PLANNING NEW REFRIGERATION PLANT & MACHINE ROOM DESIGN

BY

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Site

- Designed for good traffic flow
- Drainage
- Truck apron-140' minimum
- Trailer/container Parking
- Auto Parking
- Security
- Expansion



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PLANNING NEW REFRIGERATION AMMONIA PROCESS PLANT

Consider following points

1. City & place of Installation-distance from main communication and near ness to transport facilities like railways, high ways, ait ports
2. Weather conditions-Max. dry bulb, wet bulb temperatures, altitude of place of installation
3. Availability of adequate infrastructure-water-its quality, uninterrupted electricity and adequate power.
4. Waste disposal and effluent treatment facility planning
5. Enough space for containers, lorries to come in and go out easily with enough turning radius.
6. Steps to ensure no environmental pollution

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Earlier conventional construction - RCC



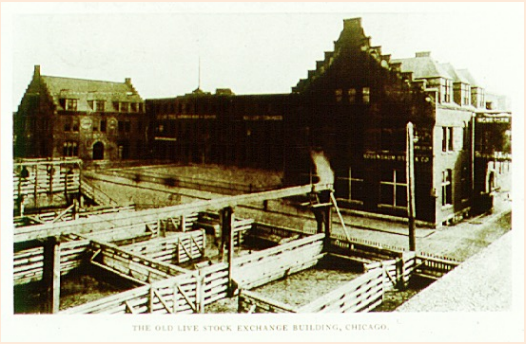
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Steel Structure-Old Design



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Old type of designs



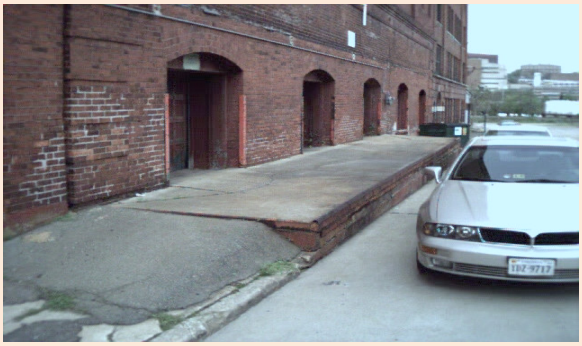
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OLD DOCKS



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OLD CURBS



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New Designs
Pre-Engineered Structure with PUF panels(PEB)



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Ammonia Refrigeration machine Room Requirements

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Machine room Design Practices- **Location**

1. Plant room should be preferably on ground level
2. Plant room should be separate building away from processing hall or other occupied premises
3. The plant room should have at least three exposed walls and exposed roof
4. The plant room should be away from heavily occupied areas, & main roadways
5. It should be away from rivers, water streams, drains- which are likely to get contaminated with ammonia
6. The plant room should have provision of direct emergency exit to roads, doors and transportation
7. Plant room should have minimum two fire resistant doors openable outward, and should be such that they cannot be locked when machine room is occupied
8. Access to the machine room should ideally be via external perimeter doors and should be restricted to authorised & trained personnel only

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Machine room Practices- **Internal Design**

9. Floor should be strong enough to take load and movement of fork lifts/portable cranes/trucks etc

10. Floor finish should be non slippery and painted with oil & water resistant paint and should be washable with a proper slope for draining water.

11. Polyurethane (PU) and specialized epoxy floor coatings are the best choices for a refrigeration machine room

12. Equipment layout should provide enough space for maintenance, tube cleaning as well as additional space for future expansion.

13. Equipment lifting /removing arrangement should be adequate-with movement of Fork lift or lifting with overhead crane

14. Provide barriers to protect refrigeration equipment, i.e., lines, valves, and refrigeration coils, from impact in areas where forklifts are used

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Machine room Practices- **Internal Design**

15. All ammonia vessels, equipment, piping should be labeled with flow direction arrows. Piping should be colour coded –Discharge **RED**, Liquid **YELLOW** and suction **GREEN** and water **BLUE** colour

16. External equipment (accumulators, receivers, condensers, etc.) mounted on or above the roof of the room should be supported **independently** of the roof in case of roof collapse

17. Because of the potential for explosion, over-pressurisation or explosion relief wall should be provided.

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Machine room Design Practices- **Installation**

18. Elevated equipment and branch pipes with hand wheels located more than 7 ft. high above floor level shall be provided with access platforms/ladders or chain operation from floor or manually controlled solenoid valve with stop switch located outside machine room.

19. Any pipework, cable penetrations, etc. through a communicating wall must be appropriately sealed and vapour tight, to ensure the fire resistance.

20. All Piping should be above 7 ft high & is usually constructed from steel or stainless steel and any pipe insulation should be non-combustible and non-absorbent.

