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June 12-13 2012 | Washington DC

Innovation in Low Charge, Packaged Ammonia Refrigeration

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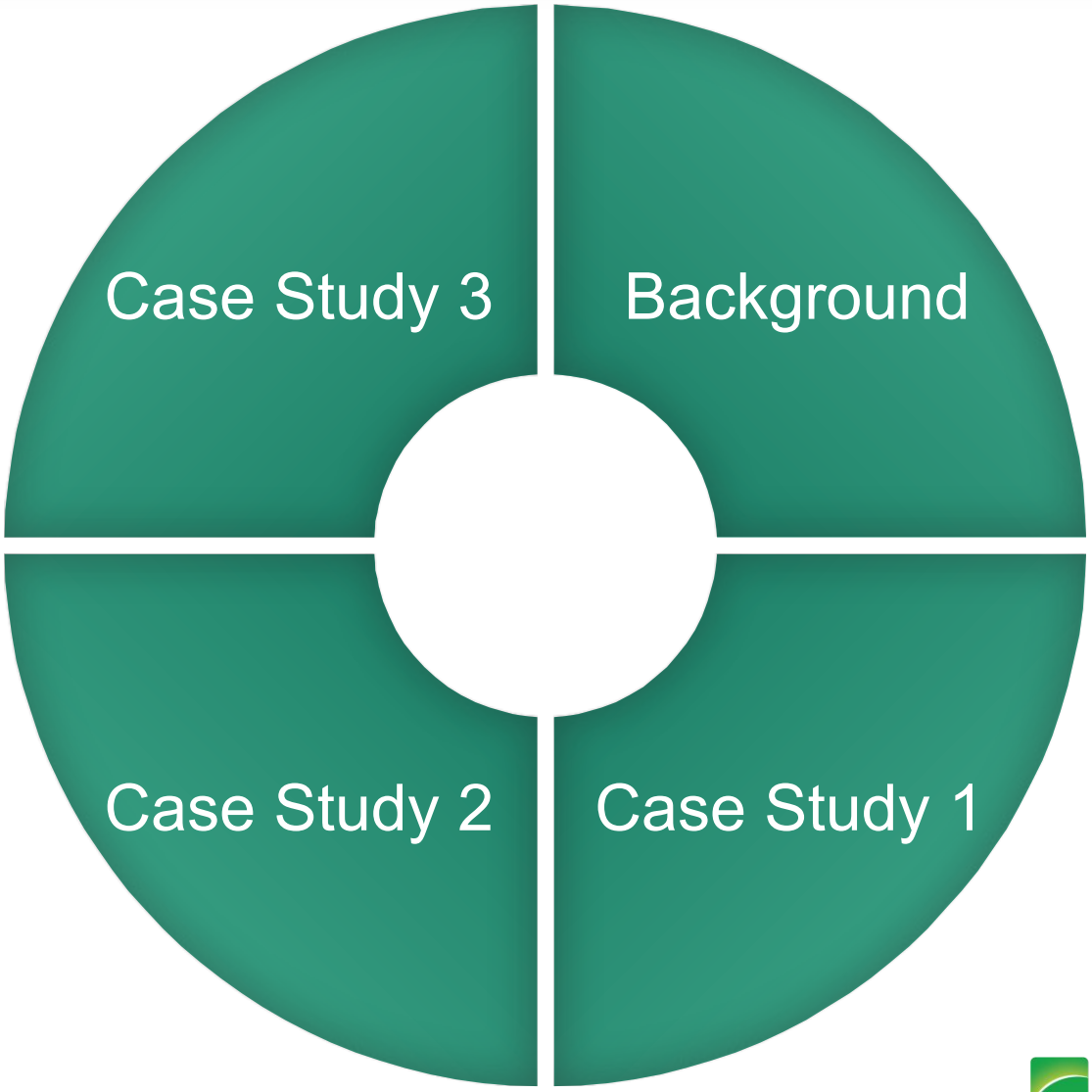
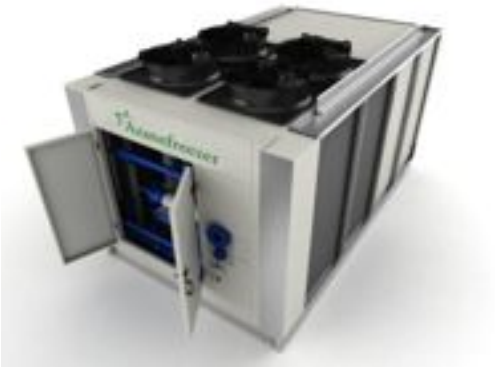
Introduction



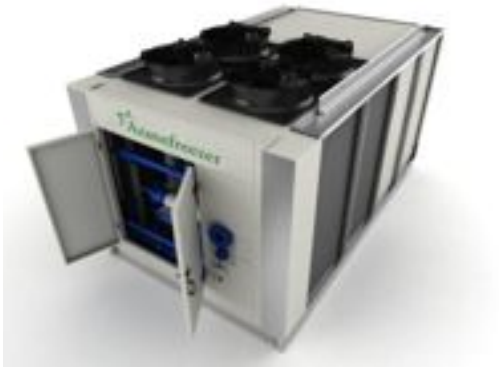
Customer Challenges

- HCFC phase out/HFC phase down
- Corporate and social responsibility
- Energy consumption
- Capital cost



Ammonia Challenges

- Regulation – OSHA, EPA, USDOT…
- Refrigerant Charge - <10,000lb
- Health & Safety - PSM
- Technology
- Education



