

Refrigeration Plant Room Safety – Identification of Hazards and Risks

The Ontario Recreation Facilities Association Inc. (ORFA) regularly researches and writes about issues that could affect our clients. These documents provide an opinion on key risk management issues but are not meant to provide any form of legal opinion or official interpretation. No one should act on such information without appropriate professional advice after a thorough examination of the particular situation. All rights reserved. ©2015 Ontario Recreation Facilities Association Inc.

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TSSA Plant Safety Series No. 11

The Technical Standards and Safety Authority (TSSA) released Plant Safety Series No. 11 (PSS No.11) in August of 2014. This document is available at www.tssa.org or as a benefit of ORFA membership, on the ORFA web site under the Resource Centre section at www.orfa.com

Important Operational Note:

ORFA members are reminded of their obligation to add PSS No.11 to their plant room operational binders, health and safety boards and staff training materials.

Governing inspectors will continue to focus on promoting a system of plant piping, controls and equipment identification specific to Ontario. The objective of the PSS No.11 guideline is to create an Ontario specific identification program that once adopted will assist in operator and public safety. Having one identical system of identification in each Ontario registered plant will allow for an operator to quickly adopt to any refrigeration plant room environment while standardizing professional development and educational learning objectives for




the province. It will further assist first responders in preparing for a significant event involving a refrigeration plant room.

Note: *It is recognized that there are a variety of other voluntary identification guidelines available to the plant owner or operator to consider. As indicated in the opening comments on page 1 of the PSS NO.11 document, Chief Officer John W.B. Coulter reminds the Chief Engineer or Operator in attended plants and the “responsible person” in an unattended plant of their obligation of “effective management of the plant”. Plant operators who currently have a system in place are encouraged to cross reference this new TSSA information to determine if changes to the current system are warranted.*

Important Operational Note:

Although a single pipe colour code system would be ideal, there may be a need for some flexibility. As long as the specific plant piping colour system selected is clearly communicated with employees and is consistent with the primary objective of ensuring a safe plant operation, there may be differences. Additionally, facility supervisors must consider ALL facility pipe markings throughout their buildings to ensure they too are properly identified.

Legend

-  Occupational Health and Safety Act – OHSA
-  Operating Engineer Regulation – OER
-  B-52 Mechanical Refrigeration Code – B-52 MRC

Definition

“Refrigeration plant” means an installation comprised of one or more refrigeration compressors, prime movers, equipment, pressure vessels and any associated piping.

Reminder

The role of the refrigeration contractor in helping to ensure plant room owners meet and maintain legislative compliance is limited to that of advisor. It is the responsibility of the Chief Engineer, Operator or plant room “responsible person” to approve and

be responsible for the final piping identification system being used.

Introduction

A clean, well lit refrigeration plant room that has correctly identified controls, equipment and systems are the first steps towards safe plant room operations. Governing officials who attend the refrigeration plant room for compliance purposes will quickly form an opinion on the dedication of the plants Chief Engineer, Operator or “responsible person” toward maintaining a safe physical plant room, the equipment contained within and the safety controls associated with its safe operation. Once effectively in place, the risk of worker or public injury in an Ontario ice arena will be greatly reduced.

Note: TSSA has three (3) levels of inspection.

1. Refrigeration plant operations that are in non-compliance or lack commitment to safe refrigeration plant operations may be inspected every 6-months or more;
2. Operations that show positive refrigeration plant room operational activities will most often be inspected annually;
3. While refrigeration plant room owners and operators that excel in their knowledge, training and over all commitment to safe operations may only be inspected by TSSA every 2-years.

Important Operational Note:

A commitment to compliance and maintaining a positive maintenance and operational program can result in financial savings.



Refrigeration Plant Room Risks and Hazards

The refrigeration plant rooms general design is an area that will have liquids (oil/brine/water) collect on the floor which creates a potential worker slip hazard. Leaks of secondary refrigerant can cause decay to the equipment which reduces life

expectancy. Neglect to housekeeping in the plant room will cause dirt, dust and grime build-up reducing the ability to collect proper readings, unnecessary wear while reducing equipment life-cycle. A clean room is a safe, “fire proofed” room. Remember, they are “non-smoking” areas.

