AMMONIA
A NATURAL REFRIGERANT

PRESENTED BY

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OXFORD COLD STORAGE

AIRAH REFRIGERANTS UPDATE SEMINAR

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OXFORD COLD STORAGE

Facts and Figures

- Started in 1975
- Family owned
- Third party warehousing
- Export, import, quarantine
- QA and ISO
- Temperatures +18°C to -30°
- Site 17 HA
- Floor Area: 96,000M²
- Volume: 1,068,784M³
- Capacity: 175,000 pallets
- 21st largest facility in the world
- 450 employees

Refrigeration liquid recirculation ammonia

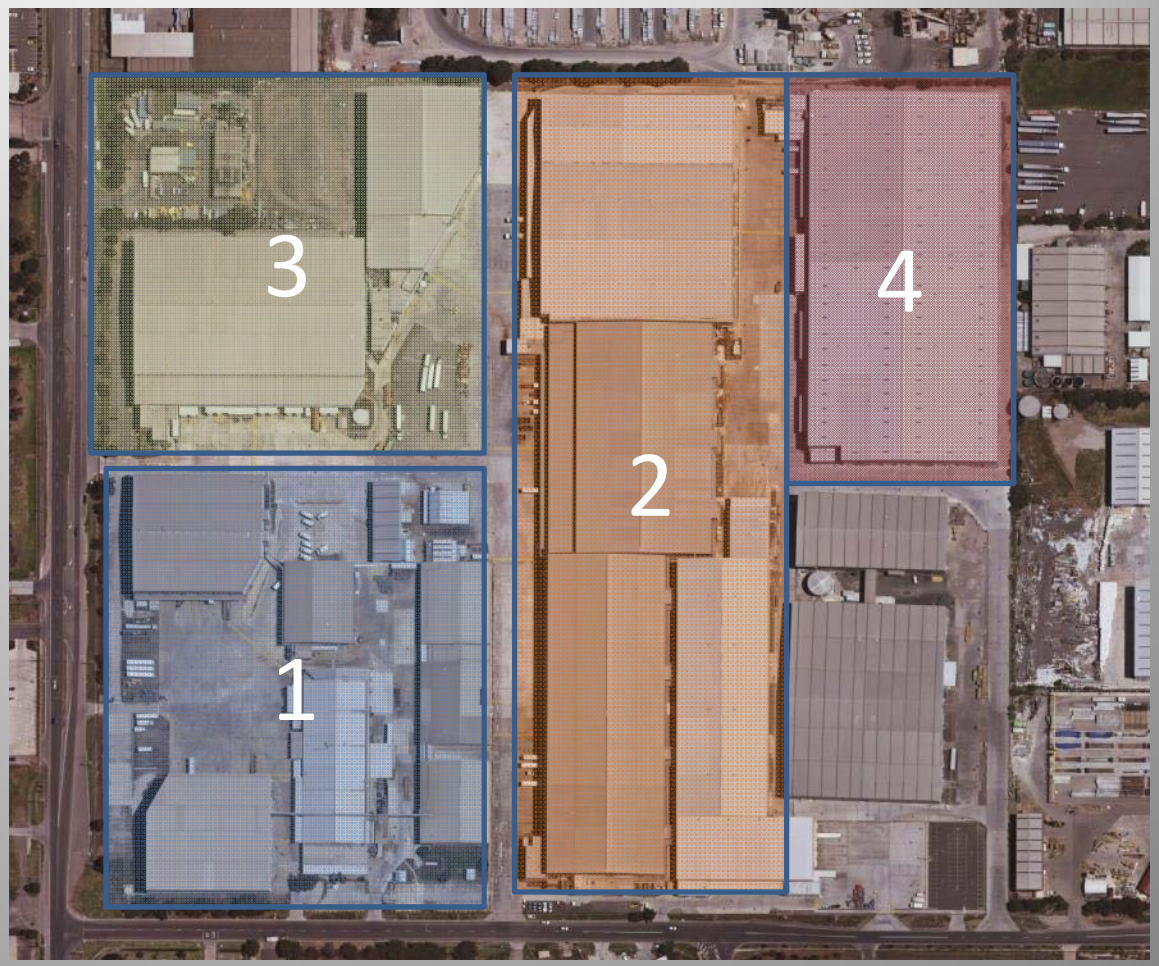
AMMONIA REFRIGERATION PLANTS

There are four ammonia refrigeration plants on site.

