimize the consequences of releases which do occur.	Makes it difficult for emergency responders and workers to safely respond to releases and wash off this corrosive, toxic chemical in the event of exposure.	ANSI/IIAR 2-2008 (2012 ed.), Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems, Section 13.1.6 (An eyewash and body shower unit shall be located external to the machinery room and readily accessible via an exit.); and ANSI/IIAR 2-2014, Section 6.7 (Eyewash/Safety Shower. 6.7.1 General. Each machinery room shall have access to a minimum of two eyewash/safety shower units, one located inside the machinery room and one located outside of the machinery room, each meeting the requirements in Section 6.7.3. Additional eyewash/safety shower units shall be installed such that the path of travel in the machinery room is no more than 55 ft to an eyewash/safety shower unit. 6.7.2 Path of Travel. The path of travel within the machinery room to at least one eyewash/safety shower unit shall be unobstructed and

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There was an eyewash station (without a safety shower) at the bottom of the wooden stairs, but it would not have been easily accessible by a worker in the machinery room upstairs, and it was not located external to the machinery room and thus would not be safe to use during a release.			shall not include intervening doors. 6.7.3 Installation Standard. Emergency eyewash/safety shower unit installations shall comply with ANSI/ISEA Z358.1).
Condition 25 Duration: At least 12/1/2012 – 4/1/2016 The floor drains in the maintenance/ammonia machinery room did not have means to prevent the entry of spilled materials such as oil and ammonia. The drains are connected with the storm drain system, which may lead to Boston Harbor.	Failure to minimize the consequences of releases which do occur.	The refrigeration system contains both ammonia and oil, so it is foreseeable that both substances could be released into the water, causing environmental damage and exacerbating the negative consequences of any releases that do occur.	ANSI/IIAR 2-2014, Section 6.9 Drains. (6.9.2 Contaminant Control. Where a drainage system is not designed for handling oil, secondary coolants, or other liquids that might be spilled, a means shall be provided to prevent such substances from entering the drainage system. 6.9.3 Control of Ammonia Systems. A means shall be provided to limit the spread of a liquid ammonia spill into the machinery room drainage system.); and ANSI/ASHRAE 15-2013, Section 11.3: (Except for the discharge of pressure relief devices and fusible plugs, incidental releases due to leaks, purging of noncondensables, draining oil, and other routine operating or maintenance procedures, no refrigerant shall be discharged to the atmosphere or to locations such as a sewer, river, stream or lake.).
Condition 26 Duration: 3/24/2016 – 4/1/2016 The windsock observed on the building could not be seen from	Failure to minimize the consequences of releases	Properly placed windsocks help minimize the consequences of releases that do occur by helping	40 C.F.R. § 1910.119 Appendix C -- Compliance Guidelines and Recommendations for Process Safety Management (Nonmandatory): (For outdoor processes where wind direction is important for selecting the safe route to a refuge area, the employer should place a wind direction indicator such as a wind sock or pennant at the highest point that

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multiple locations around the Facility.	which do occur.	emergency responders understand what direction the wind may be carrying toxic ammonia plumes. They can issue shelter-in-place orders or muster evacuees accordingly.	can be seen throughout the process area. Employees can move in the direction of cross wind to upwind to gain safe access to the refuge area by knowing the wind direction); ANSI/IIAR 2-2014, Section 5.14.6 (Where a sock, pennant or other wind indicator is provided, it shall be in accordance with specifications and locations prescribed by emergency planning documents.); and IIAR's Ammonia Refrigeration Manual, Appendix 10.1, Hazard Review Checklist, item 11.22 at A10-43 ("Is a windsock or some other means of indicating wind direction provided at the facility?").
<u>Condition 27</u> Duration: 4/1/2016 The copper water piping around the ammonia feed line to the evaporator in the fish cutting room was oxidized with a bluish-green patina, indicating that ammonia may have been leaking from the refrigeration valves or piping at some point in the past.	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases. Failure to minimize the consequences of releases which do occur.	Leaking valves or piping could lead to a release of ammonia, endangering employees. Also, a small, slow leak could get worse if not addressed.	IIAR Bulletin 109, Section 4.10.8 (If an ammonia leak is observed, the source of the leak should be investigated and the leak repaired.); and IMC 2009, Section 1101.7 (Mechanical refrigeration systems shall be maintained in proper operating condition, free from accumulations of oil, dirt, waste, excessive corrosion, other debris and leaks.).
<u>Condition 28</u>	Failure to design and maintain a safe	Adequate supports can prevent ammonia system	IIAR 2-2008 (Add. B) Section 14.4.1 (Supports and foundations shall be adequate to prevent detrimental vibration, movement and any site-specific external loads.).

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Duration: At least 3/24/2016 – 4/1/2016 One of the support legs on an icemaker in cooler room B was not bolted to the floor.	facility taking such steps as are necessary to prevent releases.	machinery and prevent detrimental vibration or movement that might make the equipment fail and release ammonia.	
<u>Condition 29</u> Duration: 7/23/2014 – 4/1/2016 Inadequate and inaccurate emergency action plan. For example, the plan called for use of particular equipment, including a portable gas meter and a self-contained breathing apparatus, but the Facility did not have this equipment. Also, the plan lists the wrong phone number to call to report releases of hazardous substances. In addition, in several instances, the plan cites emergency/evacuation procedures in "Section 3," which does not exist. Plan did not set out how Facility employees would respond to a release.	Failure to minimize the consequences of releases which do occur.	Can impede a swift, safe emergency response and thus increase risks to workers, emergency responders and people off-site.	IIAR's *Ammonia Refrigeration Management Program* Section 7 (2005) (Refrigeration facilities should develop an up-to-date, facility-specific emergency action plan that accurately describes the facility and the potentially affected population. Such a plan should include, among other items: types of evacuation, evacuation procedures and routes, procedures for employees who remain to maintain critical operations, procedures for accounting for evacuated employees, any employee rescue and medical duties, and means for reporting emergencies. An adequate emergency response program should also identify procedures for responding to an ammonia release, including shutting the system down, starting emergency ventilation, and coordinating with all relevant off-site emergency responders.).

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Condition 30 Duration: 2/7/2014 – 4/1/2016 Failure to have a program to evaluate and properly manage changes to the process. Stavis did not conduct any evaluations to manage changes to the System. The only System change for which Stavis had any management of change documents was for the installation of a condenser in 2014, but the form was neither completed nor signed.	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases.	Failure to fully evaluate and control the impacts of contemplated changes to a process could inadvertently lead to hazards that could cause a release (such as over-pressurization, reactions from incompatible metals, failure of temporary fixes, etc.).	IIAR Bulletin 107, Section 5.6 (For all system modifications, follow "Management of Change" procedures. (See IIAR Process Safety Management Guidelines; OSHA 29.1910.119 Process Safety Management of Highly Hazardous chemicals.) Ensure that all designs and installations are reviewed by the jurisdictional authority.); IIAR's *Ammonia Refrigeration Management Program* (2005), Section 11, Appendix 11.1 (recommending use of refrigeration system change procedures to manage any changes to refrigeration equipment that would result in a change to refrigeration system documentation).
Condition 31 Duration: 11/1/2014 – 4/1/2016 Failure to conduct periodic, thorough mechanical integrity audits of refrigeration equipment. The most recent mechanical integrity audit of the System was conducted by Stavis's contractor in October 2009, more than six years prior to the Release.	Failure to design and maintain a safe facility taking such steps as are necessary to prevent releases.	Risks accidental releases of ammonia if piping and/or equipment problems and/or deterioration are not identified in advance of failure.	The industry standard of care calls for a *preventative* maintenance program. *See, e.g.*, IIAR Bulletin No. 109, *IIAR Minimum Safety Criteria for a Safe Ammonia Refrigeration System*, Section 5.3 ("A more thorough inspection of an ammonia refrigeration system should be conducted by a competent refrigeration engineer and/or fire safety official and/or other authority every five years.").