ARM-LC Workshop

Ammonia Refrigeration Management – Low Charge

Kurt Liebendorfer
Vice President - Evapco

SAFE AND SUSTAINABLE USE OF NATURAL REFRIGERANTS

The Definitive Guide to Low Charge Ammonia is Here!

IIAR is pleased to introduce the **NEW *Low Charge Ammonia Refrigeration Management (ARM-LC) Guidebook and Summary Guide***! Designed to help in implementing a low charge ammonia refrigeration systems management program.

https://www.iiar.org/IIAR/WCM/WCM/IIAR_Publications/Books.aspx

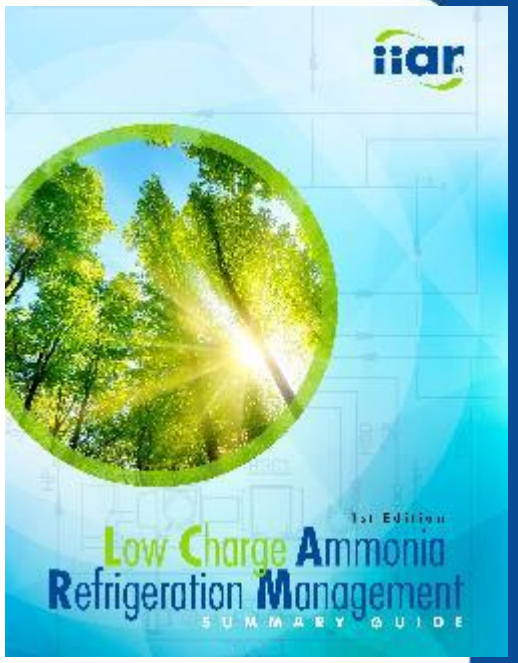
The presentation will provide an overview of the ARM-LC program sections and illustrate how it can assist users in applying ammonia refrigeration to their facilities.

It is important to know ARM-LC is a “Guideline” and not a Code or Regulation.

Workshop Overview

ARM-LC

IIAR's new *ARM-LC (Low Charge) Guidelines and Reference Manual* is a great resource to assist owners, contractors and manufacturers in applying low-charge ammonia refrigeration systems and packages to many different commercial and industrial applications. The ARM-LC program is intended to be a user-friendly tool to facilitate use of low-charge systems for industrial applications and an expanding array of commercial applications including supermarkets, small distribution and food preparation facilities, HVAC chilled water systems, pharmaceutical & bioscience, data centers, ice rinks and more.



Definitions:

Within the scope of this publication a *low charge ammonia refrigeration system* is defined as a refrigeration system or unit with a total operating inventory of less than 500 lbs. in a single closed-loop circuit. A low charge ammonia refrigeration system may be *packaged* or *site built*.

These guidelines apply to facilities that utilize a single low charge ammonia refrigeration system or multiple low charge ammonia refrigeration systems, provided the multiple systems are located such that a release from one system would not cause a release from another system or render another system inoperable.

Learning Objectives

Attending this Workshop you will be able to…

- Understand the 12 building blocks of the ARM-LC program
- Know how to apply it to a refrigeration project
- Learn how ARM-LC can bring long term benefits to all stakeholders

Why ARM-LC?


iar
NATURAL REFRIGERATION CONFERENCE & EXPO • MARCH 3–6, 2019 • PHOENIX CONVENTION CENTER

Below 10,000 lb of Ammonia

Small & Medium Systems

OSHA General Duty Clause

EPA General Duty Clause

Above 10,000 lb of Ammonia

Large Systems

OSHA PSM Regulation 29 CFR 1910.119

EPA RMP Regulation 40 CFR Part 68

Below 500 lb Per Package

Below 10,000 lb of Ammonia

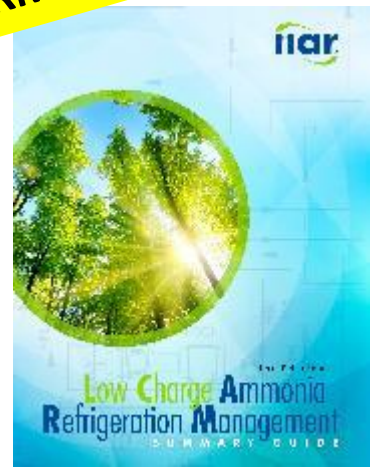
Above 10,000 lb of Ammonia

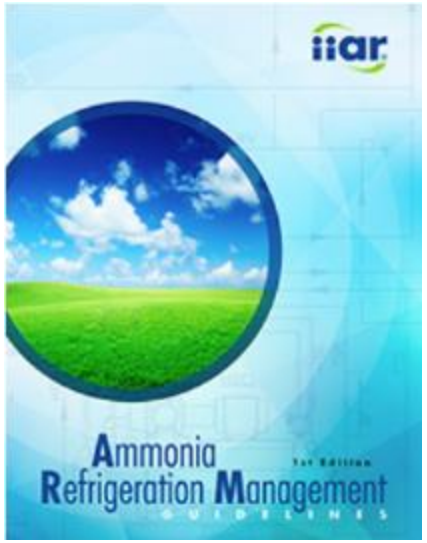
New!

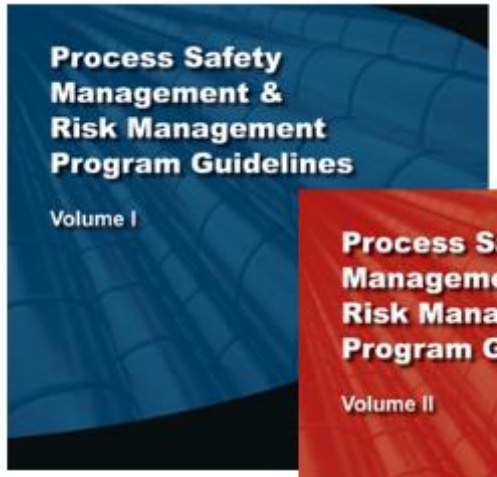
OSHA EPA

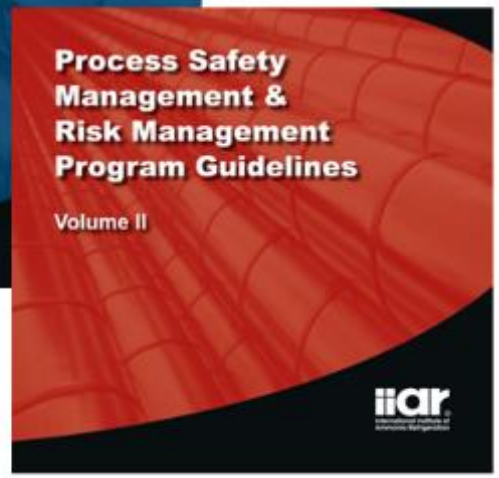
General Duty Clause

ARM-LC









OSHA 29 CFR 1910.119

PSM

EPA

40 CFR Part 68

RMP

OSHA General Duty Clause

UNITED STATES DEPARTMENT OF LABOR

Find it in OSHA

A TO Z INDEX

Occupational Safety and Health Administration

English | Spanish

ABOUT OSHA | WORKERS | EMPLOYERS | REGULATIONS | ENFORCEMENT | TOPICS | NEWS & PUBLICATIONS | DATA | TRAINING

OSHA Laws & Regulations / OSH Act of 1970

OSH Act of 1970

Table of Contents | General Duty Clause | Complete OSH Act Version ("All-in-One")

SEC. 5. Duties

(a) Each employer --

(1) shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;

(2) shall comply with occupational safety and health standards promulgated under this Act.

