

Large Scale, Central Type, Low Charge NH₃ Refrigeration Plant

Chillventa

16 to 18 October, 2018 • Nürnberg, Germany

By Stefan Jensen

Maintaining Innovation

TECHNOLOGIES | DESIGN | CONSTRUCTION | SERVICING



- **LOW NH₃ CHARGE**

- **LOW ENERGY CONSUMPTION**

- **LOW OCCUPATIONAL RISK**

- **LOW DIRECT EMISSIONS**

- **HIGH EXPECTATIONS**



How Does Low Charge NH₃ Look?



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How Does Low Charge NH_3 Look?

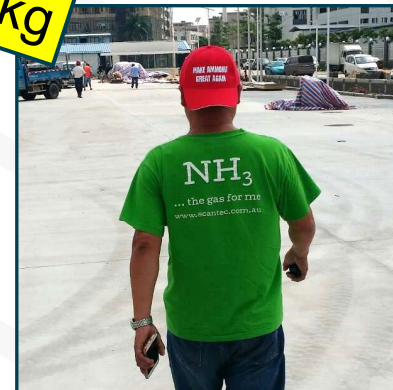


Lower ceiling = no sprinklers

Evaporator air supply



NH_3 inventory 850 kg

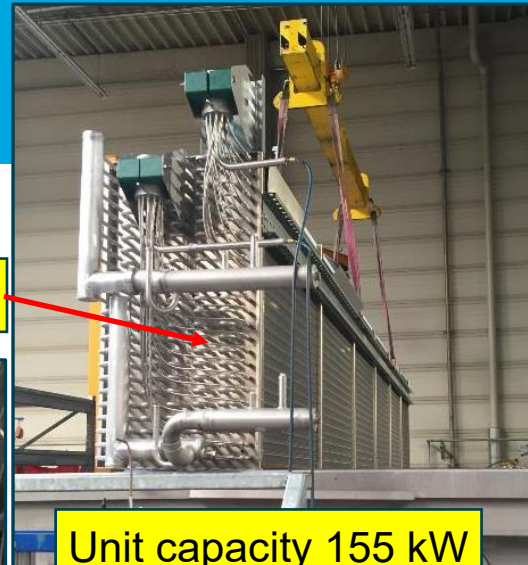
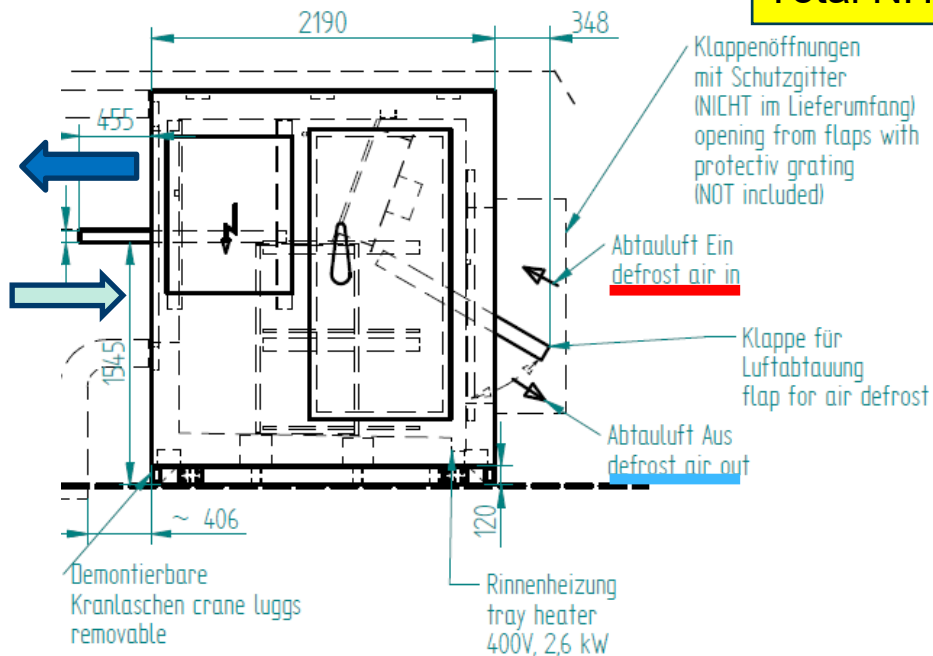




How Does Low Charge NH₃ Work?

