



Business Case for
Natural Refrigerants

June 12-14, 2018 – Long Beach



Low Charge ADX Ammonia

- Presented by: **Rick Watters**, Vice President, AMS Mechanical Systems



Low Charge ADX Case Studies





Challenges

➤ Not much historical data on low temperature

ADX

➤ How large can a building be and limit the refrigerant charge to less than 10,000 lbs.

➤ Managing liquid from defrost and heat reclaim

Challenges

- Energy consumption
- Cost
- Tradition “This is how we have always done it”
- Will it work

What changed.

- Enhanced evaporator tubes
- Liquid distribution systems on evaporators
- Motorized and Pulse Width liquid feed valves
- ADX super heat controls

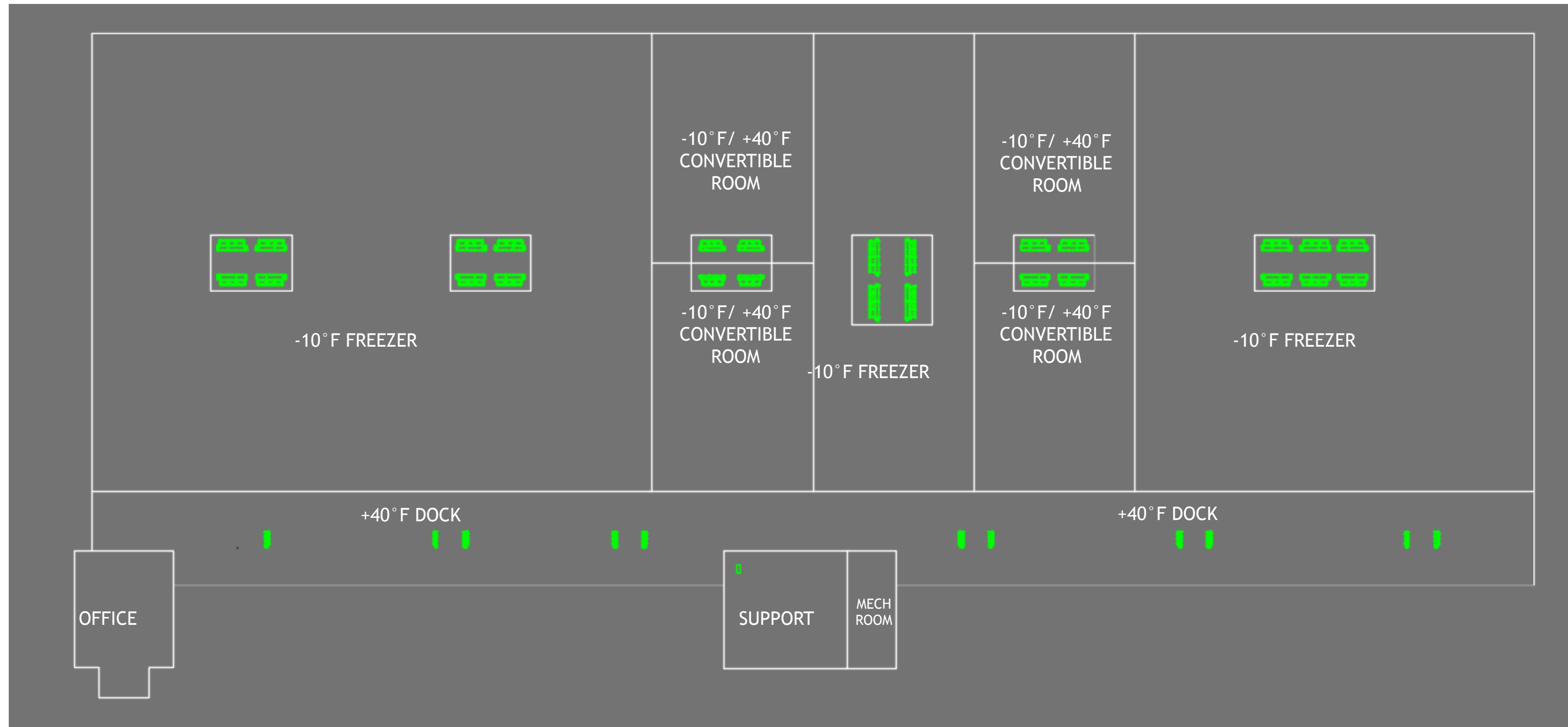
WHY USE ADX AMMONIA?