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Machine room Design Practices- **Installation**

21. Machinery or piping which may cause condensation or drips shall not be located over electrical equipment, and should be provided with proper drain collection troughs

22. Contorol panel should be at least 3m away from heat generating sources like compressors/Motors/Pumps

23. The control panel should have cabling preferrabley from top, so that it is visible and protected from rodents, water and other contaminents

24. The electrical panel should have hooter and energency stop- spring loaded valve arrangement to stop all equipment in case of emergency



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Machine room Design Practices- **Installation**

25. Machinery room lighting should be adequate so that all instructions are clearly readable. One light should be on stand by automatic battery supply in case of electricity failure.

26. Electrical wiring diagram with cable numbering should be also dispalyed in machine room

27. Piping and Instrumentation diagram should be also displayed in the machine room and easily visible and thoroughly understood by plant operator

28. Operation/maintenance manuals of all equipment should be available in the machine room

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Machine room Design Practices- **Ventilation**

Standard IIAR Bulletin 111

ANSI/IIAR 2-2014 /ASHRAE STANDARD-15

1. Ventilation fans in the plant room should be provided based on 2cfm/sq.ft. running continuously. Such two additional fans should be provided and in case of accidental leaks both the fans should be activated so that the ammonia vapours are dispensed more effectively.
2. ANSI/ASHRAE indicates cfm=system charge x √Pounds of ammonia charge.
3. There are other recommendations based on air changes and heat load of motors etc. are also followed.
4. Provide remote activation of fans outside plant room

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Machine room Design Practices- **Ventilation**

5. Rooms housing Ammonia equipment should be provided with normal ventilation Either appropriately rated mechanical or natural air ventilation
6. When occupied, the machinery room must be ventilated with outside air at a rate of of not less than 0.5 cfm/ft^2 of machinery room area or 20 cfm per occupant, whichever is greater
7. Emergency ventilation fans must discharge upward at a minimum velocity of not less than 2,500 fpm at the required emergency ventilation (capacity) flow rate.
8. Ventilation must exhaust to the outdoors and make-up air must be provided from the outdoors. Make-up and exhaust must be positioned to avoid short-circuiting and drawing contaminated air.
9. Exhaust termination must be to the outdoors and no fewer than 20 ft from a property line or opening to a building or away from occupied area.



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Machine room Design Practices- **Ventilation**

10. Ventilation must not cause the negative pressure in the room to exceed 0.25 in water column
11. Low-level fresh air inlets and high-level extracts Discharging to a safe area away from personnel, fresh air intake vents, etc.
12. Emergency ventilation must provide 30 air changes per hour based on the gross machinery room volume unless analysis indicates that a release of the entire system charge will not result in the room concentration exceeding 40 PPM
13. Emergency ventilation must be powered independently of the machinery room equipment and not affected by the emergency shutdown controls.
14. The normal extraction volume flow rate or a minimum of 0.0305m3 /m2 /minute must be provided. Emergency ventilation should be 10 times more or 0.305m3/m2/minute

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Machine room Design –**Safety Equipment**

1. Emergency eye wash basin and body shower facility readily accessible in the machine room must be provided
2. Fire protection systems as proposed and approved by local regulations shall be provided
3. Provide one bottle of boric acid and eye cup and one bottle of vinegar in the machine room
4. Keep Sulphur dioxide/hydrochloric acids to detect ammonia leaks
5. Emergency Alarm/hooter/stop switch to be provided in the plant room
6. First aid kit should be available in plant room
7. Torch & rope should be available in machine room

(Refer Ammonia AAR Book for more details)

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Machine room Design Practices- **Don’ts**

1. Boilers & other open flame producing equipment , heaters must not be stored in plant room
2. lubricating oil & other combustible materials, oxygen/nitrogen gas cylinders must not be stored in plant room
3. Machinery or piping which may cause condensation or drips shall not be located over electrical equipment, and should be provided with proper drain collection troughs.
4. Exhaust air ducts from the machinery room and intakes for make-up air must serve only the machinery room and should not be common for other areas..
5. Do not use inlet dampers with manual shut off mode, any dampers shall be of fall open shape
6. Do not wear Rings or other jewelry, long ties, gloves or loose garments when working around moving machinery
7. Do not wear watches when working around electrical equipment, and arc welding machines
8. Do not wear contact lenses
9. Do not use machine room as storage room for keeping hanging cloths,eatables , shoes etc.

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SAFETY EQUIPMENT & ACCESSORIES IN THE MACHINE ROOM

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Personal Safety Accessories



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EYE WASH



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EYE WASH SQUIRT (JET SPRAY)BOTTLE



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Hand Gloves to protect from hot surfaces



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Goggles to protect eyes from Ammonia leaks



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Ear mufflers to protect from noise above 90 Db



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Hard hat to protect from falling heavy object or hitting from overhead trays, pipes etc.



