



ATMO sphere

Business Case for
Natural Refrigerants

04/09/2018 – Singapore



NH₃





TECHNICAL MATURITY OF LOW CHARGE NH₃ SYSTEMS

Stefan S. Jensen

PACKAGED SYSTEMS

Low charge NH₃ water chiller for Council office air conditioning



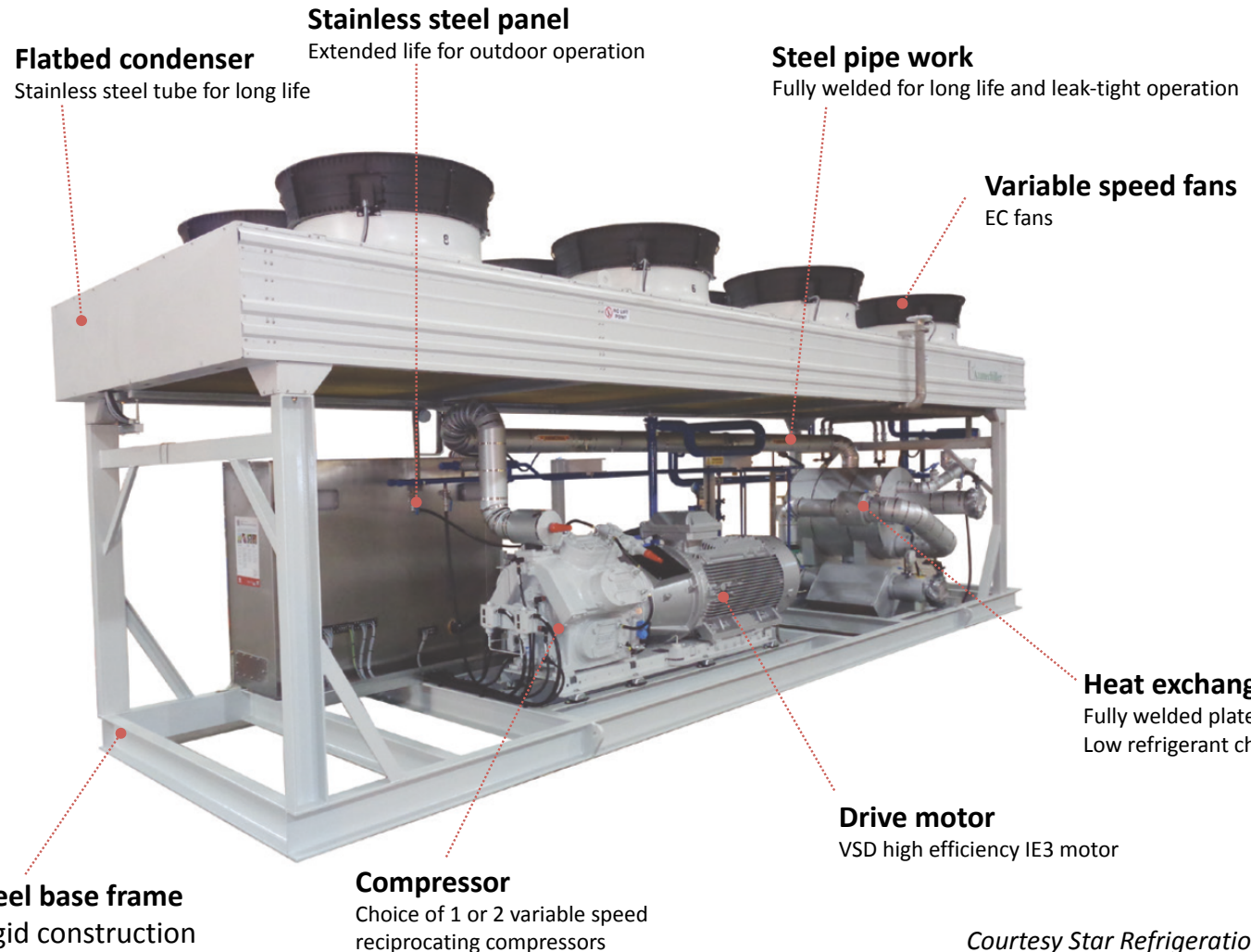
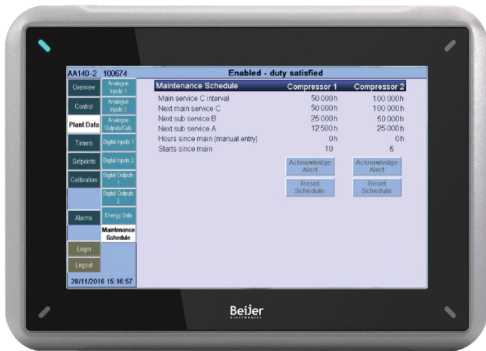
NH₃ inventory/unit ~25 kg, unit capacity 600 kW, IPLV=9.51