Packaged Ammonia Concept

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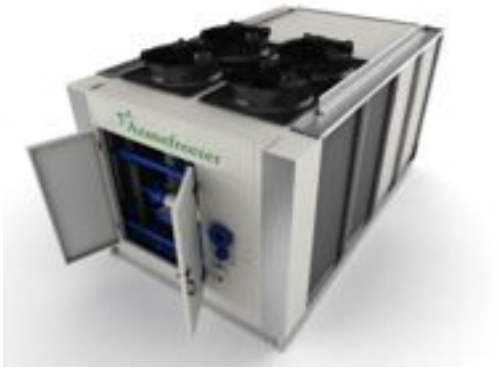
- Totally natural fluid
- Low charge
- Plug and play
- Factory packaged and tested
- Optimised energy efficiency



Case Study 1: Cold Storage

Case Study 1: Cold Storage

Customer	Soup & Sauce Manufacturer
Project type	R22 phase out
Application:	Cold Storage
Store size:	10,764ft^2
Store temperature:	-13°F
Cooling Load:	36TR
Solution:	1 x Azanefreezer
Charge:	522lb

Innovation: Low Charge, Low Pressure Ammonia

Low Pressure Receiver

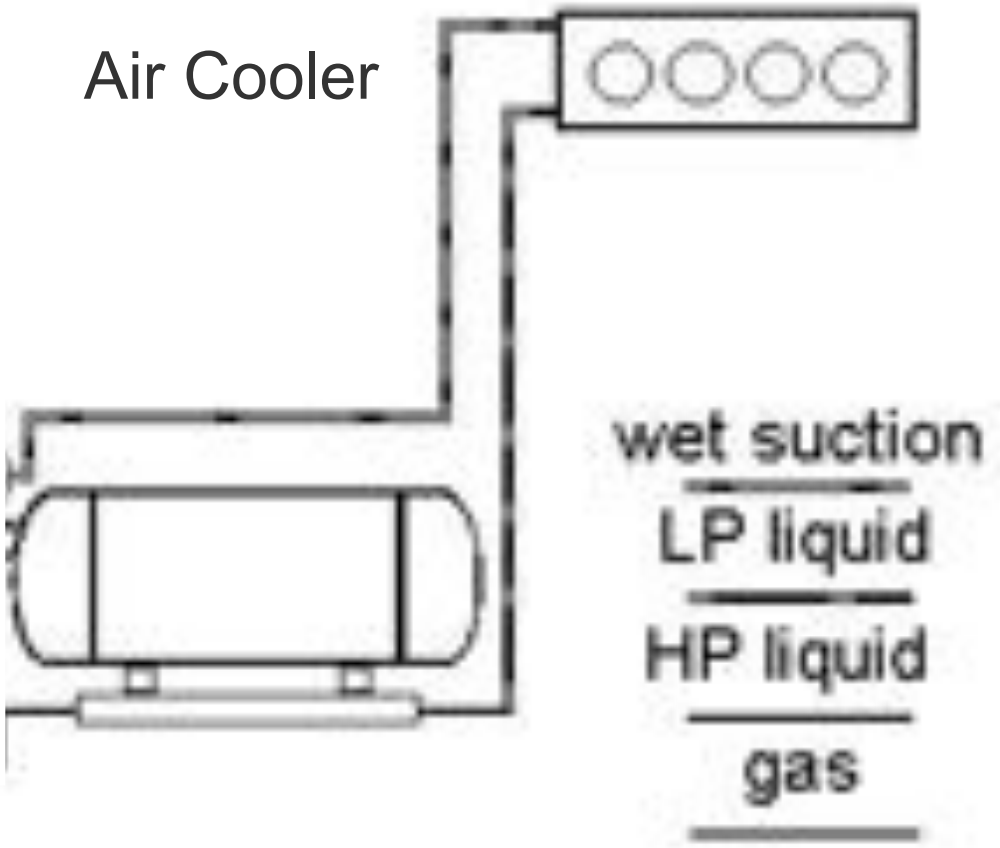
wet suction

LP liquid

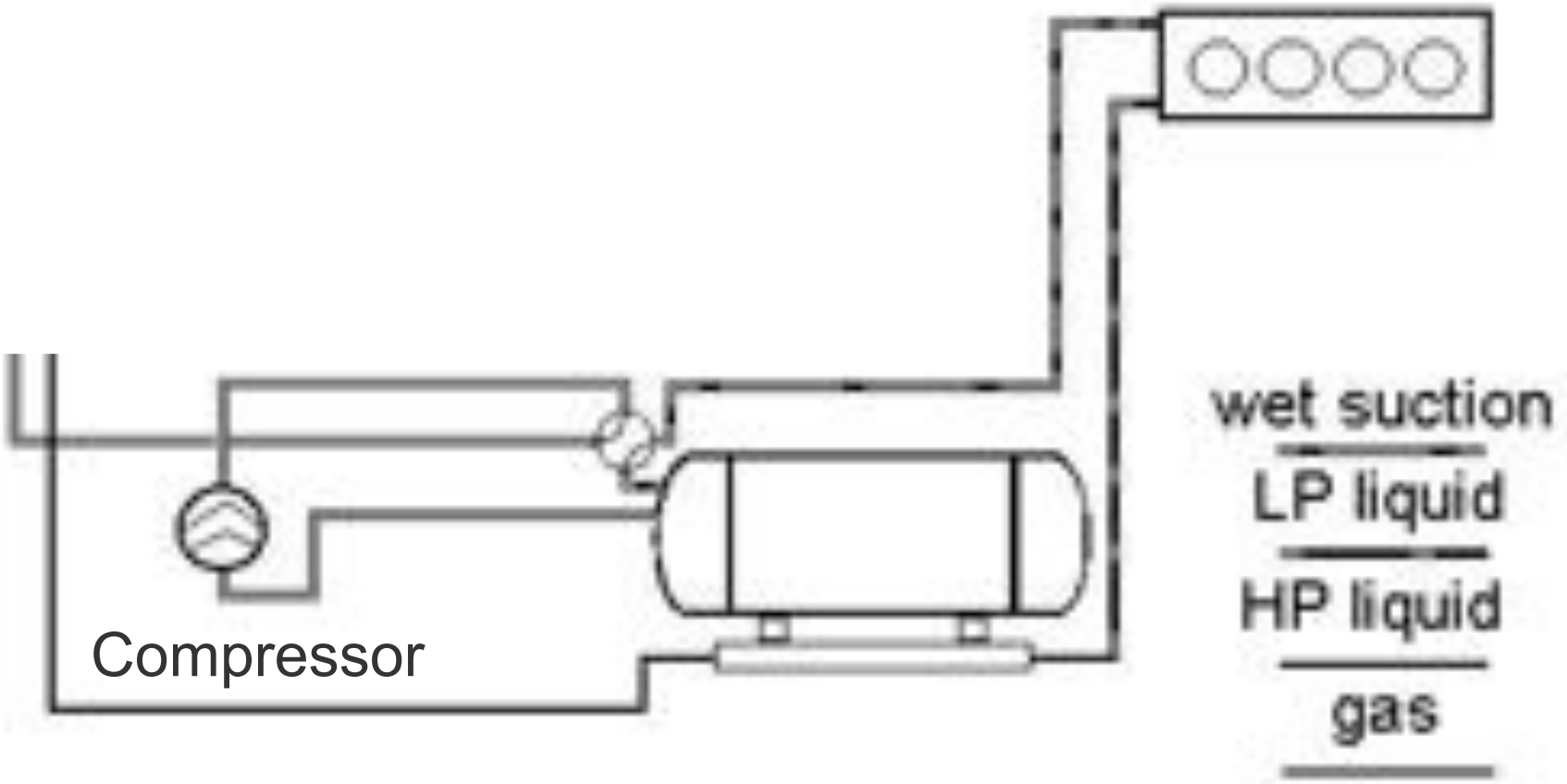
HP liquid

gas

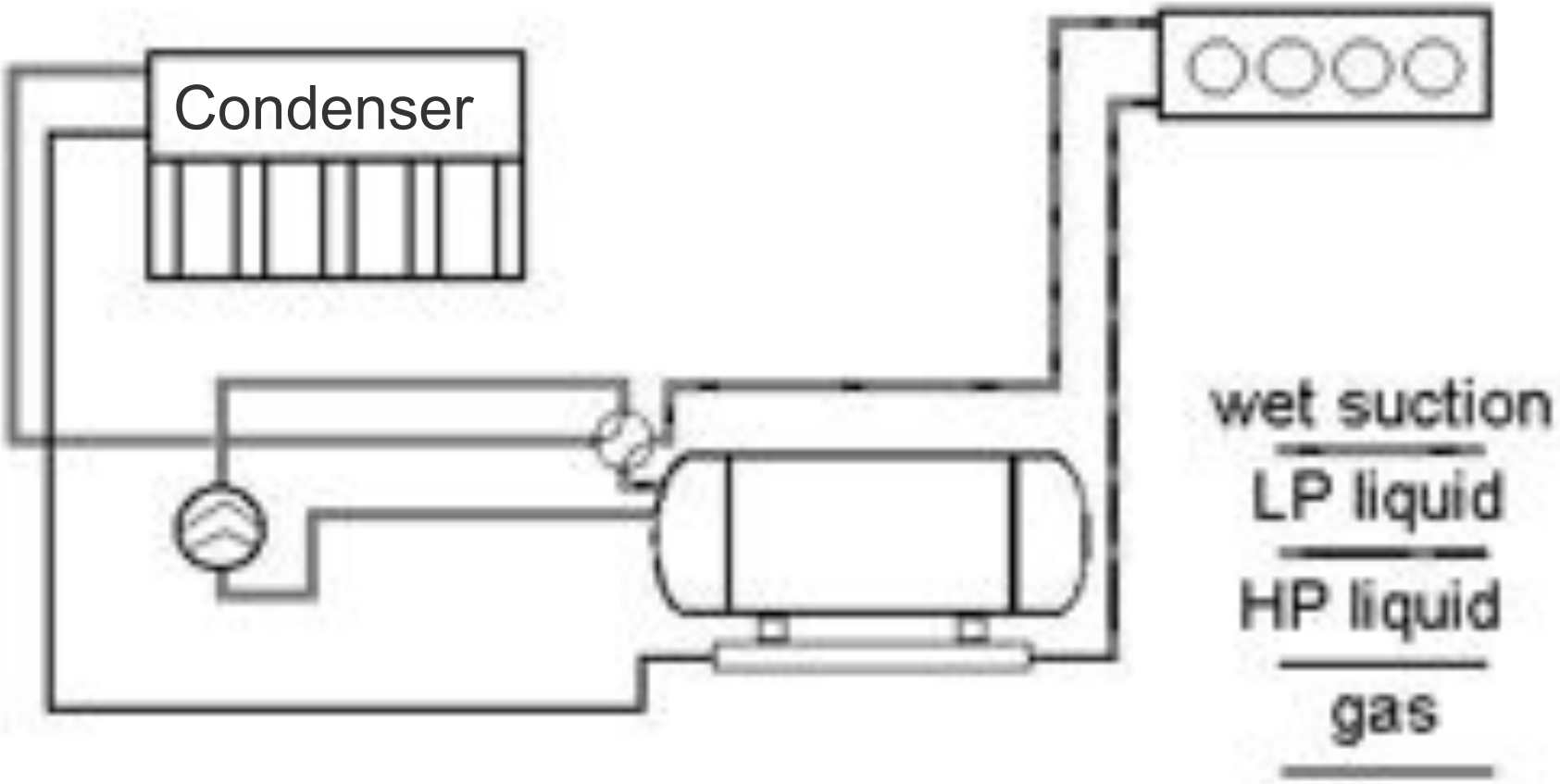
Innovation: Low Charge, Low Pressure Ammonia