Important Operational Note:

TSSA has expressed concern with ORFA regarding an unacceptable practice of using the refrigeration mechanical room for storage. Items such as fossil fueled and grounds maintenance equipment and tools, hoses, light bulbs, janitorial supplies should NEVER be stored in the plant room.

Legal Obligations for Maintaining Your Plant Room



TSSA Vision - To be a valued advocate and recognized authority in public safety.

OER

Although the OER does not specify a detailed obligation for maintenance and upkeep, there is a general duty for the owner to manage and operate the plant room in a safe condition.

The B52 Mechanical Refrigeration Code

The B-52 MRC states “the owner is required to maintain all refrigeration systems in a clean and accessible condition”. Under the OHS Act Internal Responsibility System (IRS), the level of cleanliness and repair is left up to the owner/operator to determine.

The B52 Mechanical Refrigeration Code

The B-52 MRC enforced by both MOL and TSSA provides minimum guidance to owners of plant rooms on the design and maintenance. Selected highlights of the B-52 MRC as well as sections of the OER are found throughout this guide. Owners and operators must have a current copy of the OER and B-52 MRC on site for ongoing reference.

Important Operational Note:

The B-52 MRC (05) was updated in 2013 and as such all plant rooms should now have this updated version on site and available to all who have responsibilities in the plant room.

B-52 MRC Highlights

The B-52 MRC requires that a permanent, securely attached, legible and readily accessible signage identifying the installer, refrigeration amount, lubricant amount, horsepower rating and tonnage capability and field test pressure must be installed.

Important Operational Note:

It further states that the owner has a responsibility to post a card in the plant room giving instructions that includes emergency, service and the nearest "regulatory authority" contact information.

Ministry of Labour



Occupational Health and Safety Act (OHS)

The industry is also responsible for adhering to the Industrial Regulations of the OHS and at times the Construction Regulations of the OHS. Generally, the Act requires all workplace parties to work safely and maintain a safe working culture and environment. Ontario's Ministry of Labour governs compliance of the OHS and its Regulations.

Excerpts from the OHS (Industrial)

R.R.O. 1990, Reg. 851, s. 11. A floor or other surface used by any worker shall, (a) be kept free of, obstructions, hazards, and accumulations of refuse, snow or ice; and (b) not have any finish or protective material used on it that is likely to make the surface slippery.

16. A door, (b) leading to a hazardous, restricted or unsafe area, shall be identified by a warning sign posted on it. R.R.O. 1990, Reg. 851, s. 16.

21. Where natural lighting is inadequate to ensure the safety of any worker, artificial lighting shall be provided and shadows and glare shall be reduced to a minimum. R.R.O. 1990, Reg. 851, s. 21.

46. Machinery, equipment or material that may tip or fall and endanger any worker shall be secured against tipping or falling. R.R.O. 1990, Reg. 851, s. 46

123. (2) The requirements of the Fire Code respecting keeping egress doorways, public corridors and exits free from obstruction apply at industrial establishments. 1990, Reg. 851, s. 123 (2).

139. (10) A clearly visible warning sign shall be posted at every approach to an area in the workplace where the sound level, measured as described in subsection (5), regularly exceeds 85 dBA. O. Reg. 565/06, s. 2.

OHS (Construction)

35. (1) Waste material and debris shall be removed to a disposal area and reusable material shall be removed to a storage area as often as is necessary to prevent a hazardous condition arising and, in any event, at least once daily. O. Reg. 213/91, s. 35 (1). Identification of Refrigeration System Components

WHMIS Pipe Marking Requirement

Under WHMIS, the employer can use any means to identify the controlled product. As long as the means of identification is understood by the worker, such devices as warning signs, symbols, piping diagrams or colour coding would all be acceptable [section 11 of the Regulation]. There is no requirement for a workplace label. WHMIS does make a recommendation for a legend for the piping system to be in place.

http://www.labour.gov.on.ca/english/hs/pubs/whmis/whmis_4.php

851 Industrial Regulation

62 (1) Subject to subsection (2), a piping system containing a substance which, because of its toxicity, temperature, pressure, flammability or other property, is hazardous, shall have its contents and direction of flow positively identified, (a) at valves and fittings; (b) where a pipe passes through a wall or floor; and (c) where circumstances may make such contents or direction of flow doubtful. R.R.O. 1990, Reg. 851, s. 62 (1); O. Reg. 420/10, s. 10.