29 USC 654

(b) Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct.

EPA General Duty Clause

United States Environmental Protection Agency

Environmental Topics | Laws & Regulations | About EPA | Search EPA.gov

Related Topics: Risk Management Plan Rule

CONTACT US SHARE

General Duty Clause under the Clean Air Act Section 112(r)(1)

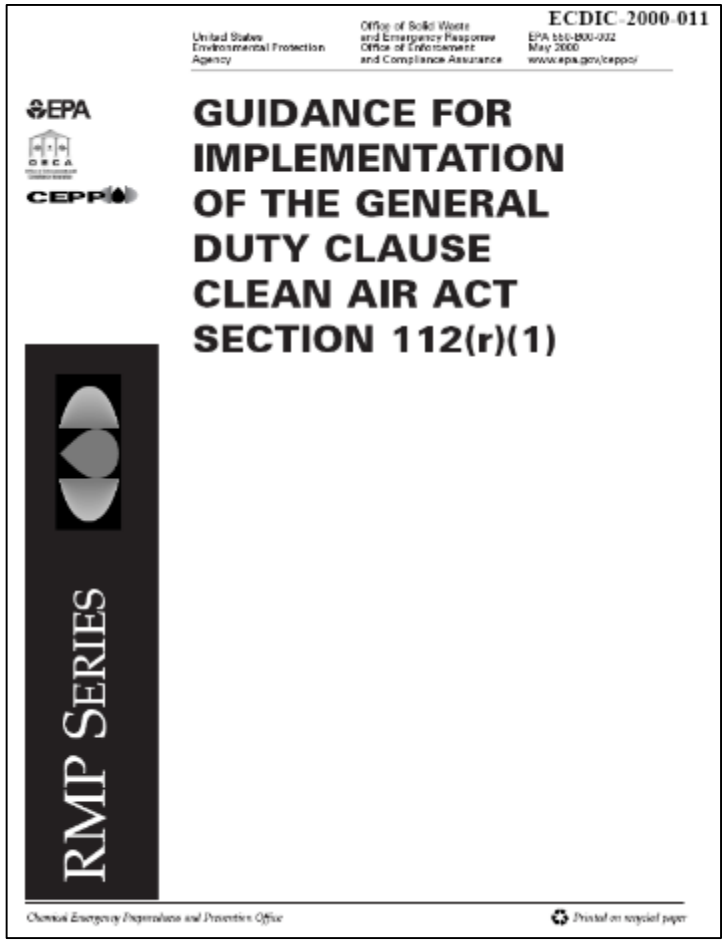
In the Clean Air Act Amendments of 1990, Congress enacted Section 112(r)(1), also known as the General Duty Clause (GDC). It applies to any facility where extremely hazardous substances are present. GDC is a performance based authority recognizing that owners and operators have a general duty and responsibility to prevent and mitigate the consequences of chemical accidents.

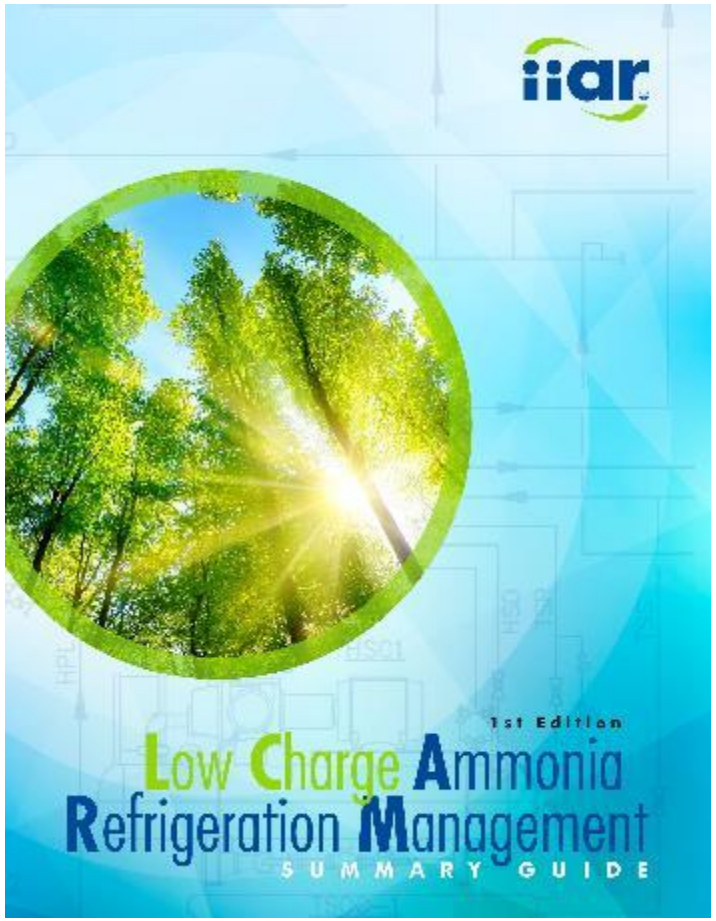
Facilities have been required to comply with GDC since November 1990.

General Duty Clause

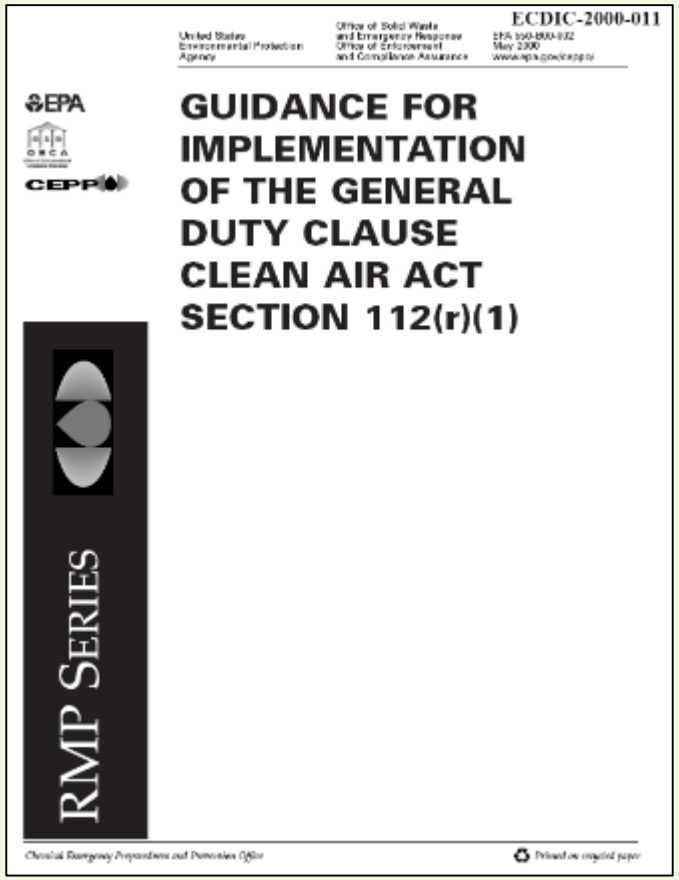
ARM-LC

50 page guidance document





General Duty Clause (GDC)