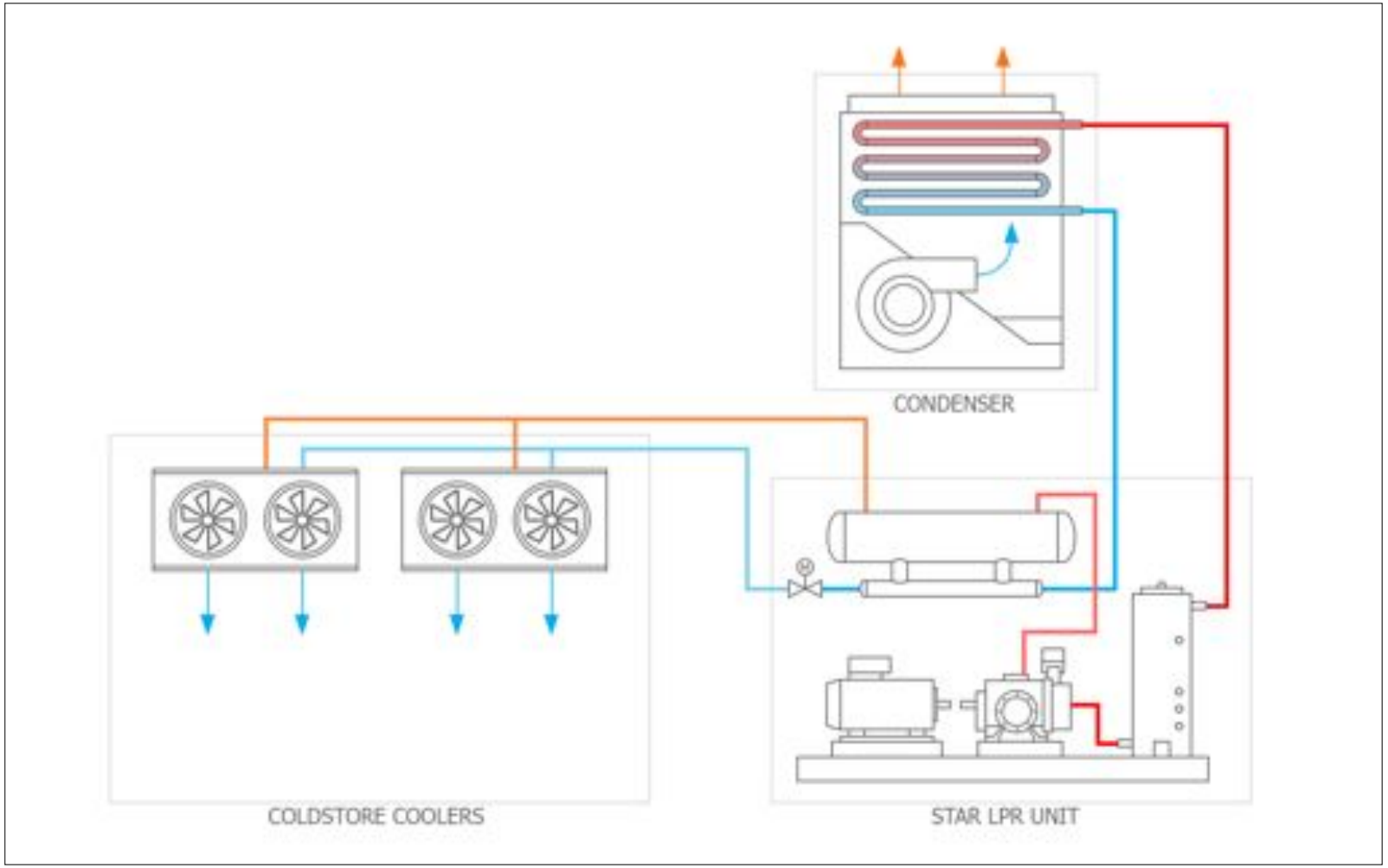
Innovation: Low Charge, Low Pressure Ammonia



