

AAR WEBINAR SERIES III- 2020

PREPARING SOP FOR PLANT OPERATION AND EMERGENCY RESPONSE

By
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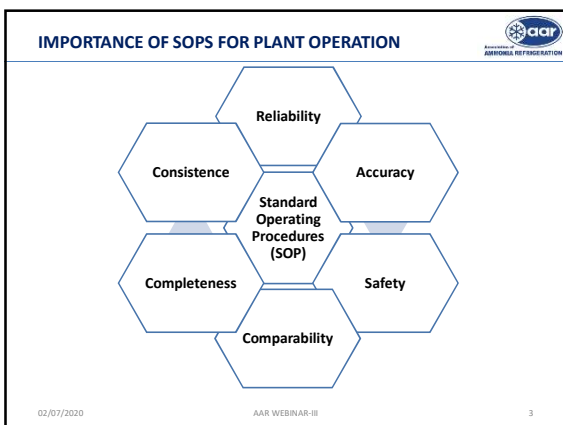
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INTRODUCTION

The Standard operating procedures (SOP) are for the Energy efficient operation of Ammonia Refrigeration plant with consistency, safety and reliability with minimum errors.

"detailed, written instructions to achieve uniformity of the performance of a particular function".

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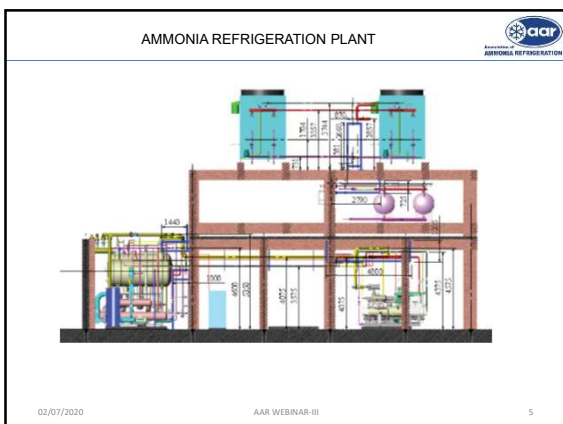
DOCUMENTATION REQUIRED FOR SOP

1. P&IDs, GENERAL ARRANGEMENT, ELECTRICAL AND LAYOUT DRAWINGS
2. LIST OF EQUIPMENTS INSTALLED with CAPACITIES.
3. O & M MANUAL FROM SUPPLIERS
4. DESIGN AND OPERATING PARAMETERS
5. SAFETY INSTRUCTION MANUALS

EQUIPMENTS involved in SOP

1. Compressor
2. Condensers
3. Pressure Vessels
4. Evaporators
5. Piping, Valves, controls and Instruments
6. Air Purger
7. Oil Rectifiers
8. defrosting system
9. Operation and Maintenance
10. Electrical system

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CONDITIONS TO CONSIDER FOR SOP

1. Steps required for Equipment Initial start up
2. Monitoring a Equipment during normal operations
3. Step Required to operate and equipment under temporary operations
4. Normal shutdown
5. Emergency shutdown
6. Emergency operations
7. Start-up following a turnaround, or after an emergency shutdown

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SOP conditions for COMPRESSOR – Screw or Reciprocating

Compressor initial Startup

- OPERATING conditions (suction and discharge pressure and temperature, lubrication oil temperature, lubrication oil level, etc.) to ensure a safe start-up.
- Corrective actions required if the conditions are outside of allowable limits.
- Location of the compressor electrical connections.
- Position of the compressor isolation and service valves.
- Status of the lubrication oil cooling system.
- Function of the compressor alarm systems.
- Steps to start the compressor.

Monitoring Normal Operation

- Verify that the following compressor parameters are within expected operating limits and troubleshoot as necessary:
 - Discharge pressure and temperature.
 - Suction pressure and temperature.
 - Oil pressure and temperature.
 - Oil filter pressure drop.
 - Oil level.
- Verify that shaft seal leakage is within the allowable limits specified by the manufacturer.
- Verify that there are no ammonia or oil leaks from the compressor beyond allowable limits of shaft seal leakage specified by the manufacturer.
- Verify that there are no unusual noises or vibrations.