- Lower refrigerant operating charge
- Natural refrigerant
- Simplify Operation
- Location Location Location

JCS aerial view



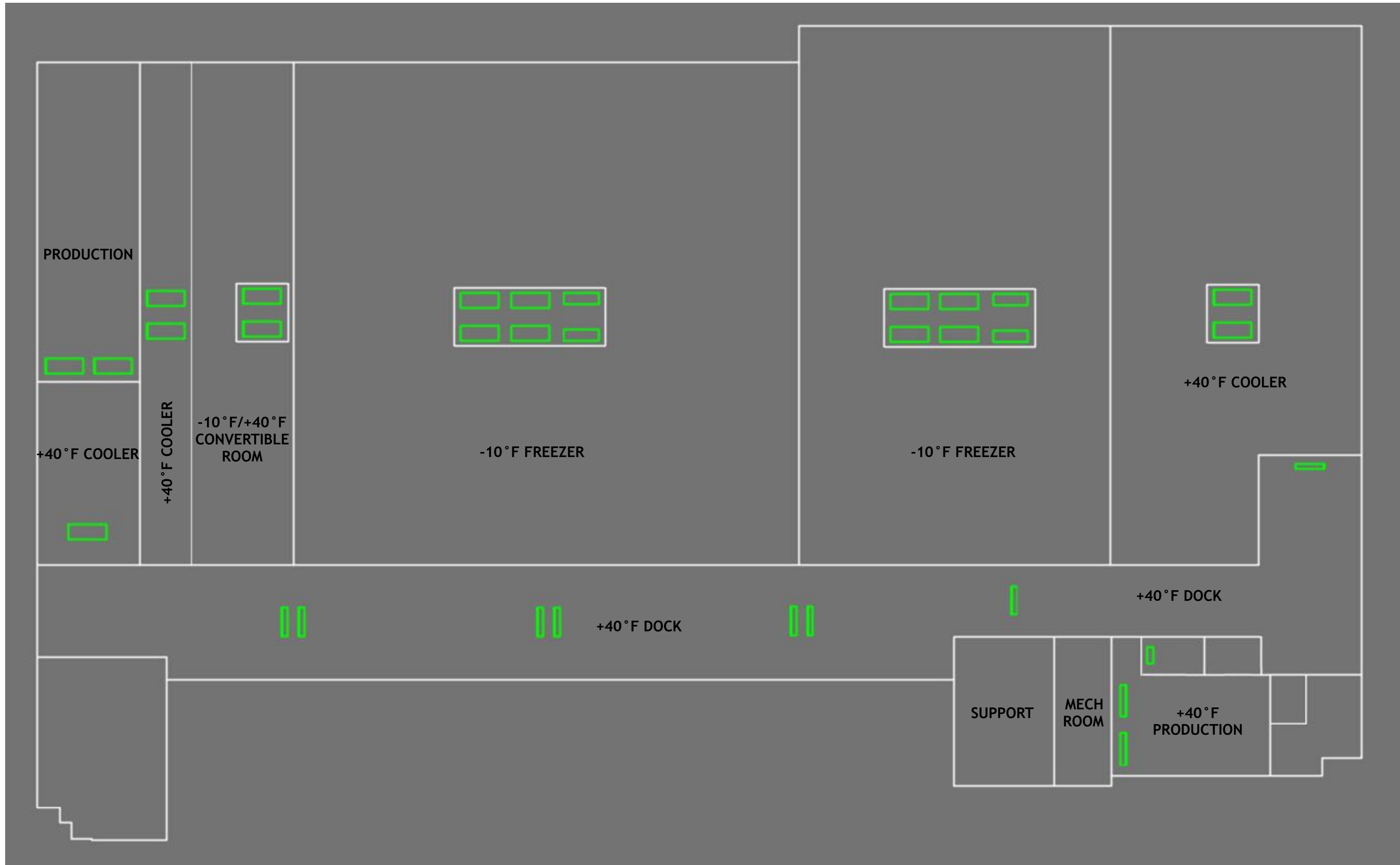
JCS plan view with Phase 2



LCS aerial view



LCS plan view
with Phase 2



JCS Refrigeration System Highlights

- Single stage economized $-15/+20/+95$
- Thermosyphon oil cooling
- Anhydrator System Cleaner
- H.A. Phillips transfer system
- Controlled pressure receiver
- $+20$ and -15 accumulators
- Nickel-Brazed Liquid Sub-Cooler
- Motorized TXV's