Valve stations and pipelines outside building

Total NH₃ operating charge 5 kg



Unit capacity 155 kW



Cold Storage Design Innovations Award Winner



Climate Suitable for Ambient Air Defrost?

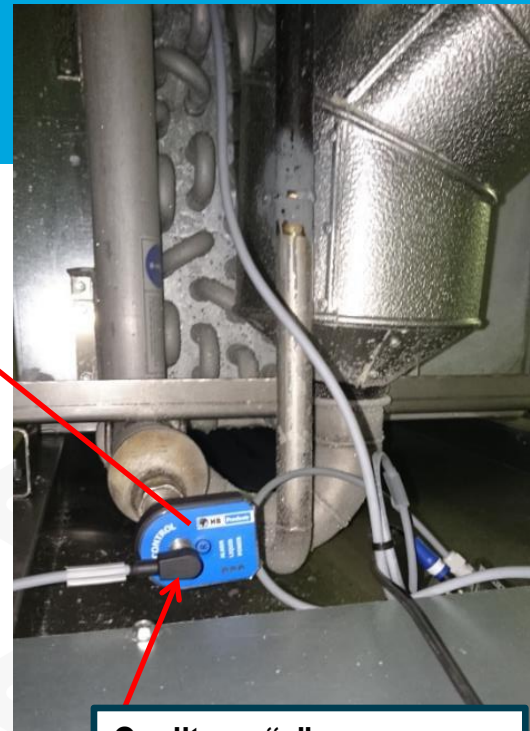
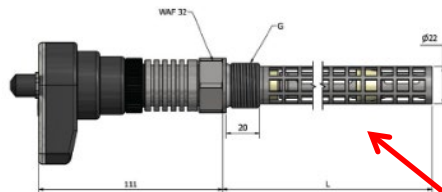
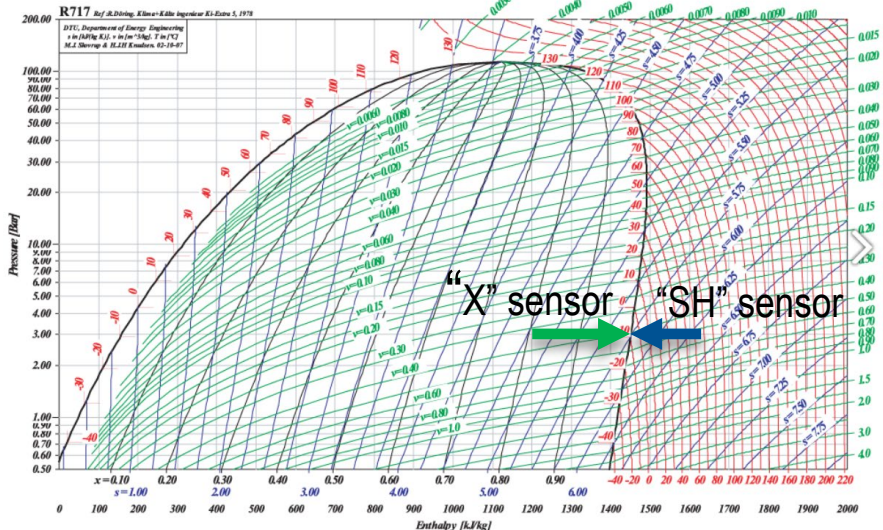
- Ambient air defrost has been used in all parts of Australia
- Applied in minimum warehouse temperature of -30°C
- Melbourne latitude $37^{\circ}, 47'\text{S}$ – penthouses; 2°C winter
- Perth latitude $31^{\circ}, 57'\text{S}$ – alcoves; night temp. 9°C



Singapore coordinates
 $1.3521^{\circ}\text{ N}, 103.8198^{\circ}\text{ E}$



How Does Low Charge NH₃ Work?