Highlights of TSSA Plant Room Safety Series No.11 – Equipment and Systems Identification (Page 3)



All piping systems must be identified as to their contained substance. The primary method of identification is obtained by applying a colour coding system to all pipes that is identical to that used for the valves. The colours are applied to the pipe in the form of colour bands around the circumference of the pipe. This is most effective if the colour bands are applied over a neutral pipe colour such as white or beige. The number and distance between the bands must be sufficient to allow effective line tracing. The width of the band will be in relation to the pipe diameter.

Suggested Band Width Sizing for Each Colour are:

Pipe Size	Identification Band Size
½ - 6 inches	2 inches
6-12 inches	4 inches
Over 12 inches	6 inches

Flow directional arrows and substance name may also be considered. It will be noted that the colours are sensibly related as exemplified by primary blue always being water with the specific type of water being identified by the secondary colour. The colours provide a clear and safe understanding of both the valves and piping content and the identification disc or plate provides the specific function of the valve. If necessary, additional colour combinations can be added relative to a specific plants varied substances. Such additions must not be in conflict with the suggested colours and should be sensibly colour related to the substance.

Primary Colour	Substance in Pipe	Secondary Colour
Blue	Potable Water	Blue
Blue	Potable Hot Water	Yellow
Blue	Soft/Distilled Water	White
Blue	Cooling Water	Dark Green
Blue	Chilled Water	Light Green
Blue	Fire Water	Red
Blue	Boiler Feed Water	Orange
Blue	Condensate	Grey
Blue	Brine	Brown
Blue	Waste Water	Black
Red	High Pressure Steam	Red
Red	Low Pressure Steam < 15PSI	Yellow

Green	Liquid Refrigerant	Green
Green	High Pressure Refrigerant Gas	Red
Green	Low Pressure Refrigerant Gas	Yellow
White	Compressed Air	White
Purple	Boiler Chemical	Purple
Orange	Lubricating Oil	Orange
Brown	No. 2 – Diesel Oil	Brown
Brown	Bunker C - Oil	Black
Yellow	Natural Gas	Yellow
Yellow	Propane	Brown

B-52 MRC Pipe Markings

The B52-MRC provides additional detail for marking and labeling requirements for an Ontario refrigeration plant room. For example, systems containing more than 110lbs (45kg) of refrigerant require signage of specific size lettering identifying main disconnect and control switches, pressure limiting switches, and each pressure vessel and their shutoffs, and all refrigeration piping and whether the refrigerant is at high or low pressure state or vapour.

Refrigeration Plant Room Valve Identification

All valves must be in English name identified as to their function and colour coded as to the substance being controlled. TSSA recommends that the valve wheel ring and outer section of a lever valve be identified as the primary colour and the valve wheel spokes and inner section of a lever valve be identified as the secondary colour. The often used code numbered tag system of identification is not considered to be effective as often tags become damaged or are removed having no value in an emergency. Further, this system often is supported by a “list” to assist the operator in identifying the equipment, valve or control. Sourcing this list during an emergency situation can often be a challenge if in fact that list information is even available.

NOT RECOMMENDED



A proven system is to apply a brass or stainless disc / washer in the centre of the valve wheel that is retained by the valve wheel nut. The content / service of the valve can then be stamped on the circumference of the disc. These can be professionally produced at low cost and are very effective. Lever valves can have a marked plate screwed to the valve handle making them resistant to damage or accidental removal. It further creates an ongoing operator educational program assisting them in knowing the plants key components.

RECOMMENDED Tagging System



Note: The picture shown is a manufacturer tag installation. The objective to the showing the tag is for example purposes of how the custom tag created by the owner would be attached to valves in a refrigeration room.

Other Refrigeration Plant Infrastructure Recommended Colour Schemes

Valve wheels	Coloured to image the content as per the colour band on the pipe.
Butterfly valve levers	Coloured to image the content as per the colour band on the pipe.
All machinery (boilers, compressors, motors, etc.)	Painted the same attractive standard colour on a contrasting but relatable base colour.
Walls	Painted an attractive light relatable but contrast colour to the machinery.
Floors	Floors that are not pre finished in tile etc. should be painted a

	light colour such as grey.
Electrical control boxes	Painted in a light colour relatable to the machinery and pipe colour.