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COMPRESSOR

Various adjustable Set Points for High Stage and Booster Comp (ex. -30 Deg C SST/ 38 Deg C Cond)

	High Stage Comp-1	Booster Comp-1
Capacity Control Pressure (Psig)	35.00	2.50
Suction Pressure Alarm	22.00	0.50
Suction Pressure Cut out	15.00	-1.00
Discharge Pressure Alarm	220.00	85.00
Discharge Pressure Cut out	230.00	88.88
High Motor Current (%)	100.00	100.00
Recycle Delay Period (Min.)	5.00	5.00
Low Oil Pressure Alarm	14.00	14.00
Low Oil Pressure Cut out	10.00	10.00

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SOP conditions for CONDENSER (ex. Evap Cond)

Initial Startup

- Appropriate practices if the condenser will be started following general maintenance, emergency shut down or after a system modification.
- Appropriate conditions (pressure, temperature, water flow, etc.) to ensure a safe start up.
- Corrective action required if the conditions are outside of appropriate limits.
- Location of the condenser electrical disconnect.
- Position of the condenser isolation and service valves.
- Function of the condenser alarm systems.
- Steps to start the condenser water flow and fans.

Monitoring Normal Operation

- Verify that the following condenser parameters are within expected operating limits and troubleshoot as necessary:
 - Discharge pressure.
 - Water treatment limits.
 - Water temperature.
- Verify that there are no ammonia or water leaks from the condenser.
- Verify that the water supply to the condenser(s) is on and if a sump is used the water is at the proper level.
- Verify that the level control is properly working.
- Verify that the water pump shaft seal is not leaking.
- Verify that there are no unusual noises or vibrations.
- Verify good water spray on coils.
- Verify tension on fan belts.

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SAMPLE SOP TEMPLATE FOR HP RECEIVER

Company Name : XXXXXX	Page 1	
Standard Operating Procedures (SOP) No. 5	Equipment Operation	High Pressure Receiver
Department : Engineering	Location : Plant room	Revision No. : Date: 0/00
SOP prepared By: Plant Engineer	Approved by: Refrigeration Chief Engineer	
Revised SOP prepared By: Plant Engineer	Approved by: Refrigeration Chief Engineer	Issue Revision - Rev-0
Responsibility / Operator	Name 1:	Name 2:
Necessary Documents	O&M Manuals with all Drawings	

Objective: This procedure is designed to describe the to set down the Standard Operating Procedures for the safe operation of Ammonia High Pressure Receiver 1 (HPR-1).

Purpose: The purpose of the TOS is to provide a description of the High Pressure Receiver, to define the function of the receiver, its operating conditions and limits, and consequences of deviation from these limits; To describe controls and instrumentation and safety systems, and set operating alignments. The purpose of the Standard Operating Procedure (SOP) is to set down the proper steps for starting, monitoring normal operation, and stopping and restarting the Receiver under normal and emergency conditions.

Concerns: Very Careful attention to valve positions, temperature, and pressure levels is extremely important to the successful completion of these procedures. Deviations from normal operating limits could cause personal injury or death, small to catastrophic release of ammonia or environmental damage, or evacuation of, or injury to, members of the public. We seek to prevent incidents such as:
 - Injury to operators and others in the area
 - Damage to the High Pressure Receiver
 - Release of any quantity of Anhydrous Ammonia refrigerant.

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SAMPLE SOP TEMPLATE FOR HP RECEIVER

Technical Operating Specifications Page 2

Function: The function of the High Pressure Receiver (HPR-1) is to provide storage for part of the Anhydrous Ammonia liquid inventory needed to supply the plant refrigeration loads, and recirculation receiver loads, as required to maintain efficient operation.