Liberty Cold Refrigeration System Highlights

- Single stage economized $-15/+20/+95$
- Thermosyphon oil cooling
- H.A. Phillips transfer systems
- Controlled pressure receiver
- $+20$ and -15 accumulators
- Nickel-Brazed Liquid Sub-Cooler
- Pulse Width TXV's





Refrigeration System Highlights

- **VFD's on large evaporator fans**





Refrigeration System Highlights

- VFD's on large evaporator fans
- ADX Evaporators







Refrigeration System Highlights

- VFD's on large evaporator fans
- ADX Evaporators
- Low Charge Condenser



Refrigeration System Highlights

- VFD's on large evaporator fans
- ADX Evaporators
- Low Charge Condenser
- Low Charge Vessels

JCS engine room



LCS engine room



Operating Efficiency

- Calculated 1.3% more Hp/Ton compared to Liquid Overfeed Systems as worst case.

Refrigerant Charge Comparison

	JCS	Liberty	Comparison Building
Freezer Temp. - Deg. F	-10	-10	-10
Freezer sq. ft.	300,400	130,100	90,301
Convertible room. Deg. F	-10/35	-10/28	-10/35
Convertible room sq. ft.	37,800	16,000	45,311
Dock Temp. - Deg. F	40	40	40
Dock/Cooler/Process area - sq. ft.	63,600	107,100	35,958
Central Refrigeration System	ADX	ADX	Pumped Liquid
Refrigeration - tons	1,060	928	335
Ammonia charge - lb.	8,500	7500	24,000
Total refrigerated sq. ft.	401,840	253,200	171,610
Charge per square foot	.0212 #/sqft	.0296 #/sqft	0.138#/sqft
Charge per Ton of Refrigeration	8.02 #/TR	8.1 #/TR	71.64 #/TR

Electrical Comparison

	JCS - Phase 1 only	Liberty - Phase 1 only	Comparison Building
Refrigerated space sq. ft.	201,805 ft ²	135,807 ft ²	137,448 ft ²
Central Refrigeration Control System	Yes	Yes	No
VFD's on Large Evaporator Fan Motors	VFD's	VFD's	No VFD's
Motion Sensing LED Lighting	Yes	Yes	No
Blast Freezing	Yes	Yes	No
2015 Total Power Usage (KWH)	4,721,655 KWH	4,227,007 KWH	5,165,708 KWH
Annual Average Power per sq. ft.	23.4 KWH/ ft ²	31.1 KWH/ ft ²	37.6 KWH/ ft ²
Percent Difference (%)	38% Lower	18% Lower	Base line

Construction Cost

- 2.37% savings over a liquid over feed
- For JCS that was \$100,000.00

Design Considerations

- Use the recommended oil (Frick #9 in this case)
- Keep the system dry and oil free
- You will have some liquid return. Defrost, under floor system. Be able to deal with it
- Going to a fluid cooler for compressor oil cooling in place of thermosyphon would have reduced the ammonia charge 750#

Design Considerations (cont.)

- Fluid cooler system would have added \$300,000.00 of install cost to the project
- Liquid injection would lower the install cost and refrigerant charge but would have decreased operating efficiency's by an additional 4.5%
- Law of unintended consequences

In Summary

- ADX Evaporators worked as advertised
- System is easy to operate. Requires minimal training
- Restarts quickly after power failure
- Both Motorized and Pulse Width DX valves work great
- Add Hot Gas heat cycle to evaporators in Coolers/Dock depending on location
- 5 projects completed, 1 under construction



Questions?





ATMO
sphere

Business Case for
Natural Refrigerants

June 12-14, 2018 – Long Beach

Thank you very much!