Refrigeration Plant Room Control and Equipment Identification System

In addition to a standard colour coding the need to clearly identify all equipment components inside the plant room is necessary. All equipment and controls for the equipment must be identified in a corresponding manner. This will help in the training of plant operators and reduce the chance of incident. It may further assist EMS during an emergency situation. For example:

Controlling Equipment	Identification of Equipment Being Controlled
Compressor control switch #1 on main panel	Compressor #1 clearly identified in print on compressor
Brine pump control switch #1 on main panel	Brine pump #1 clearly identified in print on pump
Condenser water pump control switch on main panel	Condenser pump clearly identified in print on the pump

Note: Remember that refrigeration plant room pipes are often under extreme pressure and/or temperature and that failure of the pipe is a significant cause for safety concern. **NEVER** place a ladder or hang anything from any pipe or conduit in your plant room.

Maintaining Refrigeration Plant Room Piping Systems

Refrigeration pipes are metal and as such they are prone to rust. If left unchecked, the rust will slowly destroy the pipe. Rust should be regularly removed and the pipe repainted to maintain its original strength and integrity. The same level of maintenance, responsibility and commitment should be applied to all other metal parts in the plant room. Pipes that are wrapped in insulation should not be left uninspected. Temperature and humidity inside the room must be properly controlled.

Water and moisture that is allowed to enter or collect in any mechanical room will promote rusting of metal. Insulation that becomes wet will often be

hidden while impacting the pipe inside. Be sure to add a regular detailed inspection of all piping insulation to your ongoing maintenance plan. Removing the rust from a metal plumbing pipe can be completed by properly trained facility staff. Workers will need to be properly informed on the risks of such a process and need to be provided with the right tools and personal protection. Avoid power tools such as grinders and power wired brushes. This task is always best performed by hand. Discussing how best to maintain your plants piping system with your refrigeration contractor is strongly recommended.

The steps will include removing all existing rust from the pipe, and then treating it with a rust-dissolving product. Here are some proven steps on how to remove rust.

You will need:

1. Fine grit sandpaper
2. Naval Jelly
3. Clean cloth
4. Paint brush
5. Wire brush
6. Protective gloves
7. Water
8. Primer paint

Note:

It will be important to completely remove any cleaning or rust removal agent prior to attempting to paint or place a label on the systems components.

Steps:

- Prepare the pipe surface with a wire brush to remove any loose rust flakes. Use “fine-grit” sandpaper to sand over the surface of the pipe with a small circle movement. The sandpaper will remove the rust that is too stuck for the wire brush to loosen.
- Using protective gloves apply a light coat of naval jelly to the surface of the pipe and let it soak for 30 minutes. The purpose of using naval jelly is to dissolve the rust. Rinse the surface with clean water after 30 minutes, and dry the pipes with a clean towel. Allow to dry.
- Apply a thin even primer paint for plumbing pipes or any similar product. Leave the primer overnight to dry.
- Paint may not adhere well to the mill scale on the pipe so you need to decide how to clean the piping so that the paint will fully adhere to it.

- Once completely dry apply another coat of the selected pipe paint colour.
- The time spent on preparing your surface will greatly affect how long the paint adheres.
- Record the work in the plant room log book.



Putting the Identification System to Work

Protecting workers from hazardous working conditions is a primary step towards a safe and healthy work environment. This includes but not limited to providing workers with awareness training on the risks of the area, assurances for adequate ventilation, personal protective equipment and the understanding of how the identification of pipes, valves, controls and electrical systems can reduce their chances of injury. Developing a system and not training both seasoned veterans and new hires on the design and intent of the safety program renders it ineffective.

A Virtual Tour of a Typical Refrigeration Plant Room

Let's take a virtual tour through a typical built-up ammonia/brine refrigeration plant room under 200hp and identify some of the items we have reviewed as well as the other key elements that should be found in or within close proximity to the plant room. Consider each item and whether it might apply to your refrigeration plant room?