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Safety shoes with steel Toe



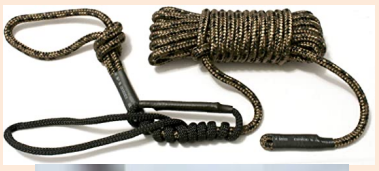
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Torch to enter dark areas like cold storages



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Rope to tie a person entering the cold rooms where leak is suspected



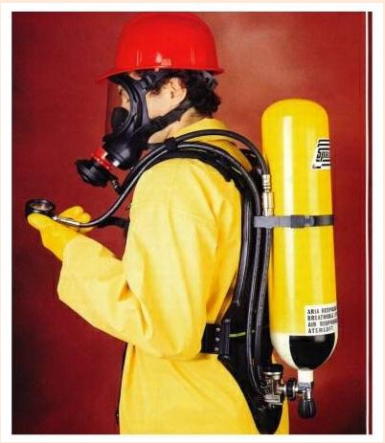


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FACE MASK

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AMMONIA SUIT

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Ammonia Leaks

1. Ammonia Liquid Leaks-Density @40^{0}C- 579.4 kg/m^3
2. Ammonia Vapor Leaks-Density@ 40^{0}C- 12 kg/m^3
3. Liquid Density 48.22 Times more
4. Liquid Ammonia Leaks are More Dangerous Than Vapor-Never spray water on Ammonia Liquid

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Possibilities of Ammonia Leaks

1. Accumulators/Receivers/LP vessels
2. Flanges –Joints-Use all welded joints
3. Stop Valves-Glands
4. Pressure Relief Valves
5. Piping-Charging methods
6. Manually operated valves-Oil drain
7. Oil Pots
8. Compressors/Pumps-Shaft Seals
9. Sight Glass

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Leak Detector & Alarm



- Detects Leakage of Ammonia from 30 PPM
- Multi Level Alarm
- Single and Multi Channel Detection Unit
- 16 X 2 Line LCD display shows continuous ammonia level
- Inbuilt Hooter, And Relay to Operate Ventilation System
- Easy to Install
- Three Core Cable connection for Sensor
- Area Covered by one sensor is @ 2000 Sq. ft.

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Fire Protection

- Overhead Sprinklers
- In-rack Sprinklers
- Heat Detection



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Electrical

- Switch Gear
- MCC Panels



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New Designs-Expansion

- Size: double? triple?
- Site: location near rail lines and roads
- Which areas?
- Initial layout with future in mind
- Non-load-bearing walls
- **Use of panels**



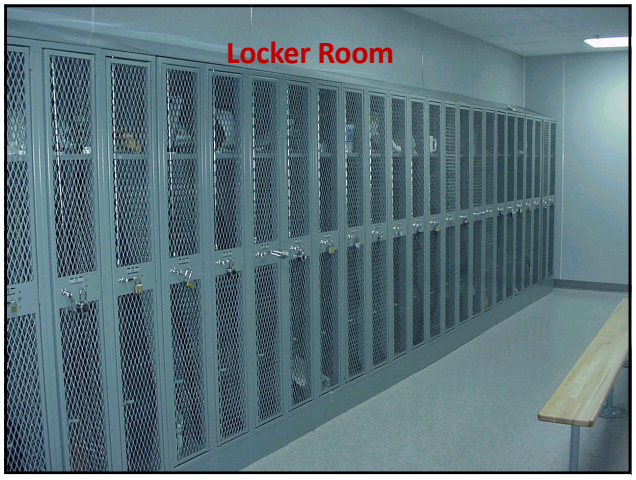
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Grading & Packing Hall



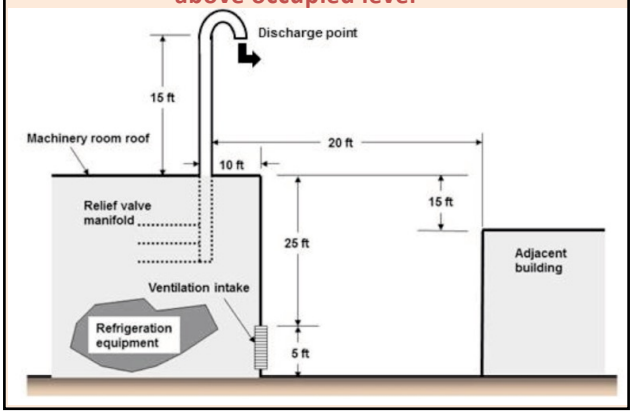
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Leak Detectors-Ventilators

1. **One Detector should alarm activate normal Ventilation at 35 PPM to 50 PPM**
2. **Second Detector Should Alarm & Activate Emergency Ventilation below 1000 PPM**
3. **Should Discharge Up Vertically with Minimum Discharge velocity of 250 FPM(12.7m/s)**

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Safety Valve outlet connection 15ft above occupied level



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AMMONIA REFRIGERATION SAFETY STANDARD



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Prevent rusting-basins/piping/vessels
Paint regularly



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AVOID WATER ACCUMULATION
COLD ROOMS/TERRACES



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Poorly Maintained Plant



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Well Designed Machine Room



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WELL DESIGNED MACHINE ROOM



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Well Designed Machine Room

- Designed for Good Maintenance Access
- Epoxy Coating on Floor
- Electrical Switch Gear and MCC Panels
- Good Ventilation



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Thank you
Any Questions ??

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