Innovation: Low Charge, Low Pressure Ammonia



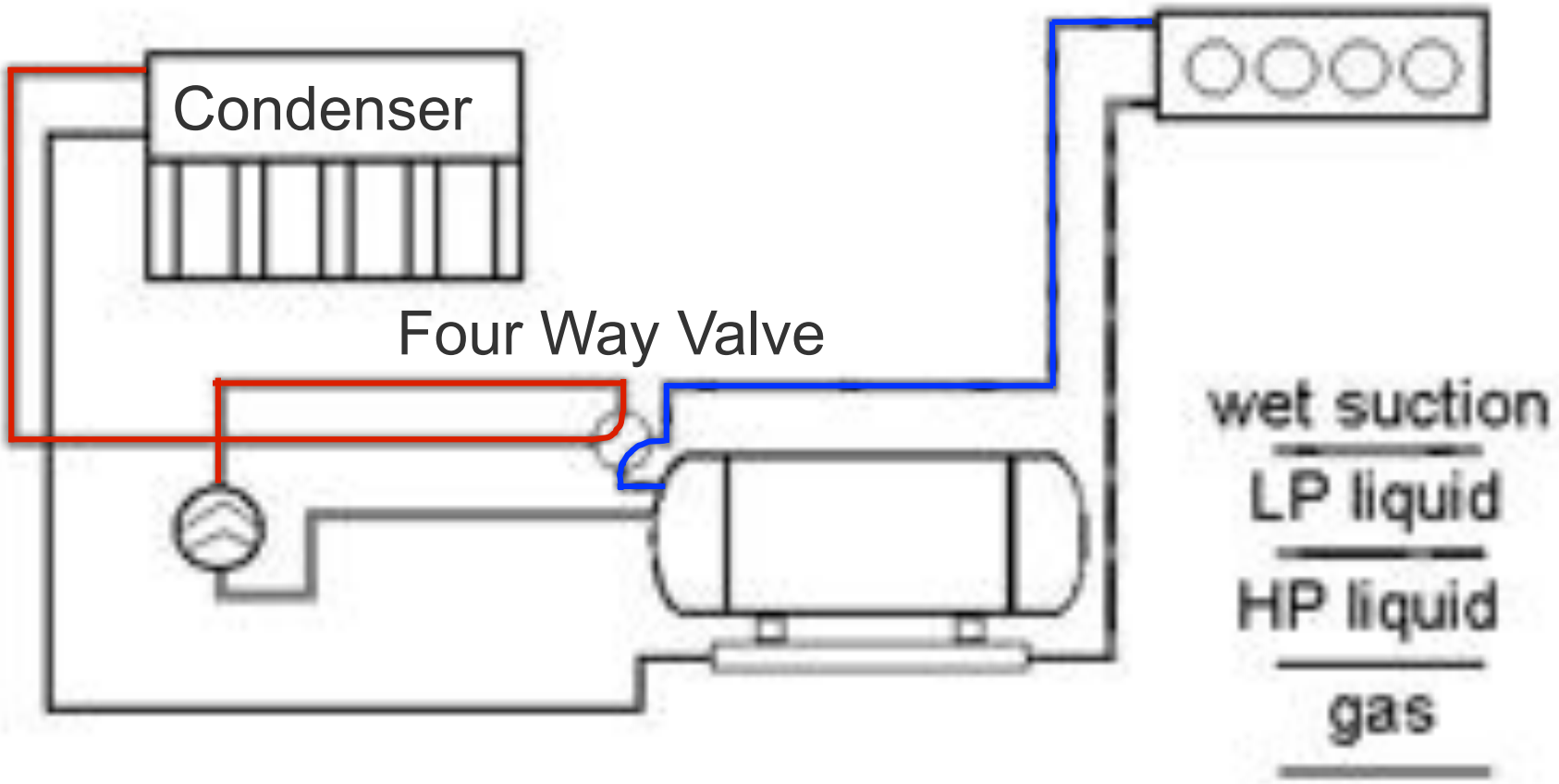
Innovation: Low Charge, Low Pressure Ammonia



