RAGAGEP: Codes, Standards, and Good Engineering Practice

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Introduction
PSM RAGAGEP References

Title 29 §1910.119(d)(3)(ii) Process Safety Information
• The employer shall document that equipment complies with recognized and generally accepted good engineering practices.

Title 29 §1910.119(j)(4)(ii) Mechanical Integrity
• Inspection and testing procedures shall follow recognized and generally accepted good engineering practices.

Title 29 §1910.119(j)(4)(iii) Mechanical Integrity
• The frequency of inspections and tests of process equipment shall be consistent with applicable manufacturers' recommendations and good engineering practices, and more frequently if determined to be necessary by prior operating experience.
RAGAGEP Citations

Citation 1
Type of Violation: Serious


On or about the employer did not document that is complied with recognized and generally accepted good engineering practices (RAGAGEP) exposing employees to the hazards of inhalation of toxic ammonia and/or fire/explosion in the following instances, see A through E:

A. The employer failed to document compliance with RAGAGEP, such as ILAR Bulletin 111A. "Identification of Ammonia Refrigeration Piping and System Components" Section 4.1 "Piping Markers" and Section 5.0 (a-d) "Marker Location", March 2014, as the employer failed to mark and/or label ammonia refrigeration equipment, including:

1. Engine Room 5, Evaporating Condenser, tower EC-1
2. Engine Room 6, Evaporating Condenser, tower EC-2
3. Engine Room 7, Evaporating Condenser, towers EC-1 and EC-2
4. Engine Room 8, Evaporating Condenser, towers EC-1, EC-2 and EC-3
5. Engine Room 11, Evaporating Condenser, tower EC-1, EC-2 and EC-3

B. Failure to document compliance with RAGAGEP, such as ILAR Bulletin 110A "Guidelines for: Start-up, Inspection and Maintenance of Ammonia Mechanical Refrigerating Systems" Section 6.6 Valves and Sensing Devices Subsection 6.6.1 Shut-off Valves, as the employer failed to change out ammonia refrigeration system safety relief valves prior to their 5 year due dates from the date of installation, including:

1. Engine Room 6, Heat Exchangers 1, 2 and 3. These are dual relief systems using Hansen Valves.

ABATEMENT DOCUMENTATION REQUIRED FOR THIS ITEM

Date By Which Violation Must be Abated: 07/29/2016
Proposed Penalty: $7000.00
OSHA RAGAGEP Memo

Four examples of RAGAGEP

1. Widely adopted codes
2. Consensus documents
3. Non-consensus documents
4. Internal standards

May 11, 2016

MEMORANDUM FOR: REGIONAL ADMINISTRATORS
THROUGH: DOROTHY DOUGHERTY
Deputy Assistant Secretary
FROM: THOMAS M. GALASSI, Director
Directorate of Enforcement Programs
SUBJECT: RAGAGEP in Process Safety Management Enforcement
Ammonia Refrigeration Code Organizations
IIAR Literature


IIAR Bulletin No. 108 Guidelines for: Water Contamination in Ammonia Refrigeration Systems


IIAR Bulletin No. 110 Guidelines for: Start-up, Inspection and Maintenance of Ammonia Mechanical Refrigerating Systems

IIAR Bulletin No. 111 Guidelines for: Ammonia Machinery Room Ventilation

IIAR Bulletin No. 112 Guidelines for: Ammonia Machinery Room Design

IIAR Bulletin No. 114 Guidelines for: Identification of Ammonia Refrigeration Piping and System Components

IIAR Bulletin No. 116 Guidelines for: Avoiding Component Failure in Industrial Refrigeration Systems Caked by Abnormal Pressure or Shock

IIAR Bulletin No. 110 §6.4.2 [emphasis mine]:

The system **should** be checked regularly for the presence of non-condensable gases which **should** be purged as necessary from the receiver(s) and/or condenser(s), **preferably** into a noncondensable gas remover or purger but **alternatively** into water. Where an automatic purger is fitted, its correct operation **should** be monitored. If there is a large accumulation of noncondensable gases the reason **should** be investigated and the cause **should** be corrected.
IIAR Suite of Standards

- ANSI/IIAR 1 Definitions and Terminology Used in IIAR Standards
- ANSI/IIAR 2 Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems
- ANSI/IIAR 3 Ammonia Refrigeration Valves
- ANSI/IIAR 4 Installation of Closed-Circuit Ammonia Mechanical Refrigeration Systems
- ANSI/IIAR 5 Start-up and Commissioning of Closed-Circuit Ammonia Refrigeration Systems
- IIAR 6 Standard for Inspection, Testing, and Maintenance of Safe Closed-Circuit Ammonia Refrigeration Systems
- ANSI/IIAR 7 Developing Operating Procedures for Closed-Circuit Ammonia Mechanical Refrigerating Systems
- ANSI/IIAR 8 Decommissioning of Closed-Circuit Ammonia Mechanical Refrigeration Systems
- IIAR 9 RAGAGEP Standard
IIAR Bulletins Currently in Publication

Guidelines for:
Identification of Ammonia Refrigeration Piping and System Components

Guidelines for:
IIAR Minimum Safety Criteria for a Safe Ammonia Refrigeration System

Guidelines for:
Start-up, Inspection and Maintenance of Ammonia Mechanical Refrigerating Systems
IIAR Standard 2

- ANSI/IIAR 2 Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems
IIAR 2 vs. ASHRAE 15
Other RAGAGEP Documents

- International Mechanical/Fire Code
- ASME B31.5 Refrigeration Piping and Heat Transfer Components
- ASME Boiler and Pressure Vessel Code Section VIII Rules for the Construction of Pressure Vessels
- ANSI/ISEA Z358.1-2014 Emergency Eyewash and Shower Equipment
RAGAGEP Confusion

- **2015 IMC §1101.6**
  - Ammonia-refrigerating systems shall comply with this code and, except as modified by this code, **ASHRAE 15** and **IIAR 2**.
- **ANSI/IIAR 2-2014 §5.7.2.1**
  - Cast iron, malleable iron, nodular iron, steel, cast steel, and alloy steel shall be permitted in accordance with **ASME B31.5** or **ASME B&PVC, Section VIII, Division 1**. Other metallic materials, including but not limited to aluminum, aluminum alloys, lead, tin, and lead-tin alloys shall be permitted in accordance with Section 5.7.1. Where tin and tin-lead alloys are used, the alloy composition shall be verified as suitable for temperature exposures, as specified in Section 5.6.
RAGAGEP Confusion

- **ANSI/IIAR 2-2014 §6.7.3**
  - Emergency eyewash/safety shower unit installations shall comply with ANSI/ISEA Z358.1.

- **ANSI/IIAR 2-2014 §6.15.1**
  - Buildings and facilities with refrigeration systems shall be provided with placards accordance with NFPA 704 and the Mechanical Code.
RAGAGEP Confusion

- **ANSI/ASHRAE 15-2013 §11.2.2**
  - 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 A13.1, Scheme for Identification of Piping Systems*.

- **ANSI/ASHRAE 15-2013 §8.5**
  - Electrical Safety. Electrical equipment and wiring shall be installed in accordance with the *National Electrical Code* and the requirements of the AHJ.
RAGAGEP Confusion

- IMC
  - IIAR 2
  - NFPA 704
  - B&PV Code Section VIII
  - ANSI/ISEA Z358.1
- ASHRAE 15
  - NEC
  - ANSI A13.1
IIAR and Model Codes

- **2015 IFC §606.12.1.1 Ammonia refrigeration.** Refrigeration systems using ammonia refrigerant and the buildings in which such systems are installed shall comply with IIAR-2 for system design and installation and IIAR-7 for operating procedures.

- **2015 NFPA 1 §53.1.3 Reference Codes and Standards.** Refrigeration systems shall be in accordance with ASHRAE 15 and the mechanical code. Refrigeration systems using ammonia as a refrigerant shall also comply with ANSI/IIAR 2, Standard for Equipment, Design and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems.
IIAR and Model Codes

- **2015 UMC §1102.1 General.** Refrigeration systems shall comply with this chapter and ASHRAE 15. Exception: Ammonia refrigeration systems shall comply with IIAR 2, IIAR 3, and IIAR 5.