Quality or “x” sensor

The dielectric spectroscopy (capacitance) measurement method uses the difference in dielectric properties of gases and liquid

Electronically controlled R717 injection based on refrigerant quality at evaporator exit



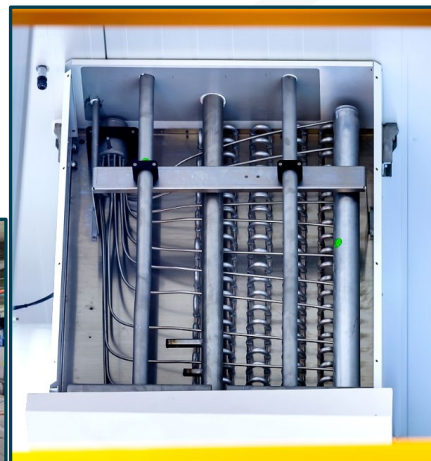
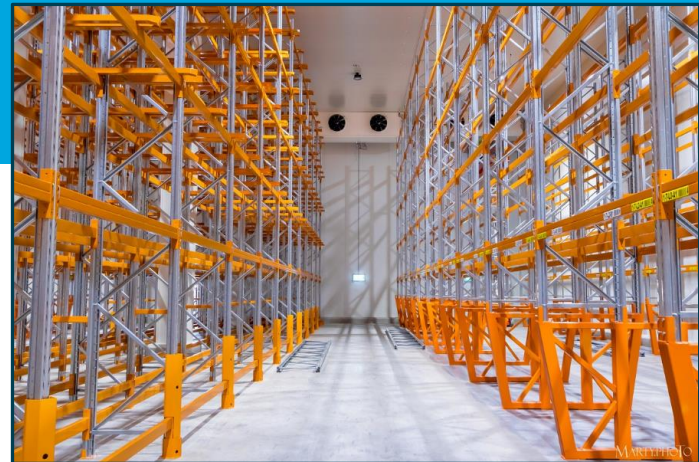
How Large can a Low Charge NH_3 Plant be?

No technical limits

Refrigerated volume 114,000 m^3
50/50% freezer/chiller
13,000 m^2 refrigerated area
500/600 kW LT/HT
750 kg NH_3 (0.7 kg/kW)
10 kWh/ $\text{m}^3 \cdot \text{a}$ (storage)
17 kWh/ $\text{m}^3 \cdot \text{a}$ (50 t/day)



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How Small?

Refrigerated volume 5,250 m³



46/54% freezer/chiller
1,264 m² refrigerated area
45/49 kW LT/HT
Replaces ten year old HFC plant
Projected electricity cost savings \$8,000/month