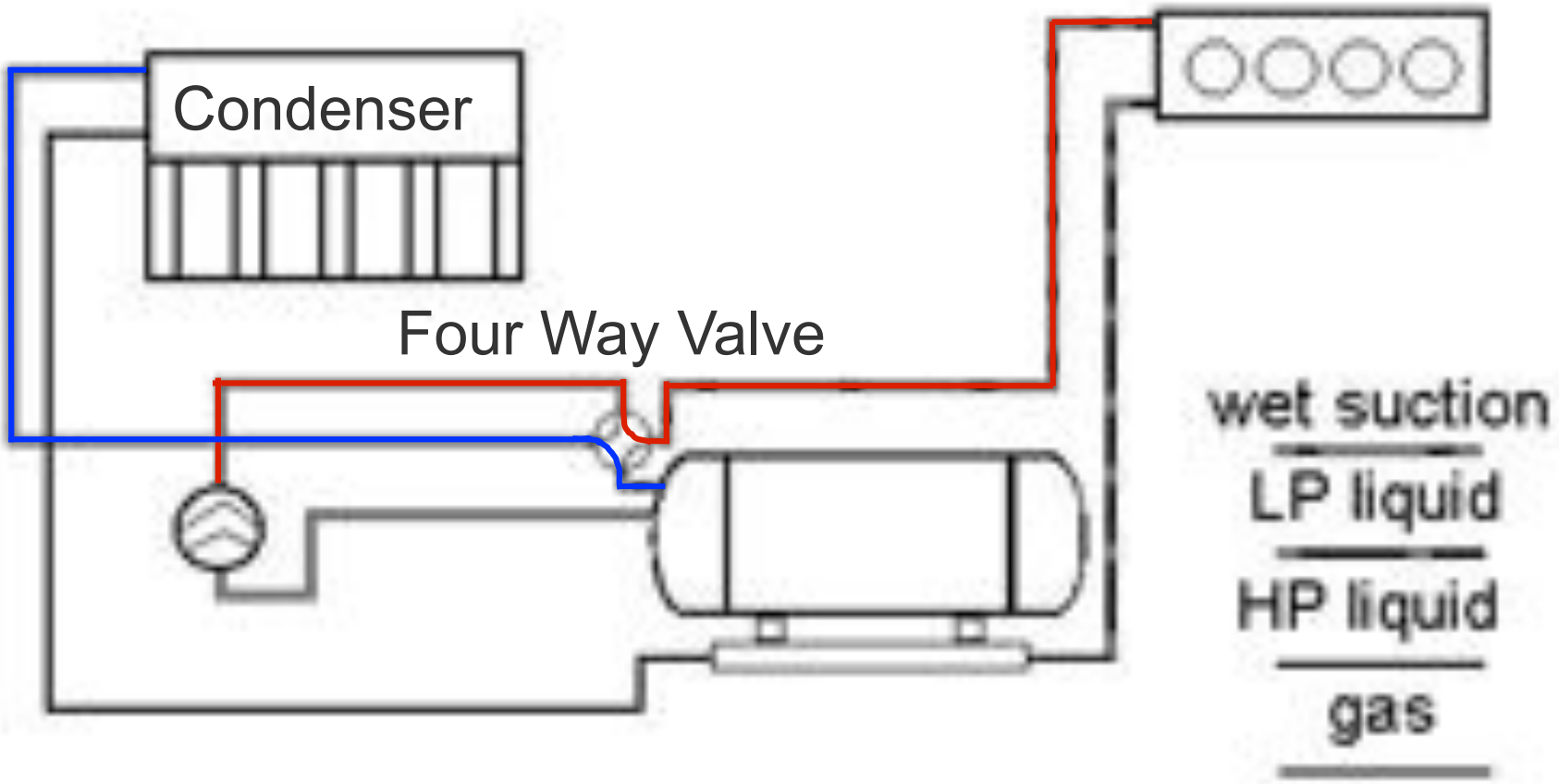
Innovation: Reverse Cycle Defrost

- Single 4-way ball valve
- Reverses plant operation
- Electrically actuated
- Rapid defrost

Innovation: Reverse Cycle Defrost



Innovation: Reverse Cycle Defrost



Innovation: Aluminum Coil

Metal	Density lb/ft^3	Thermal Conductivity Btu/h ft^2 °F
Aluminum	165	117
Carbon Steel	489	26
Zinc	440	65
Stainless Steel	501	9.4

Package Design

Energy and Cost Comparison

System	Suction Temperature	Running Cost (vs pump circ)	Capital Cost (vs pump circ)	Refrigerant Charge
Pumped Circulation	-27.4°F	0%	0%	746lb
DX (HFC)	-31.0°F	+20%	-25%	500lb
LPR	-23.8°F	-5%	-15%	522lb