	Operating	(Tot.Press.Vess)
System 1	6,428Lt	(32,144Lt)
System 2	6,809Lt	(34,068Lt)
System 3	3,167Lt	(15,841Lt)
System 4	6,792Lt	(27,185Lt)
Total NH3	23,196Lt	(109,238Lt)

Reported Capacity HP Liq. Receivers

System 1	7,800Lt
System 2	6,350Lt
System 3	6,905Lt
System 4	10,015Lt
Total	31,070Lt



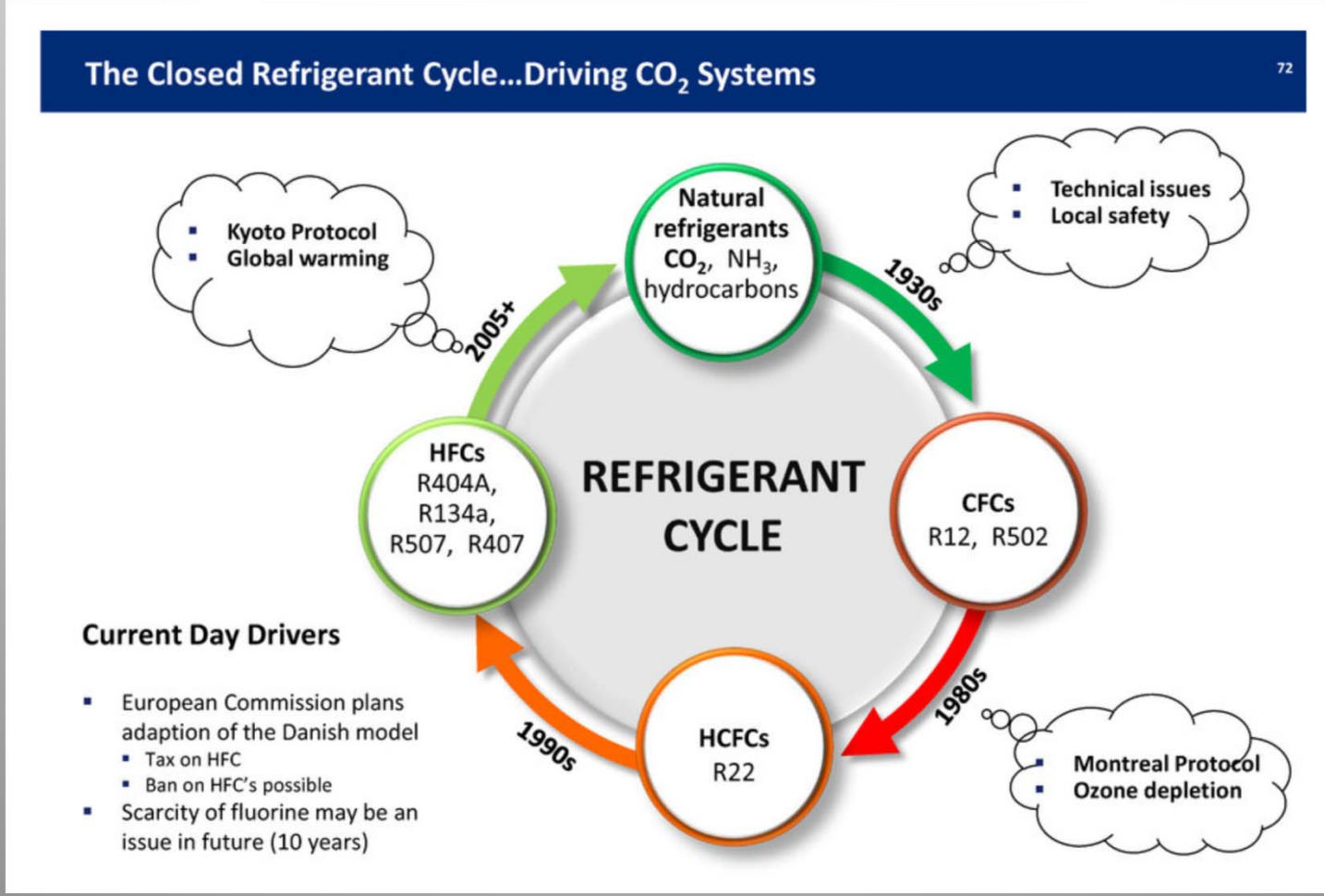
NH3 REFRIGERANT EXEMPTION

The application of AS/NZS 2022:2003 Anhydrous Ammonia Storage and Handling to refrigeration systems was discussed in December 1996 by the Joint Standards Australia/ Standards New Zealand ME/6 Refrigeration Committee and the following ruling was made:

The Committee agreed that the application of AS 2002 to ammonia refrigeration systems was inappropriate as AS:1677 covered this application of ammonia.