PACKAGED SYSTEMS

Control

PLC and touchscreen HMI. Remote access and condition based monitoring via broadband

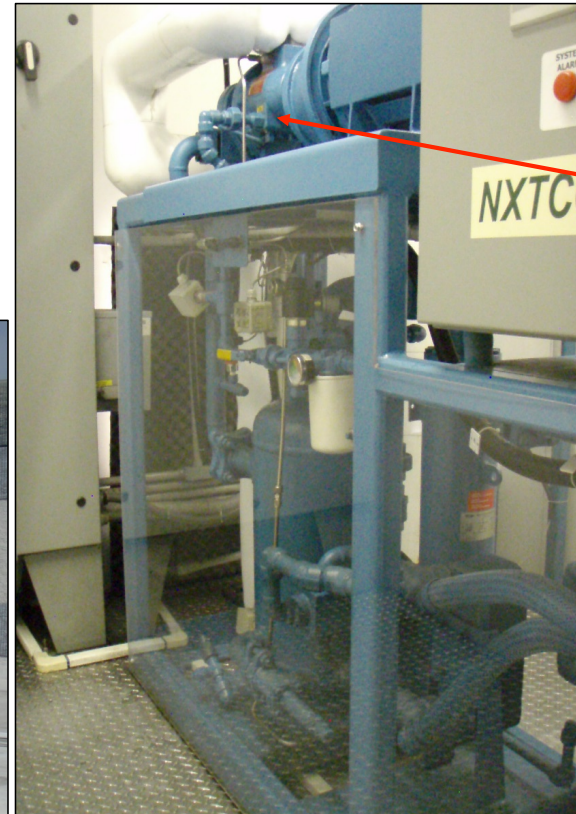


Courtesy Star Refrigeration, Glasgow



MULTIPLEXED SYSTEMS

Multiple LC NH₃ systems for refrigerated distribution centres (multiplexing):