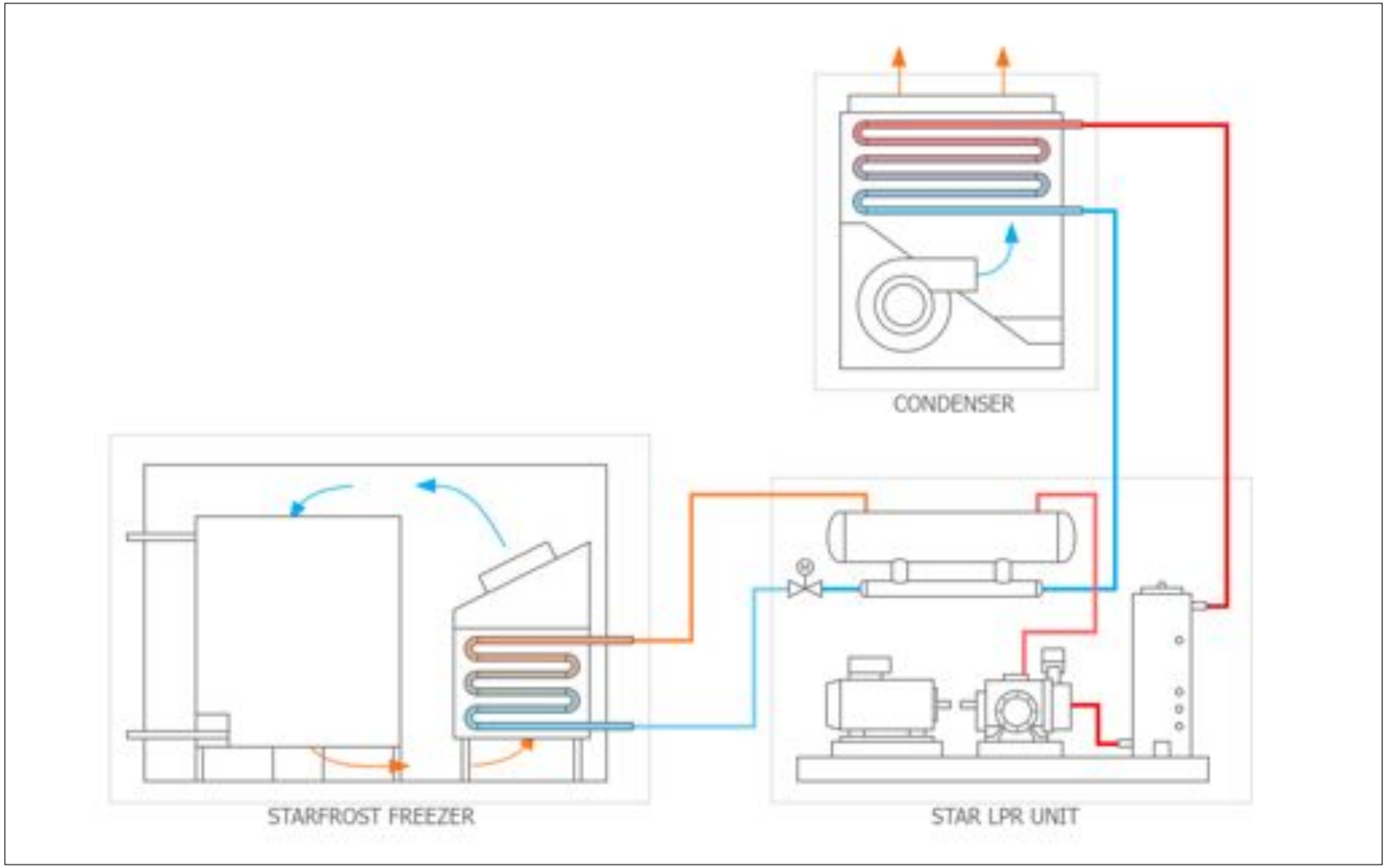
Based on -13°F store temperature

Case Study 2: Food Production

Case Study 2: Food Production

Customer	Bakery
Project type	Factory extension
Application:	Spiral Freezer
Product throughput	4,000 lb/hr
Evaporation temperature	-40°F
Cooling Capacity:	56 TR
Equipment :	1 x Glacier
Charge:	838 lb

Innovation - LPR



Innovation - Aluminum Coil and RCD

Package Design

Energy and Cost Comparison

System	Suction Temperature	Running Cost (vs pump circ)	Capital Cost (vs pump circ)	Refrigerant Charge
Pumped Circulation	-43.6°F	0%	0%	2,222lb
DX (HFC)	-47.2°F	+20%	-25%	891lb
LPR	-41.5°F	-5%	-15%	838lb