The General Duty Clause imposes the following primary obligations on the owners and operators of facilities that use ammonia, regardless of system inventory:

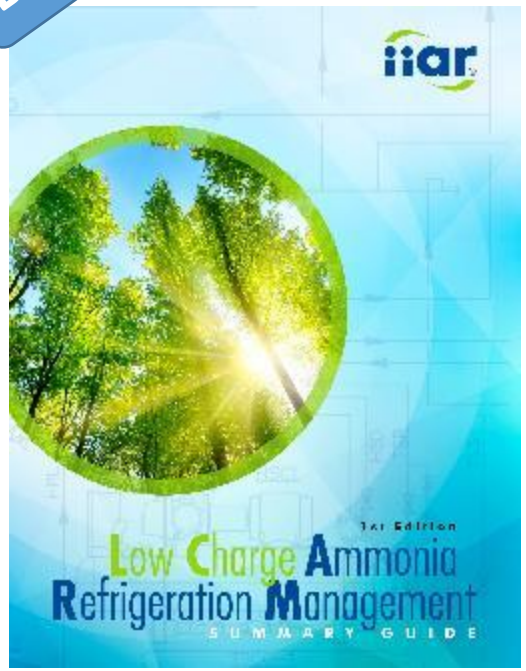
- Identify hazards & consequences that may result from accidental releases
- Design and maintain a safe facility

ARM-LC Guideline provides recommended practices for implementing a management program that addresses regulatory compliance and safety procedures for operating and maintaining a low charge ammonia refrigeration system.

ARM-LC

BOOKLET #1

SUMMARY GUIDE
Scope Split Tables

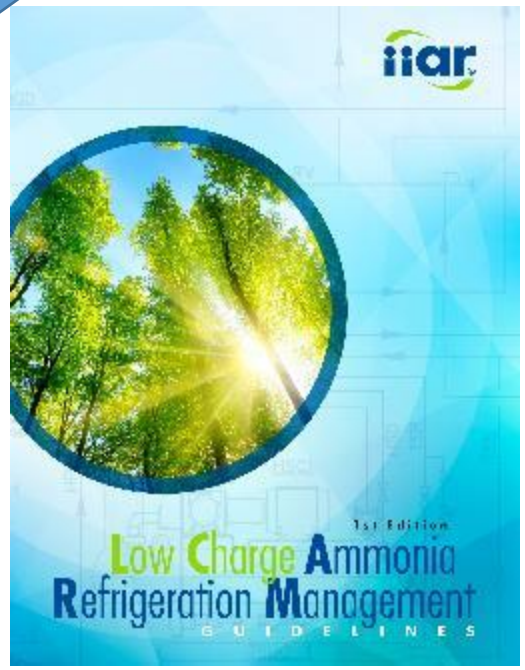


Helpful to Owners & End-users

13 page Summary Overview

BOOKLET #2

GUIDELINES
Instructions & Templates



Helpful to Contractors, Engineers & Manufacturers

86 page Guidance & Sample Templates

BOOKLET #1

SUMMARY GUIDE

Scope Split Tables

6. MAINTENANCE			
Maintenance is integral to improving operating efficiencies, reducing down time, and avoiding potential refrigerant releases. Chapter 6, "Maintenance," summarizes maintenance tasks, task frequencies, and task responsibilities associated with low charge ammonia refrigeration systems. The manufacturer or installing contractor should provide a maintenance schedule. The owner's primary responsibility is to confirm that a maintenance program is provided and implemented in a contractor service agreement.			
Recommendation	**Manufacturer Responsibility**	**Contractor/Designer Responsibility**	**Owner Responsibility**
Develop a maintenance schedule	Provide recommended maintenance schedule for the equipment scope of supply (packaged systems)	Provide recommended maintenance schedule (site-built systems)	Obtain maintenance schedule from manufacturer or contractor and include in contractor service program
Perform maintenance on low charge ammonia refrigeration system	None	Perform maintenance in accordance with equipment manufacturers' recommendations per the owner's service agreement	Confirm that maintenance is performed according to the maintenance schedule and contractor service program
Correct deficiencies outside of an acceptable range	None	Correct deficiencies in accordance with the owner's service agreement	Confirm that deficiencies outside of an acceptable range are addressed per the contractor service agreement

BOOKLET #2

GUIDELINES

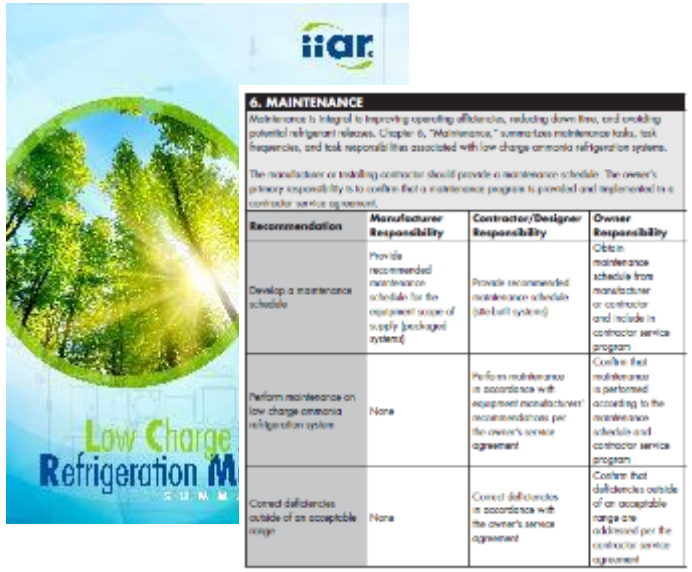
Instructions & Templates

Daily
Monitor compressor parameters such as runtime hours, suction pressure, discharge pressure, oil pressure, oil temperature, discharge temperature, oil level, oil filter differential pressure, load percentage, motor amperage, and alarms. Many systems can provide remote monitoring for these tasks.
Check compressor for oil leaks, abnormal sounds, and excessive vibration
Weekly
Inspect shaft seal leak rate.
Monthly
Inspect operation of unloader.
Semi-Annual
Lubricate component bearings where applicable.
Annual
Inspect compressor to ensure that foundation is solid and mounting bolts are in place.
Inspect compressor for pitting and other surface damage.
Inspect coupling for wear.
Inspect electrical connections.
Inspect operation of oil heaters and record amperage.
Inspect alignment of compressor motor drive shaft.
Test compressor safety shutdowns: low suction pressure, high discharge pressure, low oil pressure, high liquid level.
Calibrate pressure and temperature transducers.
Five-Year
Clean external oil pump suction strainer.
Align external oil pump suction strainer.
As Needed
Add/change oil as indicated by oil analysis or predetermined runtime.
Change oil filter as indicated by oil filter differential pressure, runtime hours, or oil analysis.
Replace shaft seal when predetermined shaft seal leak rate is reached.
Align compressor motor drive shaft when predetermined alignment parameters are exceeded.
Perform oil analysis when predetermined runtime hours are reached.