Description:	Capacity/ Size	Safe Operating Limits	Consequences of Deviation	Corrective Action
High Pressure Receiver	750 mm DIA x 4878 mm Long	250 psig Max Pressure, max capacity 75 percent fill	Over-pressurization will cause operation of pressure relief valves and leakage.	Shutdown the compressor

Controls and Instrumentation

DESCRIPTION	ITEM NUMBER	FUNCTION	POSITION AND/OR NORMAL SETPOINT
Level/Glass	Tag No.	Measures level of ammonia liquid in tank, activate warning if level exceeds	Less than 75 percent fill level, activate alarm light if reached. Light is in the main compressor room
Dual Pressure Relief Valves on manifold	Tag No.	Protect against over-pressurization above 250 psig	Set at 275 PSI

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SAMPLE SOP TEMPLATE FOR HP RECEIVER

Standard Operating Procedure (SOP) Page 3


Task Flow Diagram

- Normal start up
- Normal shutdown
- Shutdown and isolation for maintenance/repair activity
- Emergency shutdown and isolation
- Startup following emergency shutdown and isolation, or shutdown and isolation for maintenance activities

Task	Step	Comment
1. Normal Start up	1	The receiver is not shut down under normal operations. Restart under normal conditions is never necessary.
2. Normal Shut Down	1	The receiver would not be shut down during operation, for any reason. This is essential to the safe operation of the entire system.
3. Shutdown and Isolation for Maintenance or Repair	1. See Maintenance Procedures for the float columns, floats, and alarm systems	Isolation of the receiver float is not probable. Float columns and alarms can be individually isolated for maintenance and repair. See adjacent SOP

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SAMPLE SOP TEMPLATE FOR HP RECEIVER




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4. Emergency Shutdown and Isolation	4.1. Close HPL supply hand valve from condensers:	Valve number xxxx (hand valve)
	4.2. Close EQ line hand valve	Valve number xxxx (hand valve)
	4.3. Close Purge line hand valve	Valve number xxxx (hand valve)
	4.4. Close HPL return from transfer tanks 1 AND 2	Valve number xxxx (hand valve)
	4.5. Close liquid injection cooling supply line valve	Valve number xxxx
	4.6. Close liquid feed to plant hand valves	Valve number xxxx and Valve number xxxx
	4.7. Shut down liquid transfer pumps 1 and 2 at TT1 and TT2 in main compressor room	Transfer Tank 1, Transfer Tank 2, per relevant SOP for both
	4.8. Assess situation	If shutdown is for any period of time, refrigeration operations will shut down as liquid supply runs out.
	4.9 Follow instructions of Emergency Response Personnel on scene.	If this situation involves fire or engulfment, evacuate immediate area of receiver and observe from a safe distance.
		If situation involves damage to any part of the refrigeration system, prepare to mitigate and/or contain escaping liquid and vapor, using appropriate PPE. If trained to do so.

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- ### Emergency response
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- Emergency action plan
 - Ammonia Alarm and Action
 - Emergency response Team
 - Emergency Alarm and Emergency ventilation
 - First Aid
 - PPE (Personal Protective Equipment's)
 - Mock Drill Report Content and Case study
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AMMONIA ALARM & ACTION




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Gas concentration	Effect on unprotected Human Being	Time
25 PPM	Detected by most-	No health hazard exposure for long durations-Unlimited time
50 PPM	Smell is very distinct. The experienced person wants to get away from the area	8 hours per day and week is permitted in most countries
100 PPM	No dangerous effects on healthy persons, minor irritation, anxiety	Do not stay longer than necessary
400-700 PPM	Immediate irritation in eyes, nose and respiratory organs. Persons used to ammonia also cannot stay	Under normal circumstances no serious injuries during 1 hour
1700 PPM	Cough, cramp and serious irritation in nose, eyes, respiratory organs	Hour exposure can lead to serious injuries
2000-5000 PPM	Cough, cramp and serious irritation in nose, eyes, respiratory organs	Hour exposure can lead to death
7000 PPM	Paralyzed, suffocation	Lethal within few minutes