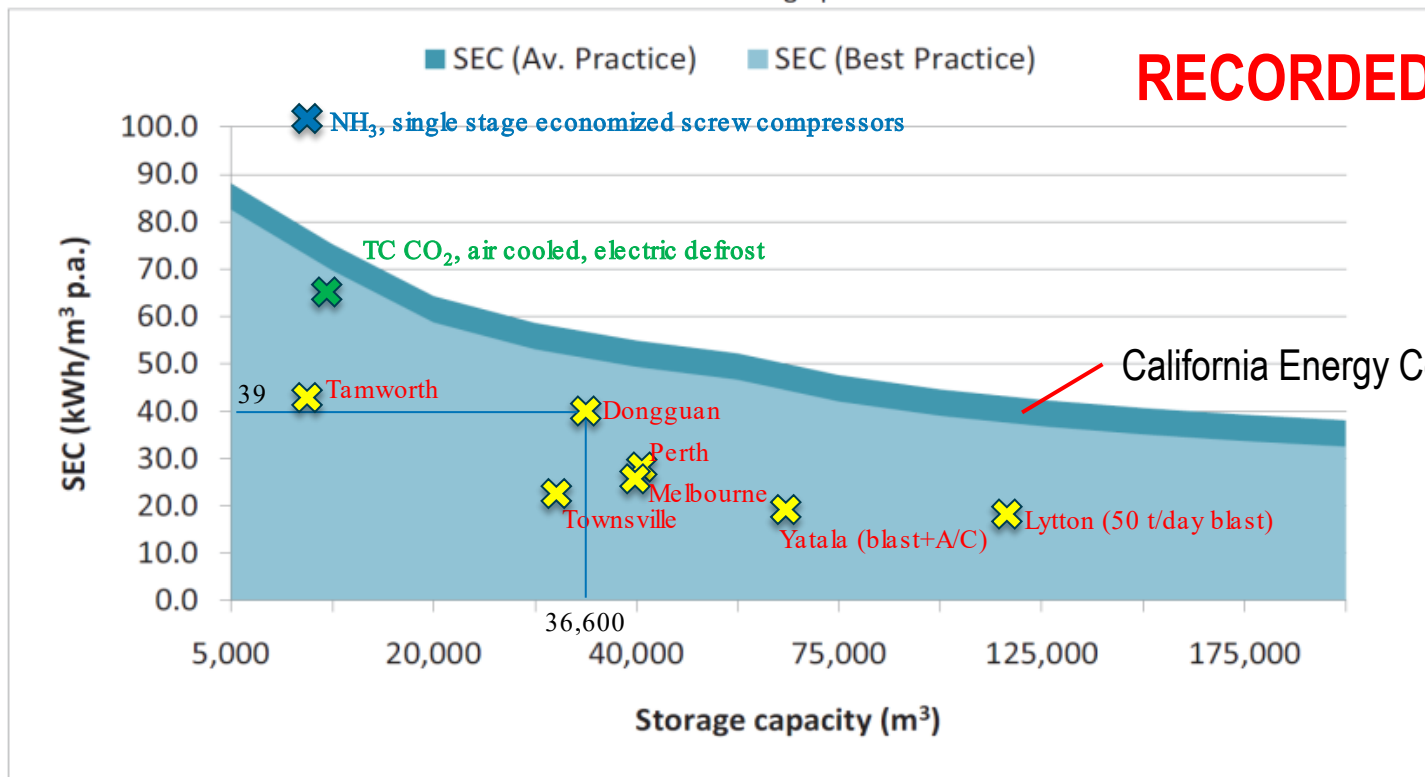


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How Energy Efficient?

$$\text{SEC (kWh/ft}^3\text{)} \text{ average practice} = 38.978 \times \text{storage volume}^{-0.2275}$$

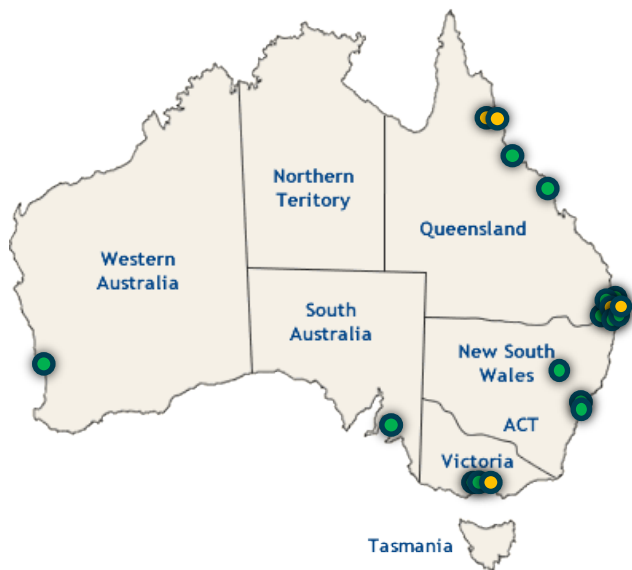


RECORDED VALUES

California Energy Commission 2008



How Is the Market Acceptance?



- Completed
- Under construction



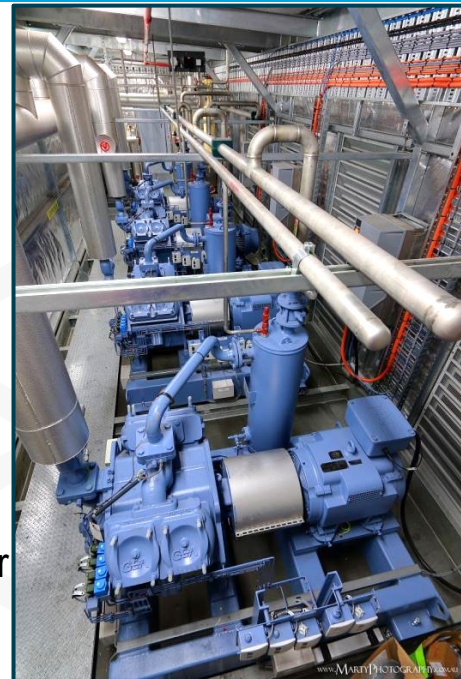
How Is the Future Likely to Be?