1. Approaching the room, an ammonia sensor system may be required. Refrigerants such as Halocarbon refrigerants do not have a “self-alarming” characteristic and can also pose risk.
2. The primary entry door to the vestibule must be secured permitting only qualified competent persons to enter. The second fire rated vestibule door must be closed. The doors fire rating plate must be visible, in good condition and readable on the hinge side of the doors when opened. The doors and all entry points for piping, electrical wires etc. must be sealed

and tight. The door must be posted as to the specific function such as Refrigeration Machinery Room, staff entry only area; hearing protection requirements (if required); ammonia (if applicable); electrical risk area; danger equipment may start without warning, and; No Smoking signage may all be required.

3. A room ventilation start switch is to be located in the vestibule leading to the plant room.

4. Additional egresses must be clear and functional during all seasons with panic hardware being in proper working order. Exterior doors must also be clearly marked as Refrigeration Mechanical Room to assist during an emergency situation. An exit light must be in place and functional.

5. Eyewash and deluge shower system must be clear and functional. Applicable/required PPE such as an ammonia canister mask may need to be accessible outside the room.

6. Proper general housekeeping practices must be in place resulting in a plant room that is neat and clean. Liquids should be immediately cleaned away, leaks recorded in the log book and repairs scheduled or made.

7. Name of installer, refrigerant amount, lubricant amount, horsepower rating and tonnage capability and field test pressure must be posted.

8. Operational and emergency instructions including emergency service contact information and nearest regulatory authority information must be posted.

9. All liquids, canisters and chemicals are to be safely and properly marked and stored.

10. Refrigerant, in addition to that in the system, shall be stored only in a machinery room. Such refrigerant shall not exceed a maximum limit of 136 kg (300lb) and shall be stored in acceptable storage containers. Storage of the refrigerant in any other room shall first be approved by the regulatory authority having jurisdiction.

11. Unrelated mechanical systems such as water heating tanks should not be installed in the plant room unless the installation conforms to all applicable Acts, codes and regulations.

12. All relevant documents including logbook, operational manual, MSDS, Standard Operational Procedures, piping scheme chart and emergency procedures should be readily available to the plant operators.

13. Electrical panels require proper lock out and access by qualified competent personnel only. *Ontario Electrical Code and OHSA*

14. All moving equipment parts require proper guarding. *OHSA*

15. Lighting switches should be within easy access at plant room entrances upon entering the room. Lighting should be adequate and properly maintained. *OHSA*

16. All required fire suppression equipment must be in place and in proper working order. *Ontario Fire Code*

17. There must be NO storage of unrelated plant room operational items (light bulbs, paper products, cleaning supplies, grounds maintenance equipment, tools etc.) *Ontario Fire Code*

18. Posting of the typical safe operating temperature ranges and pressures is considered an industry best practice. *ORFA*

Checks and Balances

- Is your refrigeration plant room on your internal housekeeping schedule of activities?
- Is there a general maintenance plan in place to deal with rust and aging paint conditions?
- Does staff play a key role in the ongoing general maintenance and upkeep activities of the plant room and surrounding areas?
- Does the plant room feel safe, secure and welcoming?

Conclusion

The ORFA recognizes that this document outlines a variety of best practices, legislative obligations and voluntary standards that may leave the reader confused as to what path to follow. Regrettably, we are not in a position to provide one solution that could possibly meet every operational need. However, the ORFA Refrigeration Technical Advisory Committee (RTAC) has directed the ORFA Technical Director to adopt all content outlined in the TSSA

PSS No.11 document and merge the information into all ORFA training materials, guidelines and best practice information as our industries best practices.

ORFA members are encouraged to consider the benefit of adopting this ORFA recommendation.

Important Industry Note:

Government agencies can be a valuable resource and made available to assist in ensuring personal and the general public safety.

Working with your Joint Health and Safety Committee, refrigeration contractor, Ministry of Labour Inspector and TSSA Inspector is the best way to stay compliant.

The ORFA strives toward instilling professional pride by promoting effective refrigeration plant room operations. The need to operate mechanical rooms safely and within all set legislative obligations helps confirm our necessity within the larger scope of community safety and general operations.

Excellence is not a skill... it is an attitude!

Ralph Marston

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