Screw compressor

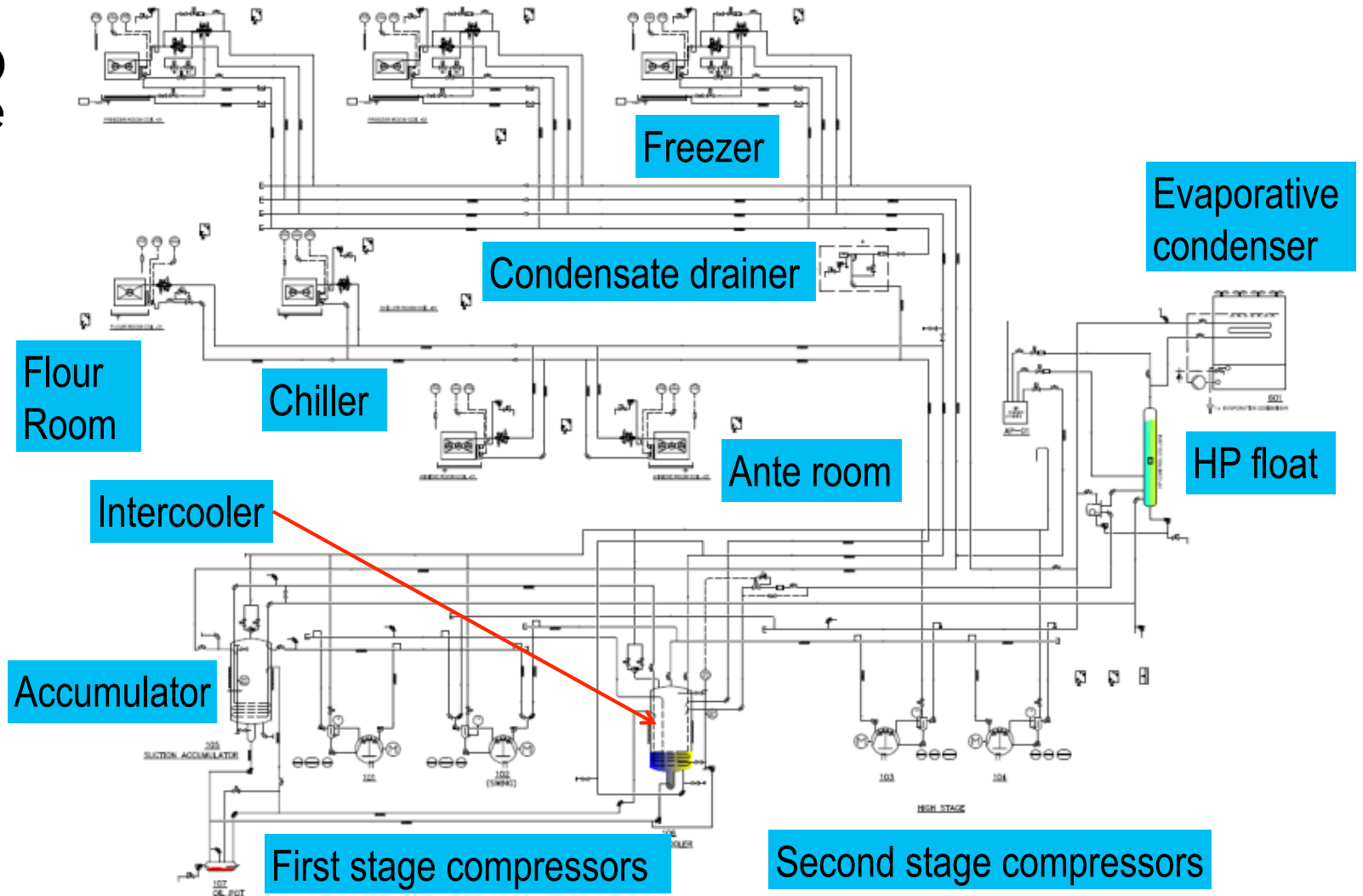
Cooling Tower



Capacity ~50 kW, ~5 kg NH₃

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Central
Condensing,
dual stage:





Central Condensing, dual stage:



Freezer

Condenser

0.65 kg NH₃/kW
~40,000 m³
200 kg NH₃



Central dual stage plant room

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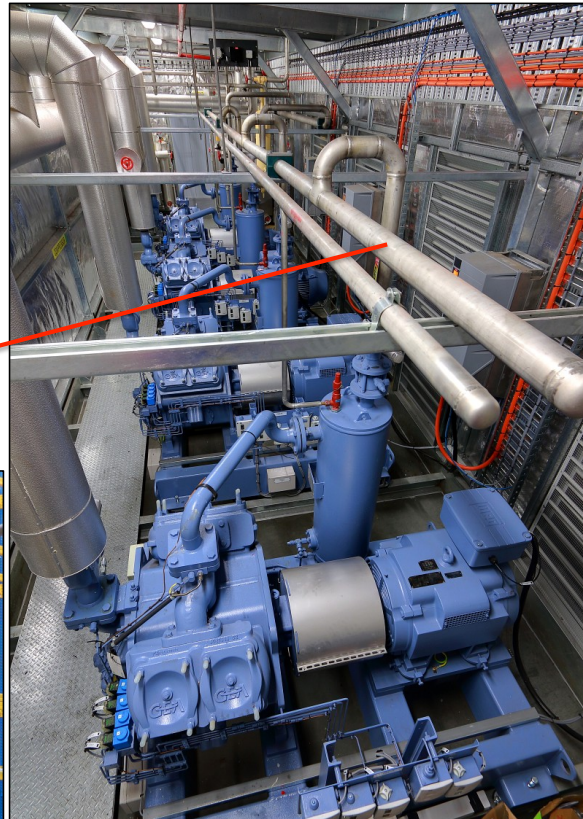


Central Condensing, Dual Stage:

Plug and play central plant

ScanPAC in dry store

Venting to ambient

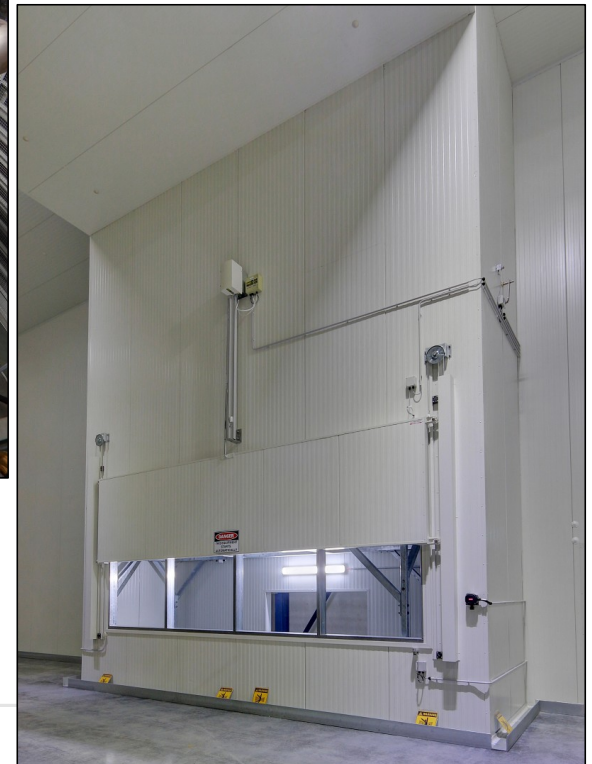


SS

Ambient air defrost alcove
Capacity 100 kW
NH₃ inventory 2 kg

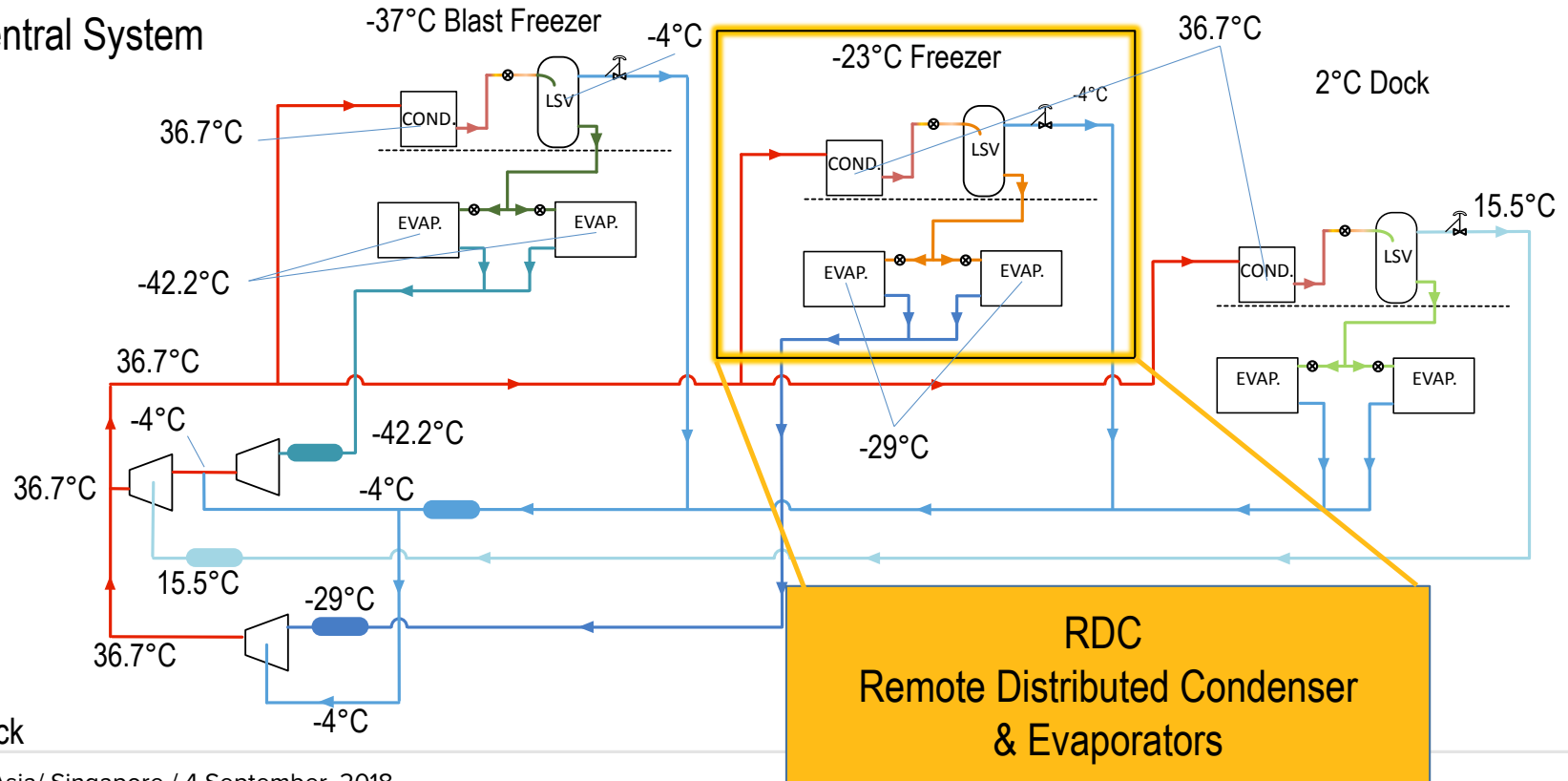


23,000 m³
\$6,000-\$8,000/month



Distributed Condensing, Dual Stage:

Two-stage Central System