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- ### EMERGENCY ACTION PLAN
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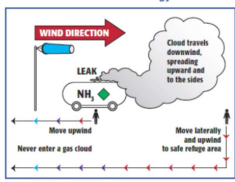
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- This section must be customized- Each facility is unique Each facility should have a custom emergency action plan
 - Ammonia should have a separate response than any other emergency in the plan and Employees must be trained on the plan
 - Alarms Should be there for ammonia release. Ammonia is monitored by An alarm will sound A call and When heard, emergency actions must be taken
 - Evacuation -When the alarm sounds Stop working IMMEDIATELY! Proceed to Exit quickly If someone is overcome, do not go back in for them Wait for instructions from Emergency Team.
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EMERGENCY ACTION PLAN



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- Gathering While evacuated Pay attention to wind direction
- Make sure you are accounted for and dismissed properly
- Do not return to work until All clear comes from Emergency crews give the all clear and Asked to return by
- Drills - Procedures for emergency drills Preparation is the key to avoiding catastrophe. Failure to participate should result in disciplinary action .Drill will be conducted (time frame)
- Results of the drills will be recorded and reviewed by Emergency team/ crew



Evacuation Strategy

WIND DIRECTION →

LEAK


Cloud travels downward, spreading upward and to the sides

Move upwind

Never enter a gas cloud

Move laterally and upwind to safe refuge area

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- ### EMERGENCY ACTION PLAN
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- Means of reporting leakages /fires and other emergencies
 - Evacuation procedures and emergency escape route assignments
 - Procedures to be followed by employees who remain to operate critical plant operations before they evacuate
 - Procedures to account for all employees after an emergency evacuation has been completed
 - Rescue and medical duties for those employees who are to perform them
 - Names or job titles of persons who can be contacted for further information or explanation of duties under the plan
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EMERGENCY RESPONSE


- ▶ Coordinate and control all emergency responders
- ▶ Identify the ammonia hazards and conditions
- ▶ Implement emergency response operations and assure that the personal protective equipment worn is appropriate for ammonia
- ▶ Ensure employees wear a positive pressure self-contained breathing apparatus while engaged in emergency response
- ▶ Limiting the number of emergency response personnel at the emergency site. Ensure back-up personnel are standing by with equipment ready to provide assistance or rescue
- ▶ Designate a safety officer with specific responsibility to identify and evaluate hazards and provide direction

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First Aid

Decontaminate the victim as quickly as possible. Start with the eyes. The whole body, or exposed area, must be flushed with generous amounts of water; this includes the hair, ears, under the chin, and armpits. Water sources such as showers, hoses, eye wash stations, or stock tanks are acceptable.

Ensure trained personnel and adequate first aid supplies are readily available

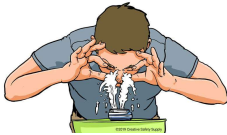
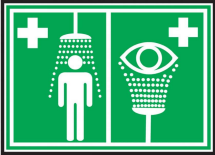


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Ammonia Contact with Eyes

Even if only a small amount of ammonia enters the eyes, irrigate the eyes with an abundance of water for a minimum of 15 minutes.

Continually and thoroughly flush the entire eye surface and the inner lining of the eyelids. Eyes affected by ammonia close involuntarily, so the eyelids must be held open so that water can flush the entire eye surface, as well as the inner lining of the eyelid.


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Ammonia Contact with SKIN

It is essential that any ammonia spilled on the worker be removed immediately and that the worker be moved to an uncontaminated area quickly.

Clothes that have been saturated by liquid ammonia may freeze to the skin. In any case, the victim, still clothed, should get immediately under a shower, if available, or jump into a stock tank, pond, or into any other source of water. Time is important! Remove clothes only after they are thawed and they can be freely removed from frozen areas. If the clothing is removed incorrectly, whole sections of skin can be torn off.

No salves, creams, ointments, or jellies should be applied to the skin during a 24-hour period following the injury since this will prevent natural elimination of the ammonia from the skin. After the 24 hour period, the medical treatment is the same for thermal burns.