Consequently, our site is a HAZCHEM facility but not a Dangerous Goods Site

RFRIGERANTS BACK TO THE FUTURE



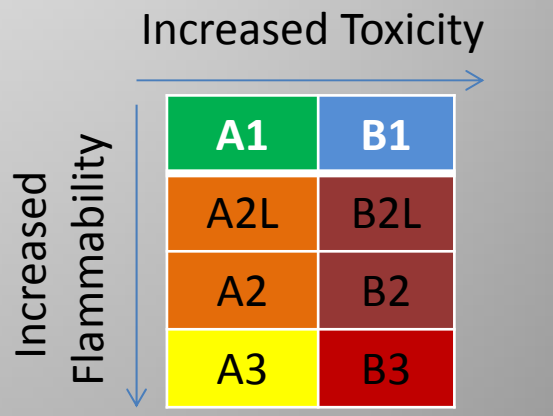
REFRIGERANTS - ODP & GWP

Refrigerant	Refrigerant	ODO	GWP
R717	Ammonia	0	<1
R744	Carbon dioxide	0	1.00
R290	Propane	0	0.30
R404A	R-125/1143a/134a (Blend 44/52/4)	0	3920
R600a	2 – methyl/propane (isobutane)	0	~20
R1270	Propane (propylene)	0	1.80
R22	Chlorofluoromethane	0.06	1810
R134a	Tetrafluorothene	0	1430
R410A	R-32/125 (Blend 50/50)	0	2090

Reference: Danfoss NH3 Training

AMMONIA - Class B2L

Refrigerant Type	Name	Name	Safety Group
-	R717	Ammonia	B2L
	R744	Carbon Dioxide	A1
HCFC	R22	Chlorofluoromethane	A1
HFC	R134a	Tetrafluorothene	A1
HFC	R404A	R-125/1143a/134a (44/52/4)	A1
HFC	R407C	R32/125/134a (23/25/52)	A1
HFC	R410a	R32/125 950/50)	A1
HFC	R507A	R125/143a (50/50)	A1
HFC	R152a	Diofluorethene	A2
HC	R290	Propane	A3
HC	R600	Butane	A3
HC	R600a	Iso-butane	A3
HC	R1270	Propylene	A3



B- Toxic

L – Low flammability

Reference: Danfoss NH3 Training

AMMONIA - A NATURAL REFRIGERANT

AMMONIA - Energy Efficiency

- Ammonia is one of the most efficient refrigerants available with applications that range from high to low temperatures.
- With the ever increasing focus on energy efficiency, ammonia is a safe and suitable refrigerant for the future
- Typically, flooded ammonia systems are 15-20% more efficient than DX R404A plants.
- Recent developments of NH3 and CO2 combination further increased the energy efficiency.
- NH3/CO2 cascade systems are very efficient at low and very low (less than -40^{o}C) temperatures
- NH3/CO2 brine systems are around 20% more efficient than traditional glycol systems

AMMONIA - Limitations

- Ammonia, (in the presence of low amounts of water) is aggressive on copper, zinc and their alloys
- Thus, iron is the only suitable material for piping ammonia plants.
- The use of traditional hermetic and semi-hermetic compressors is not possible
- More expensive capital investment than traditional copper systems.
- For large refrigeration plants this limitation is not a problem
- Increased safety requirements in many parts of the world limit the amount of ammonia in refrigeration systems
- Ammonia plants in parts of the world require the presence of qualified plant operators 24/7
- HAZCHEM and OH&S regulations restrict the use of ammonia
- Increased maintenance costs