Smaller tubes for reduced NH_3 inventories



NH_3 DX S&T's



Factory
Packaging for
Mobility and
Safety



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NH_3 DX
PHE's

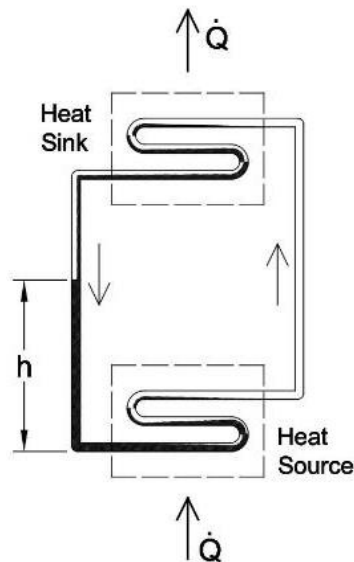
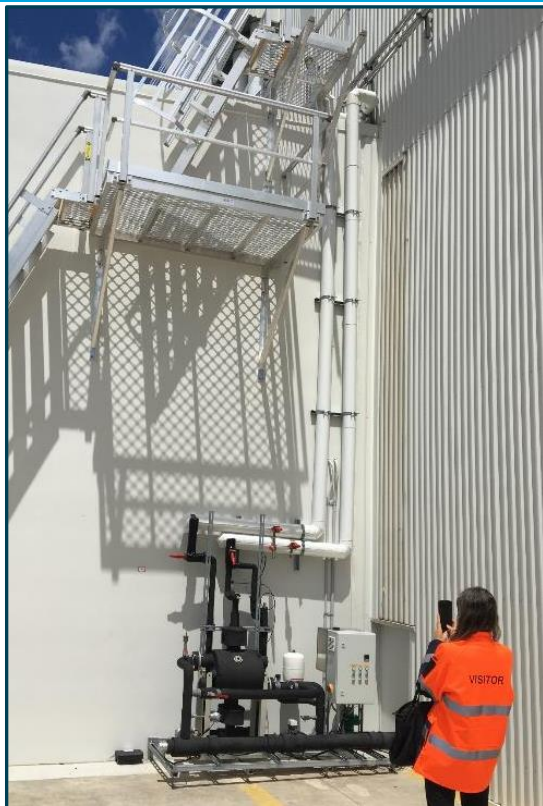


304SS piping for low friction, high corrosion
resistance, low leakage probability

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How Is the Future Likely to Be?



Secondary loop defrost for further NH_3 inventory minimization, prevention of liquid hammer, energy efficiency and better defrost efficiency

Low Charge Plate Freezers

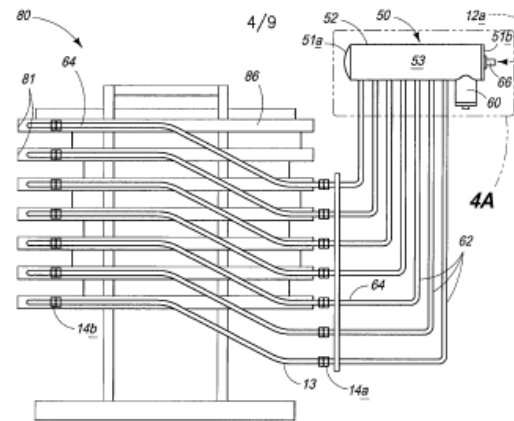


FIG. 4

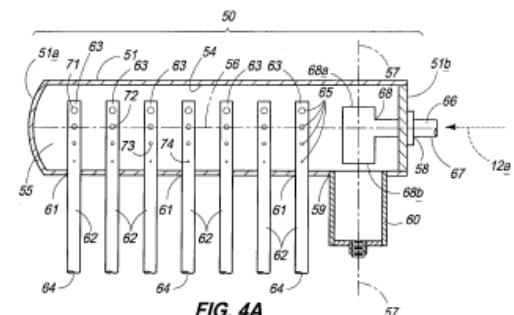


FIG. 4A



Thank You

ONCE YOU GO AMMONIA YOU NEVER GO BACK



ssjensen@scantec.com.au