Available @ liar.org

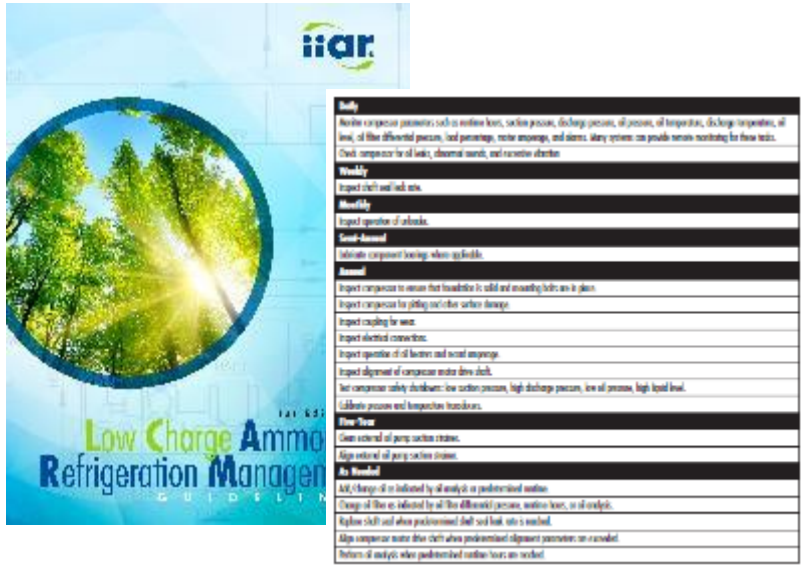
BOOKLET #1

SUMMARY GUIDE
Scope Split Tables



BOOKLET #2

GUIDELINES
Instructions & Templates



- ❑ The Summary Guide tables provide suggested responsibilities for **manufacturers**, **contractors**, and **owners**.
- ❑ The procedures, templates, & recommendations in the Guidelines should be viewed as informative and adjusted as deemed necessary by those responsible for ARM-LC Program implementation at a given site.

The 12 Building Blocks
of ARM-LC

ARM-LC

12 Main Sections

1. Introduction
2. Program Management System
3. Refrigeration System Documentation
4. Safety Review
5. Operating and Maintenance Procedures
6. Maintenance
7. Training
8. Refrigeration Management Program Review
9. Incident Investigations
10. Contractors
11. Emergency Action Plan and/or Response Programs
12. Environmental Safety Evaluation
13. Managing Changes

2. Program Management System

Who's responsible for what?

A program management system is essential to clarify responsibilities and lines of authority. A good program management system clearly defines the responsibility for each ARM-LC Program element.

Manufacturer	Contractor	Owner
• None but deliverables provide content	• Assume various responsibilities	• Assign responsibilities to contractor and employees

TEMPLATES

2. Program Management System

Element	Responsible Person	Responsibilities
Overall ARM-LC Program		• Ensure that all ARM-LC Program requirements are addressed • Ensure that each element is effectively managed and implemented
Refrigeration System Documentation		• Organize all ARM-LC Program refrigeration system documentation • Ensure that refrigeration system documentation is readily available • Ensure that refrigeration system documentation is accurate • Update refrigeration system documentation when a change renders the information inaccurate
Safety Review		• Ensure that a safety review is performed on the low charge ammonia refrigeration system • Ensure that recommendations resulting from the safety review are addressed • Update/revalidate the safety review when a major change occurs
Operating and Maintenance Procedures		• Develop and/or obtain operating and maintenance procedures for the low charge ammonia refrigeration system • Ensure that the procedures accurately reflect the facility's operating and maintenance practices
Maintenance		• Ensure that a preventative and/or predictive maintenance program is developed for the low charge ammonia refrigeration system • Ensure that preventative and/or predictive maintenance is performed on the low charge ammonia refrigeration system at an appropriate frequency
Training		• Ensure that applicable employees receive awareness, process overview, operating/maintenance procedure, and emergency action and/or response training initially and periodically thereafter • Ensure that all training is properly documented
Refrigeration Management Program Review		• Ensure that a refrigeration management program review is performed on the ARM-LC Program at least every five years • Ensure that recommendations resulting from the refrigeration management program review are addressed

3. Refrigeration System Documentation

Who Provides It?

Summarizes technical documentation the manufacturer should supply, or the contractor should develop. The manufacturer or installing contractor should provide most refrigeration system documentation. The owner's primary responsibility is to ensure that documentation is received from them.

Manufacturer	Contractor	Owner
• Provide documentation (packaged systems)	• Provide documentation (stick built systems)	• Obtain documentation

3. Refrigeration System Documentation

TEMPLATES

Declaration of Test

Refrigeration S… …tion:

Locati…

…n System: Ammonia (R-717)

…rant Charge:

Installing Contractor: _____

The low charge ammonia refrigeration system has been pressure tested a… *2016* §538.4 and §538.5 and *ANSI/IIAR 4-2015* §13.1. This declarati… required by *ASME B31.5-2016* §539.3.

Pressure Test:

Test Medium	
High Side	
Low Side	
Tested By	
Testing Date(s)	

Evacuation and Dehydration Test:

Vacuum Pressure	
Tested By	
Testing Date(s)	

Print Name _____ Signature _____ Date _____

Appendix C – Design Codes and Standards Employed Template

Note: This template is intended to serve as an example and should not be viewed as prescriptive. Alternate formats provided by a manufacturer or contractor are encouraged, if they address the best practices in this guideline.

Design and Installation Codes and Stan… Employed

The low charge ammonia system at Company XYZ was designed and … with the following codes and standards:

- *ANSI/IIAR 2-2014*, "Standard for Safe Design of Clos… …rigeration Systems";
- *ANSI/IIAR 4-2015*, "Installation of Closed-… …eration Systems";
- ANSI/ASHRAE 15-2016, "Safety St… …Systems";
- *ASME B31.5-2016*, "Refriger… …ransfer Components";
- ASME (2015), "Sectio… …ion of Pressure Vessels, Division 1," Boiler & Pressure Vessel Co…
- *UL 508a* (201… …ety for Industrial Control Panels."

Manufactures' Should Provide

Appendix D – Start-Up and Commissioning Checklist Template

Note: This template is intended to serve as an example and should not be viewed as prescriptive. Alternate formats provided by a manufacturer or contractor are encouraged, so long as they address the best practices in this guideline.