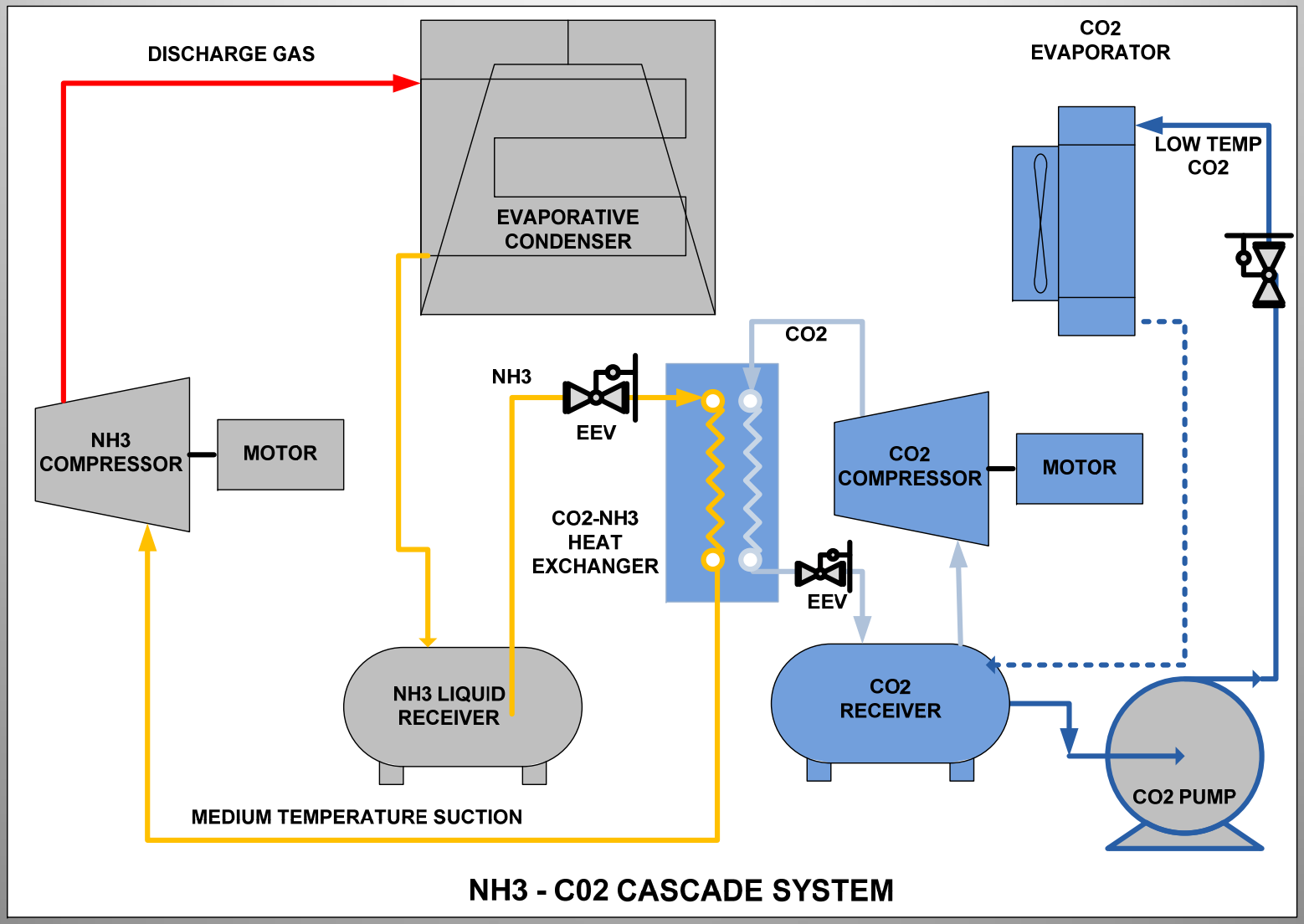
LOW CHARGE AMMONIA SYSTEMS

- It is recommended to limit the toxic ammonia charge in order to minimise safety precautions
- Smaller, low charge ammonia plants are replacing large central plants using liquid recirculation ammonia systems
- These compact systems can be:
  1. Single Stage or two stage NH3
  2. Ammonia/CO2 cascade systems
  3. Ammonia/CO2 brine systems
  4. Ammonia/Glycol systems

AMMONIA – CO2 CASCADE SYSTEMS

- The number of refrigeration systems with CO2 has increased considerably over the last 10 years.
- Due to the low density of NH3, the efficiency of ammonia systems becomes less attractive at low temperatures compared to NH3/CO2 cascade systems
- NH3/CO2 cascade system is a unique way to combine the benefits of two natural refrigerants.
- Typically, the NH3 charge can be reduced to 10% of a traditional NH3 system, minimising safety requirements.
- NH3/CO2 cascade systems have better efficiency than traditional NH3 systems