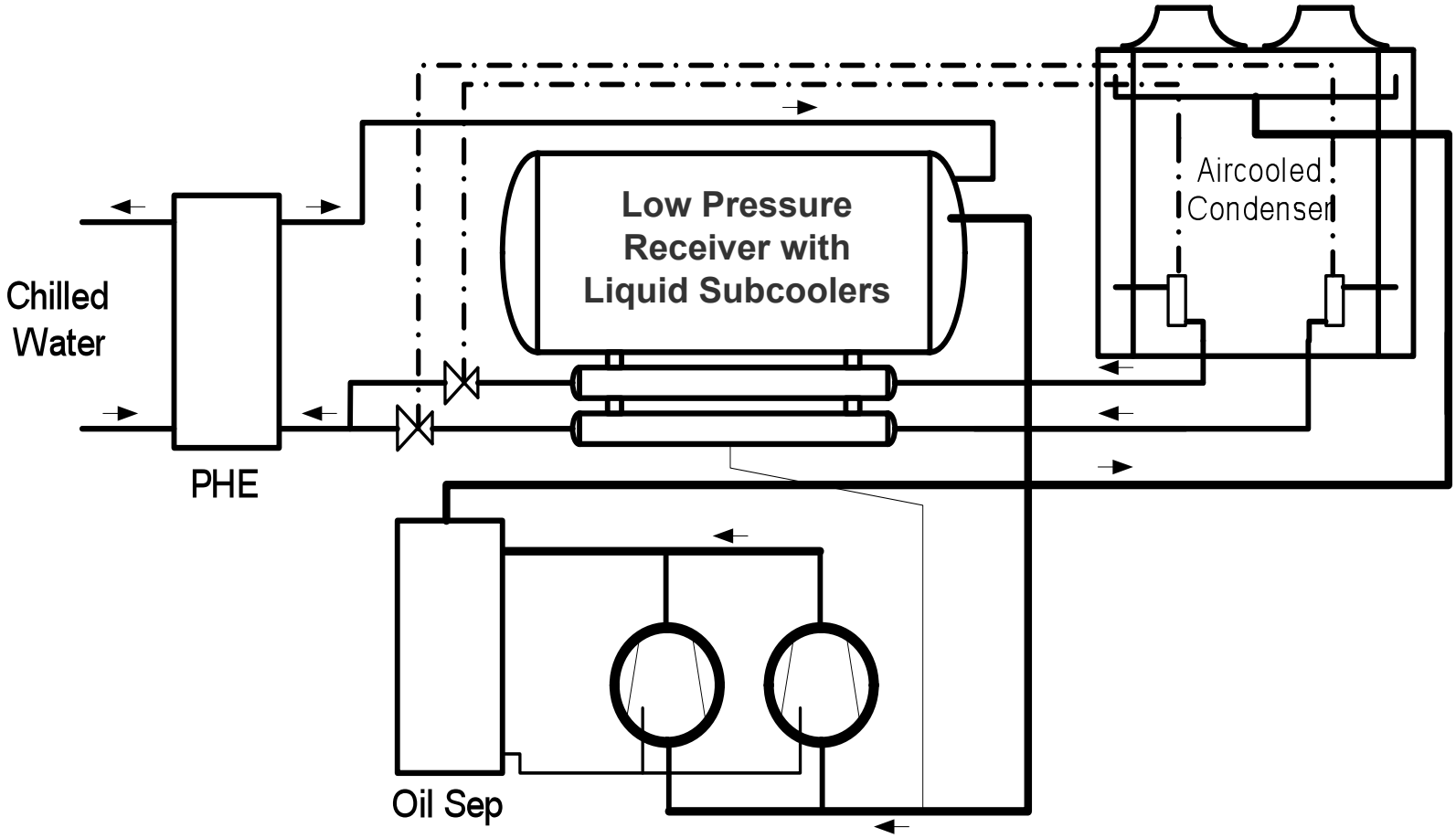
Based on -29.2°F air temperature

Case Study 3: HVAC

Case Study 3: HVAC

Customer	Retail
Project Type	New store
Application:	Retail Store HVAC
Secondary fluid:	+42.8°F
Cooling Capacity:	160TR
Equipment	1 x Azanechiller
Charge:	353lb

Packaged Ammonia Chiller



Package Design

Energy and Cost Comparison

System	Suction Temperature	Running Cost (vs DX)	Capital Cost (vs DX)	Refrigerant Charge
DX (HFC)	33.8°F	0%	0%	360lb
LPR	35.6°F	-24%	200%	353lb

Based on 42.8°F water temperature

Summary

- Packaged ammonia system help reduce
  - Cost
  - Charge
- 50% to 75% reduction in charge possible
- 20% to 25% reduction in energy consumption
- Wide range of applications
  - Cold storage
  - Food manufacturing
  - HVAC
  - Process cooling

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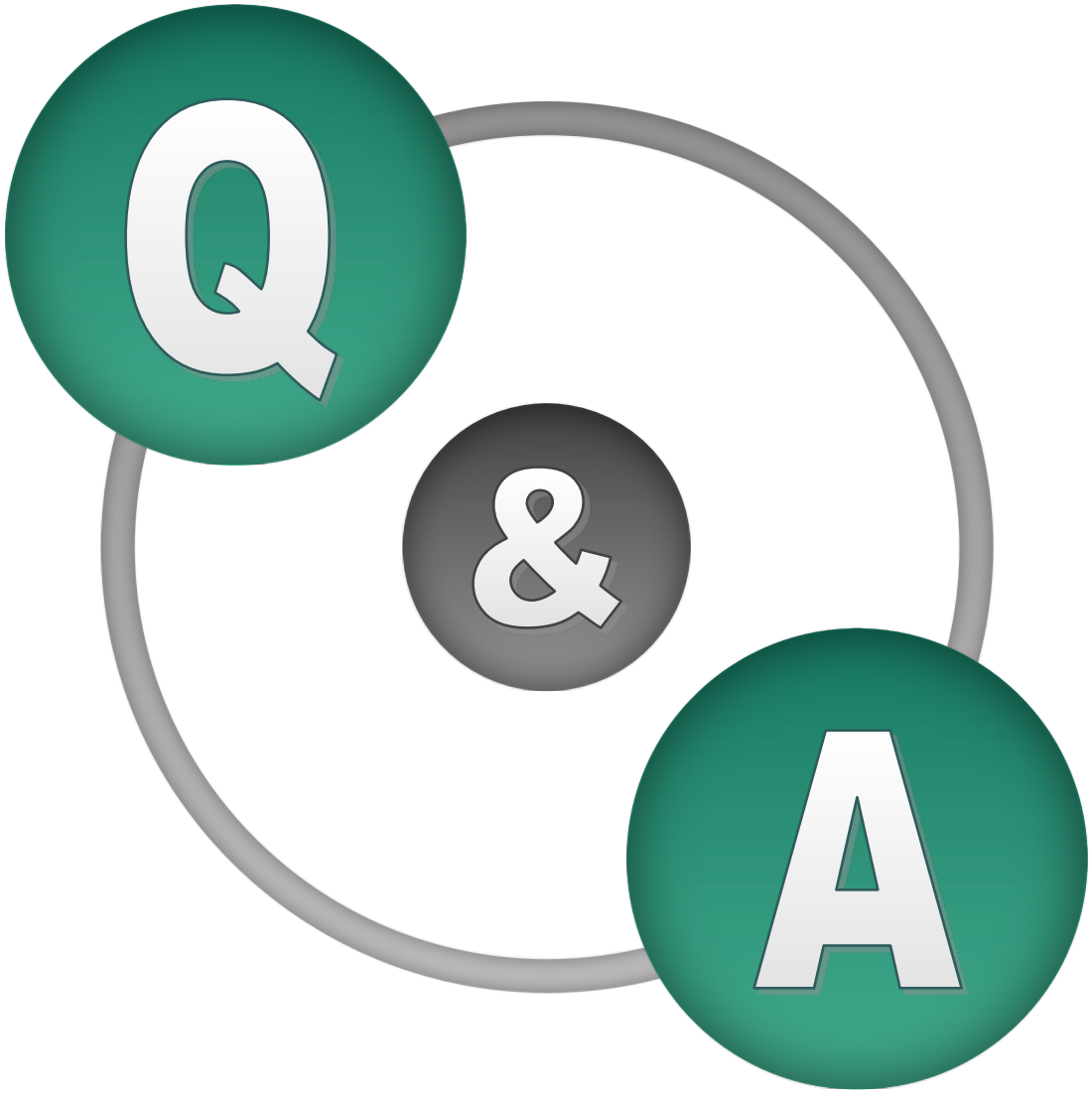

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