Instructions: Respond to each question by indicating "yes," "no," or "N/A." The questions have …en written so that a "yes" response indicates compliance with *ANSI/IIAR 5-2013*, while a "no" …onse indicates "not compliant." For any "no" responses, one or more recommendations should …proposed to correct the deficiency. Recommendations may also be developed for "yes" responses if the start-up technician and/or facility personnel agree upon a measure that could improve safety and/or the ARM-LC Program in general.

Question #	Program Element	Question	Response	Comments / Recommendations
1	Pre-Charging	Was the system designed by and installed under the supervision of persons who by reason of knowledge, training, and experience are competent for the tasks? (*ANSI/IIAR 5-2013* §6.1.1) Note: Such persons typically include • Experienced refrigeration contractors, possibly in combination with a code authority, authorized inspection agency, or property insurance underwriter; • In-house design/engineering staff of the owner or the owner's designated representative; • Consulting engineers acting on behalf of the owner or the owner's designated representative; and • Refrigeration equipment suppliers.	☐ Yes ☐ No ☐ N/A	
2	Pre-Charging	Has a system component inventory list been prepared? (*ANSI/IIAR 5-2013* §6.2.1) Note: The list shall include the major components of the ammonia refrigerating system, including compressors, condensers, evaporators, pressure vessels, liquid ammonia pumps, piping, valves and fittings, ammonia machinery room ventilation system, and other control and safety devices.	☐ Yes ☐ No ☐ N/A	
3	Pre-Charging	Does the inventory list contain a record of the maximum working pressure(s) and minimum temperatures? (*ANSI/IIAR 5-2013* §6.2.2)	☐ Yes ☐ No ☐ N/A	

4. Safety Review

Who does it?

Implemented to avoid accidental release and identify, evaluate, and control potential hazards. Manufacturers should perform a safety review for equipment scope of supply, The installing contractor, in conjunction with end user representatives, should perform initial safety reviews relative to jobsite.

Manufacturer	Contractor	Owner
Perform Safety Review on equipment	Participate/lead Safety Review for site-specific questions	Ensure that Safety Review is performed and recommendations resolved

4. Safety Review

TEMPLATES

Manufactures' Should Provide

Safety Review Do

Safety Review Te

Name	Comp

Safety Review Qu

Safety R

Item #	Rec
1	
2	

Item		Yes	No	NA	Recommended Action/Comments	Hero	Action or Resolution	Due Date	Date Completed
10.3	Is acc[illegible] the machinery room(s) restricted to authorized personnel?	Y			Signage on main access door. Control by others	Sengul Topuz	Add to "Warning" in IOM	10-15-15	4-6-16
10.10	Do the machinery rooms have tight-fitting doors which open outward and are fitted with panic-type hardware?	Y			Panic-type hardware to be added	Mark Shaffer	New lever type handle installed in main door. Investigating with [illegible]ufacturer (Wintech) alternate panic hardware	9-18-15	4-6-16
10.12	Is a sign or signs posted in a conspicuous location providing emergency instructions and phone numbers of emergency safety and operating personnel?			N/A	By customer	Sengul Topuz	Add [illegible]	10-15-15	4-6-16
10.13	Is a wind sock or some other means of indicating wind direction provided on the penthouse package?			N/A	By customer	[illegible]	[illegible]to "Warning" in IOM	10-15-15	4-6-16
10.14	Have adequate drains been provided in the machinery room to properly dispose of all wastewater?		N		Add drain in wall at 2 inches ab[illegible]	[illegible]affer	A 3" "WALL DRAIN" has been added behind the recirculator package.	9-18-15	9-10-15
10.15	If floor drains are utilized in the machinery room, has a means been provided to prevent contamination of the drainage system by oil or ammonia?			N/A	See 10.14	Mark Shaffer	Add label next to drain saying it may contain ammonia, oil, water or glycol. I think we should have a special name such as "Emergency Drain" on this label	9-18-15	9-11-15
10.17	Have the compressor and other heavy equipment supports and foundations been designed in accordance with manufacturer's recommendations and other parameters dictated by structure conditions, vibrations, and the relative potential for earthquakes?	Y			Valid[illegible]e design	Don Hamilton	Calculations completed, Need to plan for shake table test.	11-1-15	11-1-15
10.21	Is the machinery room equipped with light fixtures to provide a minimum of 30 ft.-candles (320 lumen/m^2) at the working level, 36 inches above floor?	Y			Validate	Jake Myers	Changed lighting to LED type which provide required ft-candles.	9-18-15	10-4-15

5. Operating and Maintenance Procedures

Who writes them?

The manufacturer of packaged systems, or the installing contractor for field built systems, should provide operating & maintenance procedures. The owner's primary responsibility is to ensure procedures are implemented & updated if changes occurs.

Manufacturer	Contractor	Owner
Provide procedures (packaged system)	Provide procedures (site built systems)	Obtain procedures Ensure that procedures are accessible

5. Operating and Maintenance Procedures

Normal Operations

1. Check the system regularly for proper operation. System parameters can be monitored remotely through the control and alarm systems.
2. Check the low charge ammonia refrigeration system for normal operation of all compressors, condensers, pressure vessels, heat exchangers valves, sensing devices, and relief valves.
3. Verify that system parameters such as temperature, pressure, oil level, noise, and vibration are within normal operating range.
4. Verify that the control panel is free from alarms.
5. Shut down the low charge ammonia refrigeration system if any of the following conditions occurs:
   - Ammonia or oil leaks beyond allowable limits, and
   - Unusual noises or vibrations.

Temporary Operations

Temporary Operations during c

1. Turn the low charge ami ion system "off" at the control panel.
2. Monitor the system pressure power returns.
3. Follow the system start-up procedure to restart the system once power returns.

Ammonia Fill Procedure:

1. Ensure that personnel involved with ammonia delivery are familiar with the emergency procedures for the facility.
2. Identify the location of the nearest eyewash/safety shower (a portable system is generally accepted).
3. Identify the location of the valves that have to be closed to isolate the line/equipment in an emergency.
4. Ensure that personnel involved with ammonia delivery are familiar with ammonia first-aid procedures.
5. Ensure that personnel involved with ammonia delivery are familiar with the line and equipment opening procedures.
6. Notify personnel and supervisor in the area that ammonia fill procedures are to be carried out.