Courtesy JCI/Frick



Distributed Condensing, Dual Stage: Roof view of LCC system



System is readily expandable. Extend vapor lines to new location on the roof for new evaporators. Or glycol pipes for glycol cooled condensing.

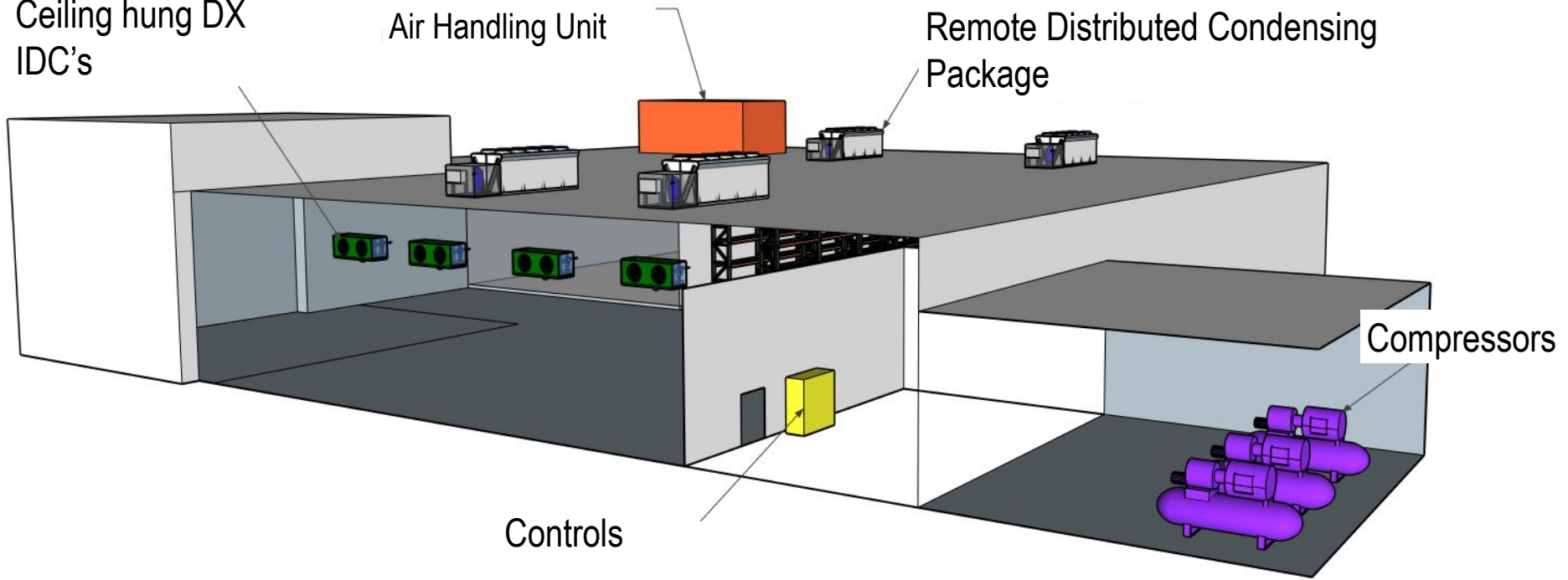


Distributed Condensing, Dual Stage:

Ceiling hung DX
IDC's

Air Handling Unit

Remote Distributed Condensing
Package



Courtesy JCI/Frick

Multiplexed Systems, Low Overfeed Rate (n=1.2):

Installing Evapcold Units

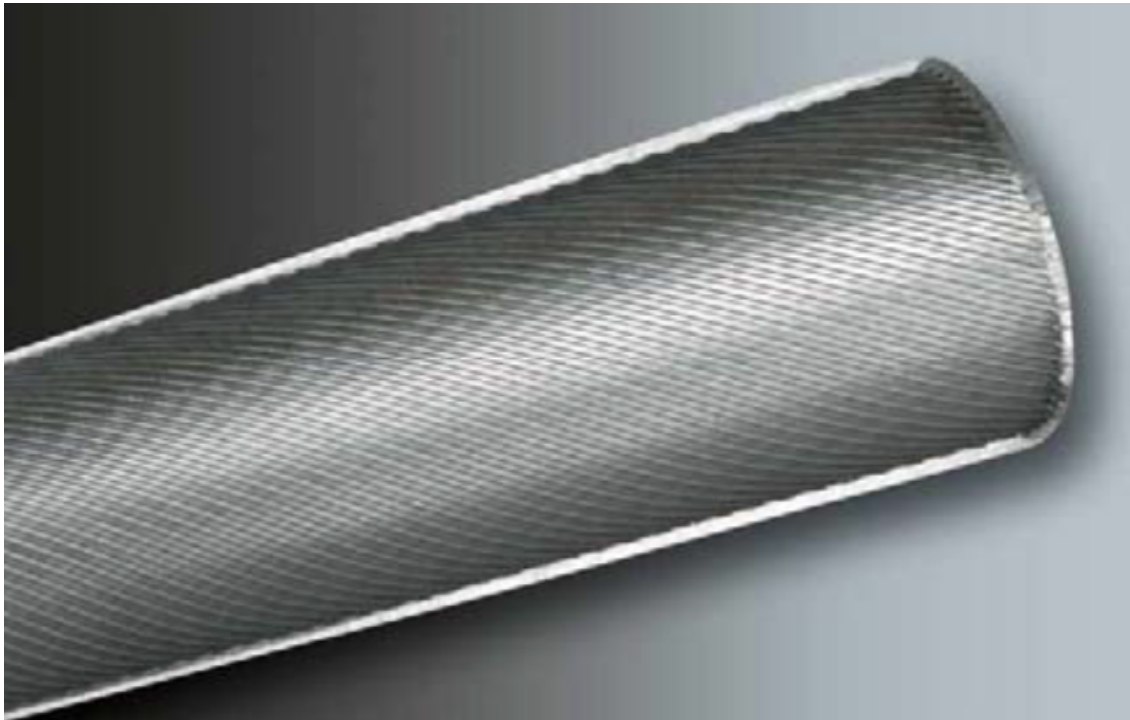


Source: ATMOsphere Chicago 16-17 June, 2016



Multiplexed Systems, Low Overfeed Rate (not DX):

Internal tube surface enhancement:



Optimal overfeed rate $n=1.2$ for 16 mm O.D. tube and $n=1.8$ for 25.4 mm O.D. tube

Results: Lower liquid inventory in wet return lines compared with conventional overfeed, but NH_3 inventory in evaporators not as low as for DX



Defrosting:

Defrost methods requiring condensate management:

- Conventional hot gas defrost
- Reverse cycle defrost

Methods minimizing condensate management (refrigerant inventory):

- Ambient air defrost
- Electric defrost
- Warm glycol defrost
- Secondary loop defrost with phase change



Thank you for listening!



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