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Ammonia Taken Internally

Inhalation

In all inhalation exposures, severe or minimal:

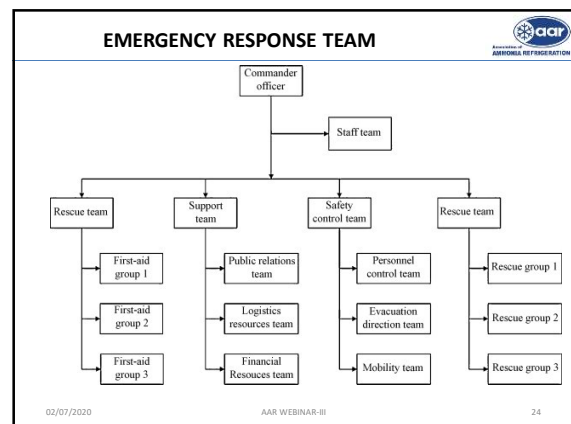
- Take the exposed workers at once to a clean, uncontaminated area.
- Watch workers exposed to low concentrations for a short period of time. They will usually require no treatment and can be released.


For severe exposure to higher concentrations:

- Call a physician.
- Administer oxygen by an individual who is trained and authorized to do so by a physician. This will help relieve pain and symptoms of lack of oxygen.
- Begin artificial respiration immediately if the patient is not breathing.
- Keep victim warm (but not hot) and rested until transported to the hospital.

- This is what you should do if ammonia is ingested: Call a physician.
- If conscious, have the victim drink large amounts of water.
- Do not induce vomiting if the victim is in shock, in extreme pain, or is unconscious.
- If vomiting begins, place the victims face down with head lower than hips. This prevents vomit from entering the lungs and prevents severe injury.

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EMERGENCY ALARM AND VENTILATION SYSTEM

- EMERGENCY ALARM AND VENTILATION SYSTEM**

Detection of ammonia vapour concentrations at or above 150 ppm shall activate



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Safety Equipment's should be available – Personal protection equipment's (PPE)




Gas Mask with oxygen cylinder




Gas Mask with canister



Eye Goggles




Eye Shower and wash




Ammonia Suit

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IMPORTANCE MOCK DRILL AND TRAINING

- The main purpose of mandatory drill is to check the reaction of occupants/employees of the building and to know the workability of emergency plan , fire fighting/ leak detection system installed in the building so that deficiencies may be removed and further improvement plan may be executed to avoid life and property loss in the important building.
- The mock drill should be planned with External experts with team.




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MOCK DRILL REPORT - CONTENTS

- 1 Date of onsite Ammonia Gas Leakage Mock Drill
- 2 Aim
- 3 Objective
- 4 Extended Scope of Mock Drill
- 5 Need and Rationale of Conducting an on-site Mock Drill
- 6 Steps & Framework of Mock drill
- 7 Pre-Mock drill Planning
- 8 Emergency situation
- 9 Area to be covered in Mock Drill & Location of Occurrence
- 10 Name of deputied observers
- 11 Event Schedule
- 12 Number of Head Count at Assembly Points
- 13 Details of First Aid given
- 14 The details of treatment given at Hospital and feed-back from Doctor about victim's condition
- 15 Post Mock Drill Activity.
- 16 Observations and Corrective actions
- 17 Learning for the future


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REFEREENCES

1. AAR STANDARD (IS 14430)
2. AAR ADVANTAGE AMMONIA PRENTATIONS
3. ACCIDENT PREVENTION AND RESPONSE MANUAL -U.S. ENVIRONMENTAL PROTECTION AGENCY
4. ISO STANADARD
5. SPECIAL THANKS TO AAR WEBINAR COMMITTEE MR. ANIL GULANIKAR, MR. HARESH RUPCHANDANI , MR. ANAND JOSHI AND MR. PRAKASH PATIL FOR HELPING WITH THIS PRESENTATION.

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THANK YOU

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