TEMPLATES

Task	Step	Comment
Normal Start of the Unit	1. Visually check the control panel for any shutdowns or alarms, if any are present clear them under the Alarms/Active tab. If alarm or shutdowns return to the screen rectify the issue(s) before moving forward.	
	2. Enable Evaporator #1 by touching "Enable" under the System/Evaporator tab.	
	3. Enable Evaporator #2 by touching "Enable" under the System/Evaporator tab.	
	4. Start the compressor by touching the "Auto" tab in the top left home screen under Control Mode. "Manual" or "Remote could also be selected depending on site specific preferences.	
Normal Operations	1. Confirm that the unit continues to operate within its design parameters, by logging and reviewing operating data and by visual inspection.	Please refer to sec of Operations detailed COLD and their
	2. Perform any unit maintenance at the intervals specified by the IOM	
	3. Actively monitor coil frosting and adjust def and intervals accordingly with seasonal	01 for more detailed information defrost.
Temporary Operations	Dehydration of newly constructed curing.	e SOP-TO-01 for more detailed information on Hot Starts and elevated temperature operations.
Normal Shutdown	1. Unload compressor under Control M tab capacity is under 25%.	Run mode must be in "Hold" to unload manually.
	2. Hit the de.	
	3. Di or 2 by touching "Disable" orator tab.	
Manual Emergency Shutdown	p" button on inside or outside panel.	
	2. outside of the machine room and close	
	3. Activate the machine room exhaust fan by turning the knob on the outside control panel to "HAND".	
	4. Refer to site specific leak control procedures.	
Automatic Emergency Shutdown	Automatic control panel function.	See SO-ESD-01 and SO-ESD-02 for automatic control panel emergency shutdown functions.
Startup following a turnaround or an emergency shutdown	1. Perform pre-startup safety review in accordance with OSHA 29 CFR 1910.119(i).	
	2. Visually check the system for Lockout/Tagout devices.	
	3. Using *4.1.1 Valve Positions* verify all valves are in the correct positions for operation of the unit.	
	4. Follow steps 1-7 of Initial Startup Procedure	

Manufactures' Should Provide

6. Maintenance

Who writes procedures?

The manufacturer of packaged systems, or the installing contractor for field built systems, should provide a maintenance schedule. The owner's primary responsibility is to confirm that a maintenance program is provided and implemented.

Manufacturer	Contractor	Owner
Provide maintenance schedule (packaged system)	Provide maintenance schedule (site built system) Perform maintenance at owner's request	Ensure that maintenance is performed

6. Maintenance

TEMPLATES

Equipment Maintenance

Monthly Maintenance of a Low Cha… …em

1. Lubricate electric motors per manu… …instructions.
2. Inspect and clean heat exchanger surfaces, as necessary.

Quarterly Maintenance of a Low Charge Ammonia System

1. Inspect condition of the compressor drive, including guards.
2. Inspect control indicator lights.
3. Inspect and test ammonia detection audible and visual alarms.
4. Inspect piping for corrosion and insulation damage.

Annual Maintenance of a Low Charge Ammonia System

1. Inspect compressors per manufacturer's instructions.
2. Check, clean, or replace compressor filters and strainers, including oil filter if necessary.
3. Clean air-cooled condenser fins, if necessary.
4. Calibrate thermocouples, temperature probes, and gas detectors.
5. Inspect electrical connections for tightness or perform a thermal scan.
6. Analyze compressor oil and replace if necessary.

Test Emergency Stop Switch (E-Stop)

1. Inform all necessary personnel that the low charge ammonia refrigeration system will be shut down for a period of time.
2. Activate the E-Stop.
3. Verify that the system has been completely shut down.
4. If the E-Stop fails to operate when tested, initiate corrective measures immediately to resolve the deficiency.
5. If the E-Stop functions properly, restart the system following the operating procedure.

Manufactures' Should Provide

EQUIPMENT	TEST OR INSPECTION	FREQUENCY
Entire System	Monitor and fill in daily log sheet	Once a Day
	Conduct a thorough inspection of the refrigeration system using inspection checklists such as those in IIAR Bulletin #109	Once a Year
	Conduct a thorough inspection of the refrigeration system using inspection checklists such as those in IIAR Bulletin #109 by an outside contractor	Once Every Five Ye…
Plate and Shell Condenser (Water Cooled Units)	Monitor condenser water treatment system	Mo…
	Check cooling tower fans, guard… and nozzles; flush cooling t… pans; check water filter…	…nths
Air Cooled Condenser (Air Cooled Units)	Monitor condense… for excessive d… clean as n…	Monthly
Compressor	Check… …bottle. In… …indicate …eal failures.	Monthly
	…pressor safety cut- …calibration instrumen- …n	Once a Year
	Oil analysis	Every Six Months
	Vibration analysis	Once a Year
	Check coupling elastomer elements for wear	Once a Year
	Thorough inspection of shaft seal, check valve, oil solenoid valve, oil stop valve, oil filter, bearings	Every 5,000 hours
	Replace shaft seal, check valve and bearings	Every 20,000 to 40,000 Hours or Based on Operating Conditions
	Replace oil solenoid valve	Every 100,000 Hours or Based on Operating Conditions
Recirculator System	Check pump bearing monitor	Every Six Months
	Test the high level compressor cutout on the recirculator vessel	Once a Year

7. Training

How does it get done?

Many low charge ammonia refrigeration systems are designed for unattended operation with monitored control. Therefore, the installing contractor or manufacturer will often provide training. The owner's primary responsibility is to ensure that servicing entity has proper credentials and appropriate provisions for emergency action plans.

Manufacturer	Contractor	Owner
Provide initial training at owner's request (package systems)	Provide initial training at owner's request (site built systems)	Ensure that employees receive training

7. Training

Date of Training: _____

Description of Training:

TEMPLATES

Participants:

Trainees: _____

_____

_____

_____

_____

_____

_____

_____

_____

Trainer: _____

Method of Competency Verification:

☐ Observation ☐ Discussion ☐ Demonstration

☐ Oral Exam ☐ Written Exam ☐ Other

8. Refrigeration Management Program Review

How to keep current?

Re-evaluating compliance with the ARM-LC Program periodically is important. The servicing entity can perform most self-audits. The owner's primary responsibility is to ensure that a refrigeration management program is reviewed periodically to address any safety or compliance issues.

Manufacturer	Contractor	Owner
• N/A – support as requested	• Participate in audit at owner's request	• Perform a Self Audit every five (5) years

8. Refrigeration Management Program Review

Refrigeration Management Program Review Team

Name	Company	Title	Expertise	Team Leader
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No
				☐ Yes ☐ No

Refrigeration Management Program Review Questions

TEMPLATES

Refrigeration Management Program Review Recommendations

Item #	Recommendation	Responsible Person	Due Date	Actual Completion Date	Description of Resolution and Supporting Documentation
1					
2					

Question #	Program Element	Question	Response	Comments / Recommendations
13	Refrigeration System Documentation	Does the refrigeration system documentation include a description of safety systems?	☐ Yes ☐ No ☐ N/A	
14	Refrigeration System Documentation	Does the refrigeration system documentation include start-up and commissioning documentation?	☐ Yes ☐ No ☐ N/A	
15	Refrigeration System Documentation	Does the refrigeration system documentation include a site map indicating the location of the low charge ammonia refrigeration systems?	☐ Yes ☐ No ☐ N/A	
16	Safety Review	Has a safety review been performed on each low charge ammonia refrigeration system?	☐ Yes ☐ No ☐ N/A	
17	Safety Review	Have all safety review recommendations been addressed?	☐ Yes ☐ No ☐ N/A	
18	Safety Review	Has a report been prepared for each safety review?	☐ Yes ☐ No ☐ N/A	
	Operating and Maintenance Procedures	Have operating and maintenance procedures been prepared to outline the steps to safely operate and maintain the low charge ammonia refrigeration system?	☐ Yes ☐ No ☐ N/A	
	Operating and Maintenance Procedures	Are the operating and maintenance procedures readily available to personnel responsible for performing the procedure tasks?	☐ Yes ☐ No ☐ N/A	
	Operating and Maintenance Procedures	Have operating and maintenance procedures been reviewed periodically to ensure that they reflect current operating practice?	☐ Yes ☐ No ☐ N/A	
	Maintenance	Has a maintenance program been developed for the low charge ammonia refrigeration system?	☐ Yes ☐ No ☐ N/A	

9. Incident Investigations

How does it get done?