- **2015 IMC §1101.6 General.** Refrigeration systems shall comply with the requirements of this code and, except as modified by this code, ASHRAE 15. Ammonia-refrigerating systems shall comply with this code and, except as modified by this code, ASHRAE 15 and IIAR 2.
IIAR and Model Codes

- **NFPA 70-2017 §505.5** Refrigerant machinery rooms that contain ammonia refrigeration systems and are equipped with adequate mechanical ventilation that operates continuously or is initiated by a detection system at a concentration not exceeding 150 ppm shall be permitted to be classified as “unclassified” locations. Informational Note: For further information regarding classification and ventilation of areas involving closed-circuit ammonia refrigeration systems, see ANSI/ASHRAE 15-2013, Safety Standard for Refrigeration Systems, and **ANSI/IIAR 2-2014**, Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems.
Conflicts in RAGAGEP

- Maximum Length of Relief Valve Discharge Piping
Conflicts in RAGAGEP

Maximum Length of Relief Valve Discharge Piping

**2012 UMC:**

\[ L = \frac{9P^2d^5}{16C^2} \]

**VS.**

**2012 IMC:**

\[ L = \frac{0.2146d^5(P_0^2 - P_2^2)}{fC_r^2} - \frac{d\times\ln(P_0/P_2)}{6f} \]
Conflicts in RAGAGEP

Relief Valve Discharge Termination
RAGAGEP Conflicts – Best Practices

- **Documentation** - Clearly document the RAGAGEP(s) used in design and installation
- **Communication**
  - Role of the AHJ
  - Role of the Design Engineer
  - Role of the Contractor
  - Role of Consultant / PHA Team

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### Design and Installation Codes and Standards Employed

To the best of the undersigned’s knowledge, the Ammonia Refrigeration Project at ACME Cold Storage was designed and installed in accordance with the following codes and standards:

- 2016 International Mechanical Code, Chapter 11 Refrigeration
- 2016 International Fire Code Section 608 Mechanical Refrigeration
- ANSI/IIAR 4-2015 Installation of Closed-Circuit Ammonia Refrigeration Systems
- ASME B31.5-2016 Refrigeration Piping and Heat Transfer Components
- 2015 ASME Boiler & Pressure Vessel Code Section VIII Fusible for Construction of Pressure Vessels, Division 1

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Print Name | Signature | Date
Grandfathering

Scenario:
- Cold Storage Facility was built in 1969 in accordance with the 1967 UMC.
Grandfathering

Scenario:
- In 1998, modifications were made to the machinery room
  - New compressor installed
  - AHJ required ventilation and detection to be upgraded
  - All changes performed in accordance with 1997 UMC
Grandfathering

Scenario:
• In 2014, facility hired a contractor to construct a new cold storage room
  o No machinery room modifications required
  o New room must comply with 2012 IMC and ANSI/IIAR 2-2008 Addendum B
  o Facility elected to upgrade detection for entire facility to comply with 2012 IMC
Grandfathering

What RAGAGEP is applicable at the facility?

- Originally Installed System
- New Compressor and Ventilation System
- New Room and Detection System
Consideration of New RAGAGEPs

When a new code/standard is released, what do I do?

• Role of Process Safety Information
  o Title 29 CFR §1910.119(d)(3)(ii) *The owner or operator shall document that equipment complies with recognized and generally accepted good engineering practices.*
Addressing New Codes/Standards

When a new code/standard is released, what do I do?

- Role of PHA

### 1: Flooded Accumulator (Surge Drum)

<table>
<thead>
<tr>
<th>What If</th>
<th>Scenarios</th>
<th>Consequences</th>
<th>Safety Likelihood Risk Rankings</th>
<th>Safeguards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What if the equipment or associated components is damaged by nearby activity?</td>
<td>A forklift driver accidentally hits this piece of equipment.</td>
<td>1. Death 2. Injury 3. Low pressure liquid ammonia release 4. Reactive maintenance</td>
<td>4 1</td>
<td>1. The flooded accumulators are located behind bunker walls which provide some protection from forklift impact. 2. Facility forklift drivers have been trained to take extra care when driving around the refrigeration equipment. 3. The flooded accumulators are located on the roof which is inaccessible to vehicle traffic.</td>
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</tbody>
</table>
When a new RAGAGEP is released, what do I do?

- Role of Mechanical Integrity
  - Title 29 CFR §1910.119(j)(4)(ii) Inspection and testing procedures shall follow recognized and generally accepted good engineering practices.
Questions?

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