AMMONIA – CO2 CASCADE SYSTEMS



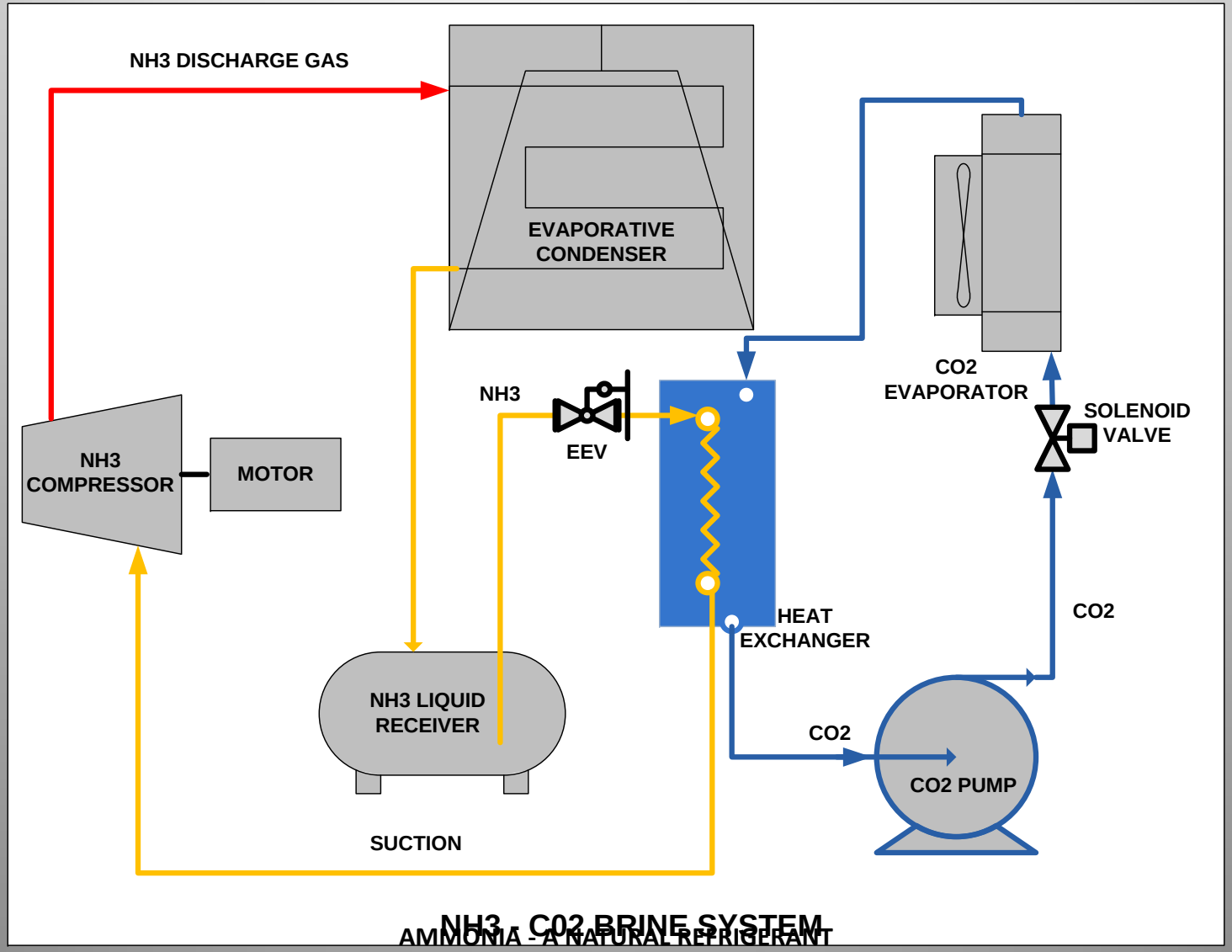
NH3 - C02 CASCADE SYSTEM

AMMONIA - A NATURAL REFRIGERANT

AMMONIA – CO2 BRINE SYSTEMS

- A number of manufacturers supply plants with NH3/CO2 pump systems (brine system)
- The refrigeration plant can be single stage or two stage and the CO2 brine solution is pumped to the evaporators as the heat transfer media.
- This system combines the benefits of low ammonia charge and simple system design.
- Liquid CO2 requires 10% of the pump power to circulate around the system
- CO2 liquid and return lines are much smaller in size than pipes used in liquid recirculation ammonia or water based glycol solutions.

AMMONIA – CO2 BRINE SYSTEMS



NH3 - C02 BRINE SYSTEM