When an incident occurs, the owner's primary responsibility is to initiate an investigation. The owner will often solicit assistance from the servicing contractor when performing an incident investigation.

Manufacturer	Contractor	Owner
N/A – support as requested	Participate in investigations at owner's request	Investigate incidents Ensure corrective measures are implemented

9. Incident Investigations

TEMPLATES

Date of Incident: _____

Date of Investigation: _____

Description of Incident:

Factors that Contributed to the Incident (Select All that Apply):

- ☐ Equipment Failure
- ☐ Human Error
- ☐ Design Failure
- ☐ Unusual Weather
- ☐ Maintenance Activity/Inactivity
- ☐ Bypass Condition
- ☐ Over-Pressurization
- ☐ Unsuitable Equipment
- ☐ Management Error
- ☐ Other _____

Incident Investigation Recommendations:

Item #	Recommendation	Responsible Person	Due Date	Actual Completion Date	Description of Resolution and Supporting Documentation
1					
2					

Incident Investigation Leader: _____

10. Contractors

How to do it right?

Owner's primary responsibilities are to select a qualified contractor, inform them of site emergency procedures & periodically evaluate contractor. The manufacturer of a packaged system should provide installation instructions and associated safety precautions for the contractor to follow.

Manufacturer	Contractor	Owner
Provide installation instructions & safety precautions to install & start equipment provided	Provide documentation of qualifications to work on system	Obtain contractor qualifications, Review site emergency procedures with contractor, Periodically evaluate contractor

10. Contractors

TEMPLATES

Question #	Question	Response	Comments / Recommendations
1	Does the contractor have experience working on ammonia refrigeration systems?	☐ Yes ☐ No ☐ N/A	
2	Has the contractor implemented a safety program that ensures that contract employees are trained to perform their jobs safely?	☐ Yes ☐ No ☐ N/A	
3	Has the contractor been informed of all relevant emergency procedures at the facility?	☐ Yes ☐ No ☐ N/A	
4	Does the contactor have an adequate safety record?	☐ Yes ☐ No ☐ N/A	
5	Has the contractor been made aware of its responsibilities under the ARM-LC Program?	☐ Yes ☐ No ☐ N/A	

11. Emergency Action and/or Response Programs

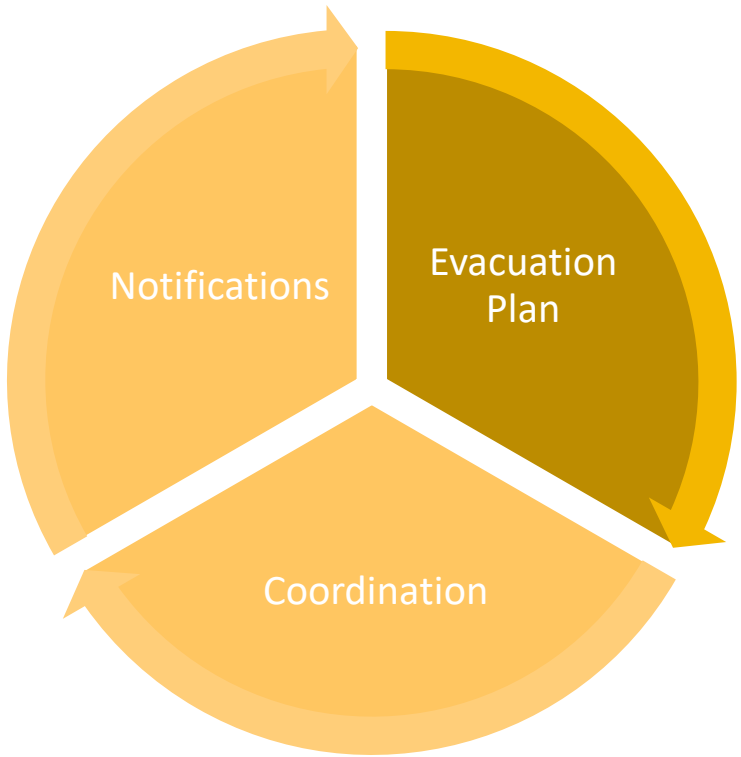
What to do in an emergency?

The owner's primary responsibility is to update any existing emergency action plan and/or response program to ensure that the plan reflects the installation of the low charge ammonia refrigeration system on site.

Manufacturer	Contractor	Owner
N/A	Provide documentation to address emergency actions if applicable to services provided	Update EAP to include consideration of ammonia system, Ensure employees are trained, Coordinate with local responders, Notify contractor and authorities if a release occurs

11. Emergency Action and/or Response Programs

TEMPLATES



Name	Phone Number	Coordination Description
Fire/Police/Ambulance	911	Available for all emergency situations.
National Response Center	(800) 424-8802	Will be notified in the event of an accidental release of anhydrous ammonia of 100 lb or more over a 24-hr period.
Local Fire Department		Available for response to fires and other emergencies.
Local Police Department		Available for response to criminal activity.
Local Sheriff's Office		Available for response to criminal activity.
Local Hazmat Team		Available for emergency response activities that the facility cannot handle.
OSHA Regional Office		Any work-related employee fatalities or catastrophes must be reported to OSHA.
Hospital **1234 Main Street** **Somewhere, CA 99999**		Nearest local hospital.
Safety/Environmental Consultant		Provides emergency response and ammonia compliance consultation.
Company Contacts • **Name** • **Name** • **Name**		Company employees/management who must be notified during an event.
Refrigeration Contractor		Company refrigeration contractor.
Offsite Contacts • **Neighbor 1** • **Neighbor 2** • **Neighbor 3**		Businesses and other public receptors that could be impacted by an accidental release.

12. Environmental Safety Evaluation

How to determine the impact of a release?

The design consultant, manufacturer or installing contractor may provide the initial environmental safety evaluation. The owner is responsible for confirming that the initial environmental safety evaluation is performed as part of the installation and service agreement and reviewed every five years thereafter.

Manufacturer	Contractor	Owner
Provide Hazard Assessment criteria (packaged systems)	Provide Hazard Assessment documentation	Obtain Hazard Assessment documentation Review and update every five (5) years

12. Environmental Safety Evaluation

TEMPLATES

Appendix L – Hazard Assessment Report Template

Date:

System Name:

Release Scenario:

The worst-case release scenario of the low charge ammonia refrigeration system is the failure of a system component causing a complete loss of refrigerant over a 10-minute duration as recommended in IIAR's Low Charge Ammonia Refrigeration Management (ARM-LC) Program.

Details of Release:

Chemical Name:	Ammonia
Physical State:	Gas Liquified by Pressure
Scenario:	Liquid Spill and Vaporization
Quantity Released (lb):	
Release Rate (lb/min):	
Release Duration (min):	10
Wind Speed (m/s):	1.5
Atmospheric Stability Class:	F
Surface Roughness:	
Distance to Toxic Endpoint (miles):	
Estimated Residential Population Within Distance to Endpoint:	
Release Location (Inside/Outside):	

Public Receptors Within Distance to Endpoint:

- ☐ Schools
- ☐ Prisons
- ☐ Major Commercial Offices or Industrial Areas
- ☐ Parks
- ☐ Health Care Facilities
- ☐ Residences
- ☐ Recreational Areas
- ☐ Hospitals
- ☐ Day Cares
- ☐ National or State Parks, Forests, or Monuments
- ☐ Federal Wilderness Areas
- ☐ Other:

13. Managing Changes

Has anything been changed?

The servicing entity typically makes any changes to a low charge ammonia refrigeration system. When a change occurs, the servicing entity should supply documentation describing the change. The owner's primary responsibility is to confirm that changes are properly documented and received.

Manufacturer	Contractor	Owner
• Provide documentation (packaged systems)	• Provide documentation (site built systems)	• Ensure that changes are documented

TEMPLATES

13. Managing Changes

Question #	Question	Response	Comments / Recommendations
1	Is the scope of the change such that no new hazards are introduced that were not previously considered during the safety review? If the change will introduce new hazards, a safety review should be performed on the change.	☐ Yes ☐ No ☐ N/A	
2	Has the refrigeration system documentation been updated to reflect the system change?	☐ Yes ☐ No ☐ N/A	

Applications, Benefits & Next Steps

ARM-LC

GROWING ARM-LC APPLICATIONS - LOW CHARGE NH3 SYSTEMS

COLD STORAGE FACILITIES

FOOD & BEVERAGE MANUF.

PROCESS COOLING

CHEMICAL PLANTS

DISTRIBUTION FACILITIES

FOOD PREPARATION

SUPERMARKETS

PHARMACEUTICAL & BIOSCIENCE

DATA CENTERS

MANUFACTURING PLANTS

BUILDING HVAC

ICE RINKS

ARM-LC REDUCTION OF NH3 CHARGE & SAFER SYSTEM OPERATION

RECOGNIZED SAFETY BENEFITS OF ARM-LC:

- Reduced liability & exposure to fines
- Inherently Safer Technology
- Lower Regulatory Burden
- Reduced off site consequences
- Strong Compliance with codes & standards
- Hazards Identified sooner
- Strong quality control & testing
- Great documentation
- Makes training easier

Significantly less ammonia, safer to operate, maintain & work around

OTHER BENEFITS

Clamed By Providers

OTHER BENEFITS OF PACKAGED LC:

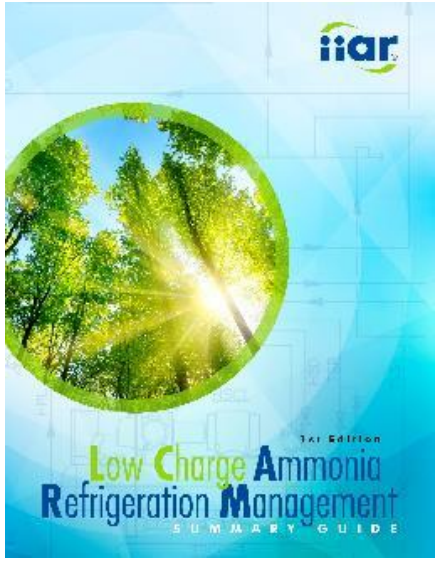
- Can have Lower Energy Usage
- Eliminate Central Machine Room
- Faster Installation & Customer Use
- Competitive Cost
- Easier accelerated tax depreciation
- Lower Life Cycle Costs
- Latest Technology

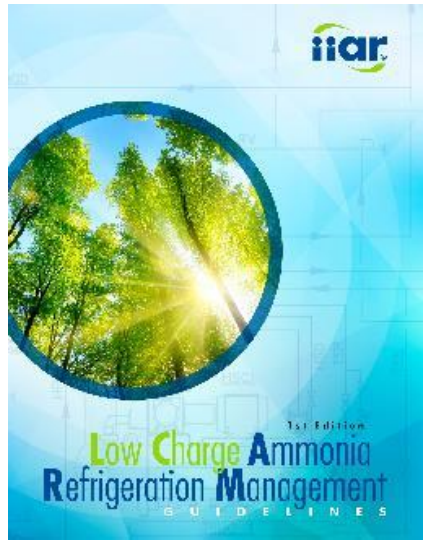
ARM-LC

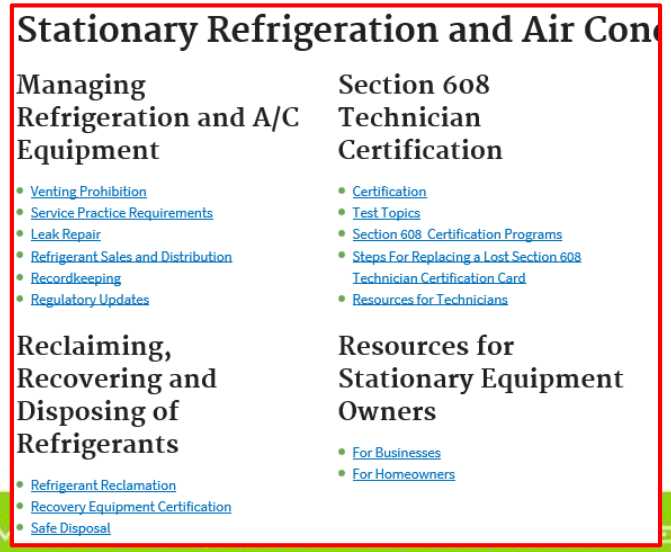
Seeking Input

What's Next?

- Please provide feedback & Input on survey form provided
- Compliance Guideline Committee can continue development
- Possible areas of updates:
  - Less than 100 lb?
  - Benefits of lower offsite consequences?
  - Accessorize with safety options
  - Code updates (IIAR-2)?
- Comparison - don't forget HCFC's must comply with EPA's 608 regulation….*and eventually HFC's too!*







Stationary Refrigeration and Air Con

Managing Refrigeration and A/C Equipment

- Venting Prohibition
- Service Practice Requirements
- Leak Repair
- Refrigerant Sales and Distribution
- Recordkeeping
- Regulatory Updates

Section 608 Technician Certification

- Certification
- Test Topics
- Section 608 Certification Programs
- Steps For Replacing a Lost Section 608 Technician Certification Card
- Resources for Technicians

Reclaiming, Recovering and Disposing of Refrigerants

- Refrigerant Reclamation
- Recovery Equipment Certification
- Safe Disposal

Resources for Stationary Equipment Owners

- For Businesses
- For Homeowners

ARM-LC Workshop: