



Business Case for
Natural Refrigerants

11-12/04/2018 – Beijing



Digital Compressors & EXVs Improve Reliability & Performance of Retailer's CO₂ Cascade System

UNDP/UNEP Demo Project, CO₂ Technology
Application in Homeful Supermarket

Yunker You

Marketing Manager Cold Chain

Project Press Conference on 5th Nov. 2017, Hefei

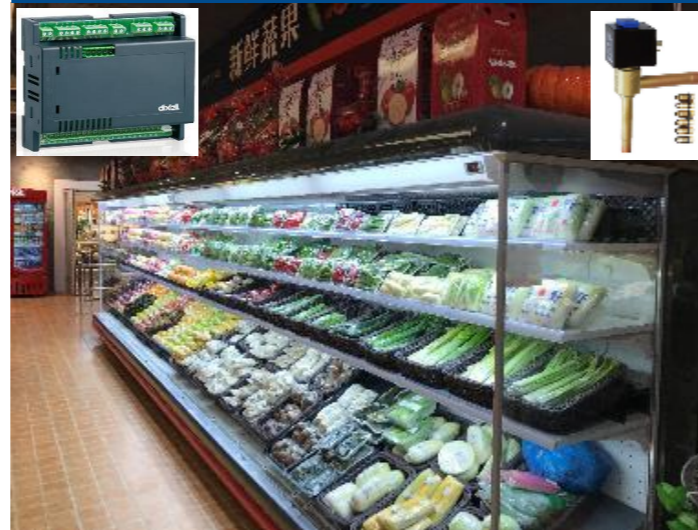


Equipment On Field

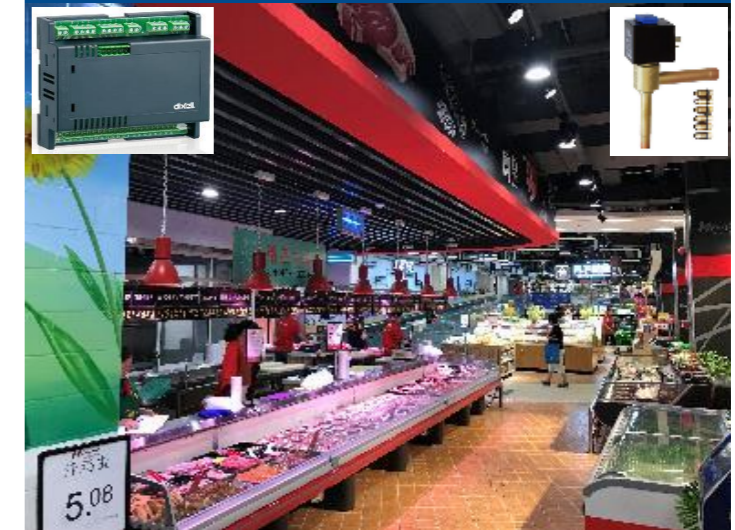
**LT Case - Freezer
w/ EX2**



**MT Case - Vegetable
w/ EX2**



**MT Case - Pork & Beef
w/ EX2**



LT CO₂ Scroll Rack



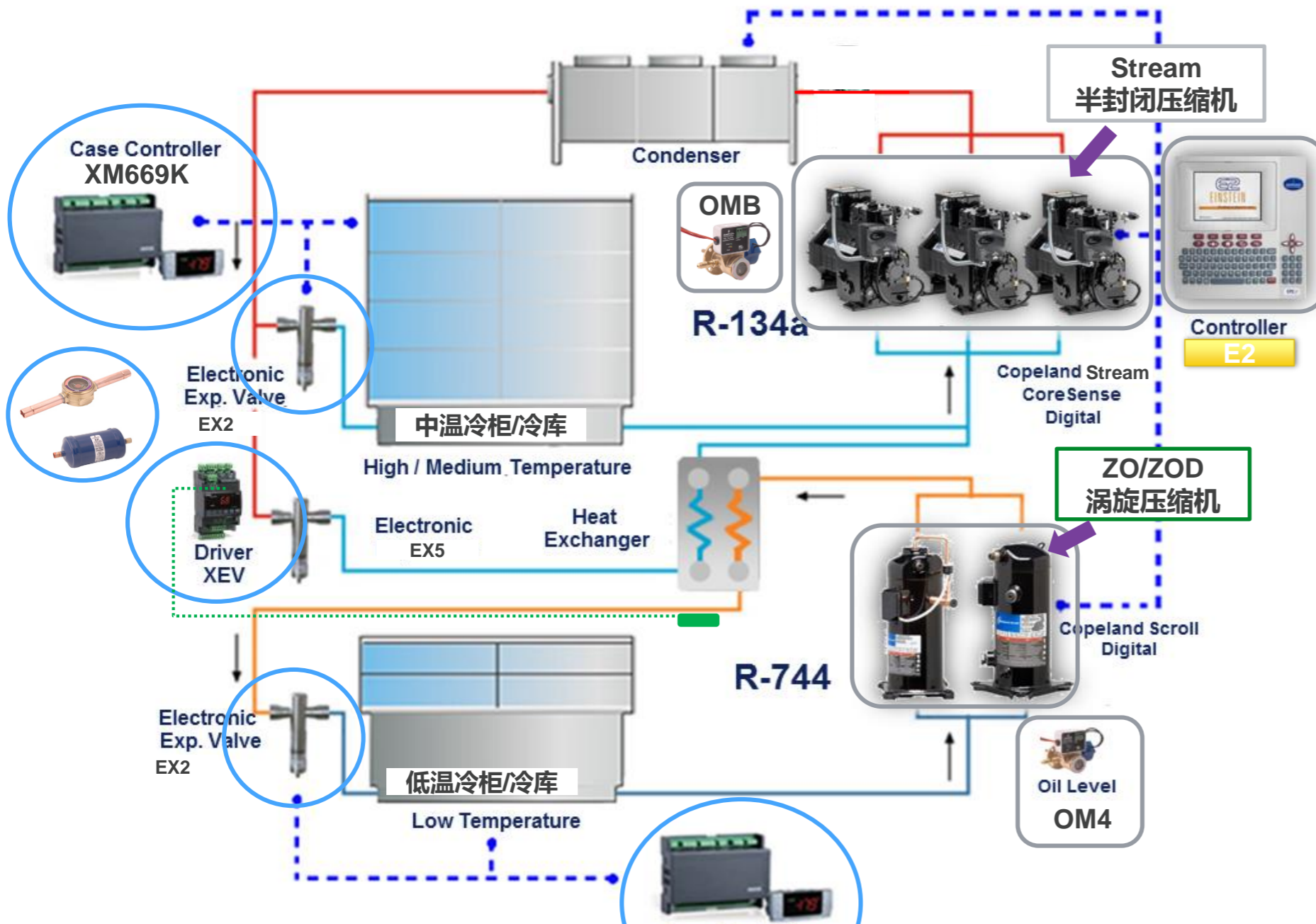
MT R134a Rack



E2 Controller



Homeful CO₂/R134a System Architecture



Digital Compressors + Electronic EX Valves + E2 Main Controller

MT Part R134a		
Equipment	Qty	Heat Load (Total)
Showcase	20	85.6 kW
Cold Room	1	
MT (R134a) Compressor	Qty	Remark
4MHD-25X	1	Digital
4MH-25X	3	

LT Part CO ₂		
Equipment	Qty	Heat Load (Total)
Showcase	13	16.1 kW
Cold Room	1	
LT (CO ₂) Compressor	Qty	Remark
ZOD34	1	Digital
ZO34	2	

Powerful CO₂ Software Helps On System Design

R744 Cascade Cycle Compressor Selection

Enter your parameters

Click on a model to select:

Low Temperature (LT) Parameters

LT required evaporator capacity (kW): 16.13

LT evaporating temp., t11 (°C): -35.00

LT useful superheat, t12+t11 (K): 7.00

LT suction line superheat, t13+t12 (K): 3.00

HX subcooling, t9+t10 (K): 0.00

LT condensing temp., t9 (°C): -5.00

HX temp. difference, t9+t7 (K): 5.00

Desuperheating, t15+t16 (K): 20.00

Medium Temperature (MT) Parameters

MT refrigerant: R134a

MT required evaporator capacity (kW): 64.92

MT evaporating temp., t7 (°C): -10.00

MT useful superheat, t5+t7 (K): 5.00

MT suction line superheat, t6+t5 (K): 5.00

Condensing temperature, t17d (°C): 45.00

MT subcooling, t17b+t4 (K): 0.00

Heat recovery, t2+t3 (K): 0.00

System Diagram

Temp. °C

1	-1.14
2	73.76
3	73.76
4	45.00
5	-5.00
6	0.00
7	-10.00
8	-5.00
9	-5.00
10	-5.00
11	-35.00
12	-28.00
13	-25.00
14	-25.00
15	62.86
16	42.86

LTHP: 30.46 bar
MTLP: 2.01 bar
MTHP: 11.60 bar

Output Summary

LT Pack

1 x ZOD34K3E-TFDN, 25.83 %
2 x ZO34K3E-TFDN

Delivered evaporator capacity: 16.13 kW

Power input: 4.58 kW

Mass flow rate, mft: 0.063 kg/s

Subcooler Load: 0.00 kW

Desuperheating load: 1.36 kW

LT system COP: 1.25

With variable compressor at 100 %

Available evaporator capacity: 21.57 kW

Relative to required: 133.75 %

MT Pack

MT refrigerant: R134a

MT required pack capacity: 86.34 kW

1 x 4MHD-25X, 100 %
3 x 4MH-25X

Delivered pack capacity: 85.58 kW

Power input: 36.36 kW

Mass flow rate, mfmt: 0.492 kg/s

Mass flow rate, mfhx: 0.146 kg/s

Mass flow rate, mfsun: 0.638 kg/s

Heat recovery load: 0.00 kW

Condenser capacity: 121.20 kW

Condensing temperature: 45.0 °C

MT system COP: 2.32

With variable compressor at 100.00 %

Available pack capacity: 85.58 kW

Relative to required: 99.12 %

Overall system COP: 2.98

Parameters Input

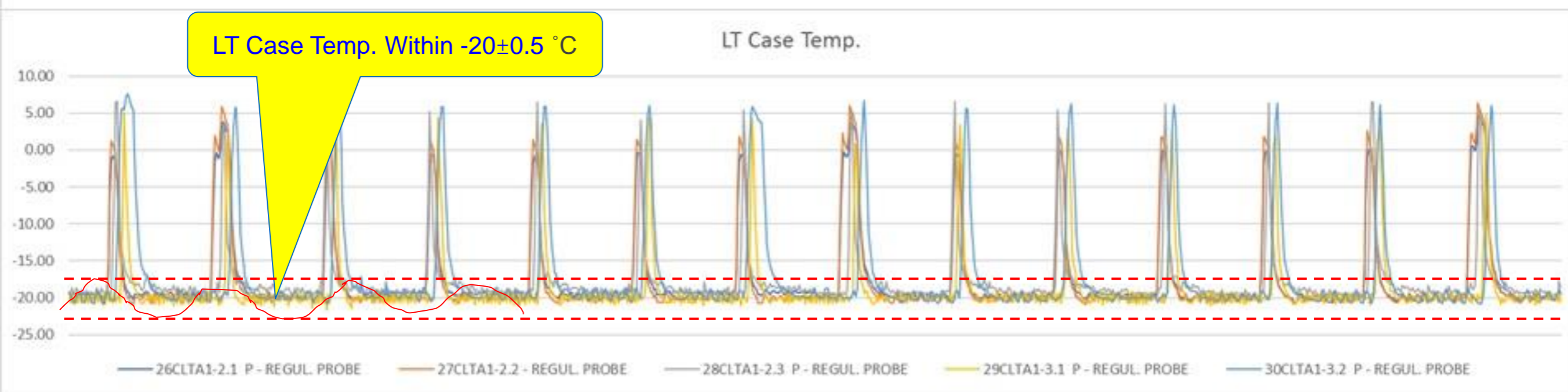
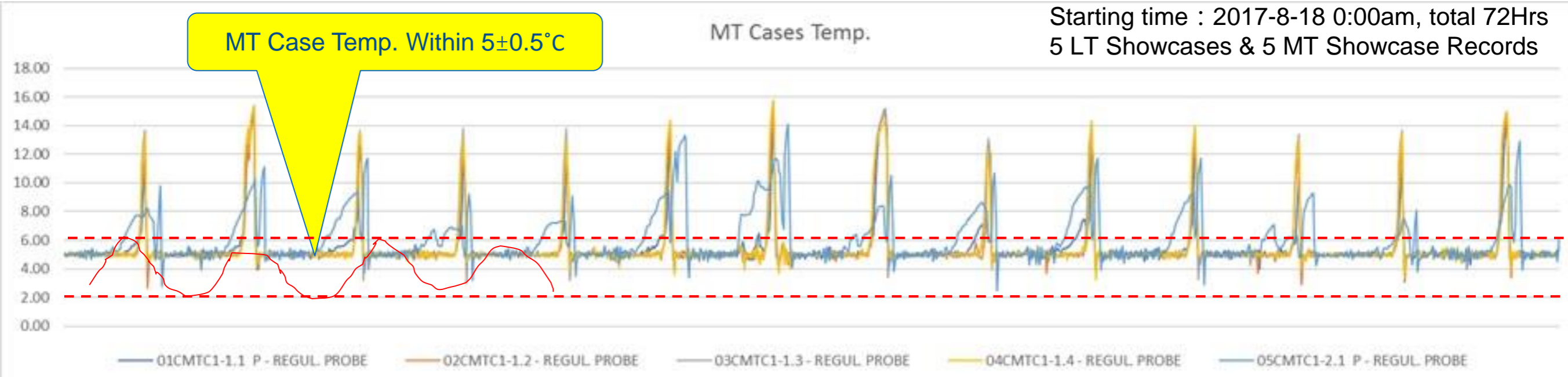
P-H Diagram

System Performance

Operation Data -MT and LT Cases Temp. Record

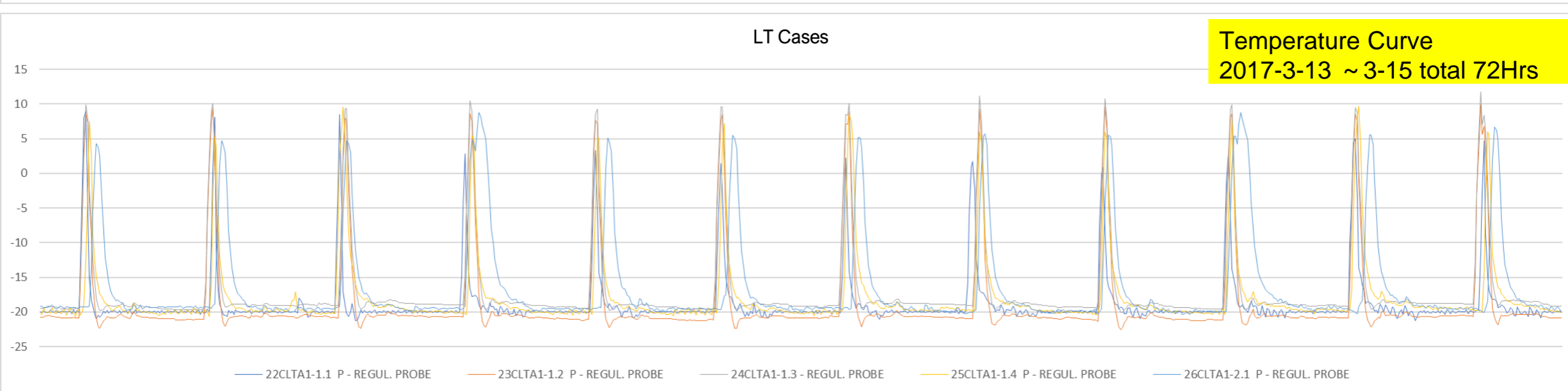
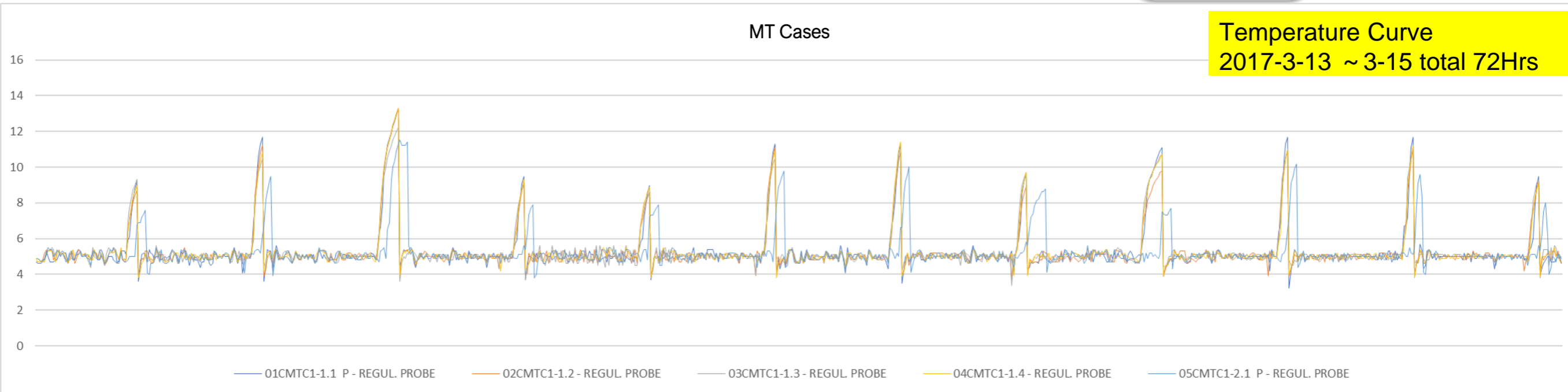
Showcase
Temperature
Accurate
($\pm 0.5^{\circ}\text{C}$)

Starting time : 2017-8-18 0:00am, total 72Hrs
5 LT Showcases & 5 MT Showcase Records



Operation Data -Same Result In 2018 March

Showcase
Temperature
Accurate
($\pm 0.5^{\circ}\text{C}$)

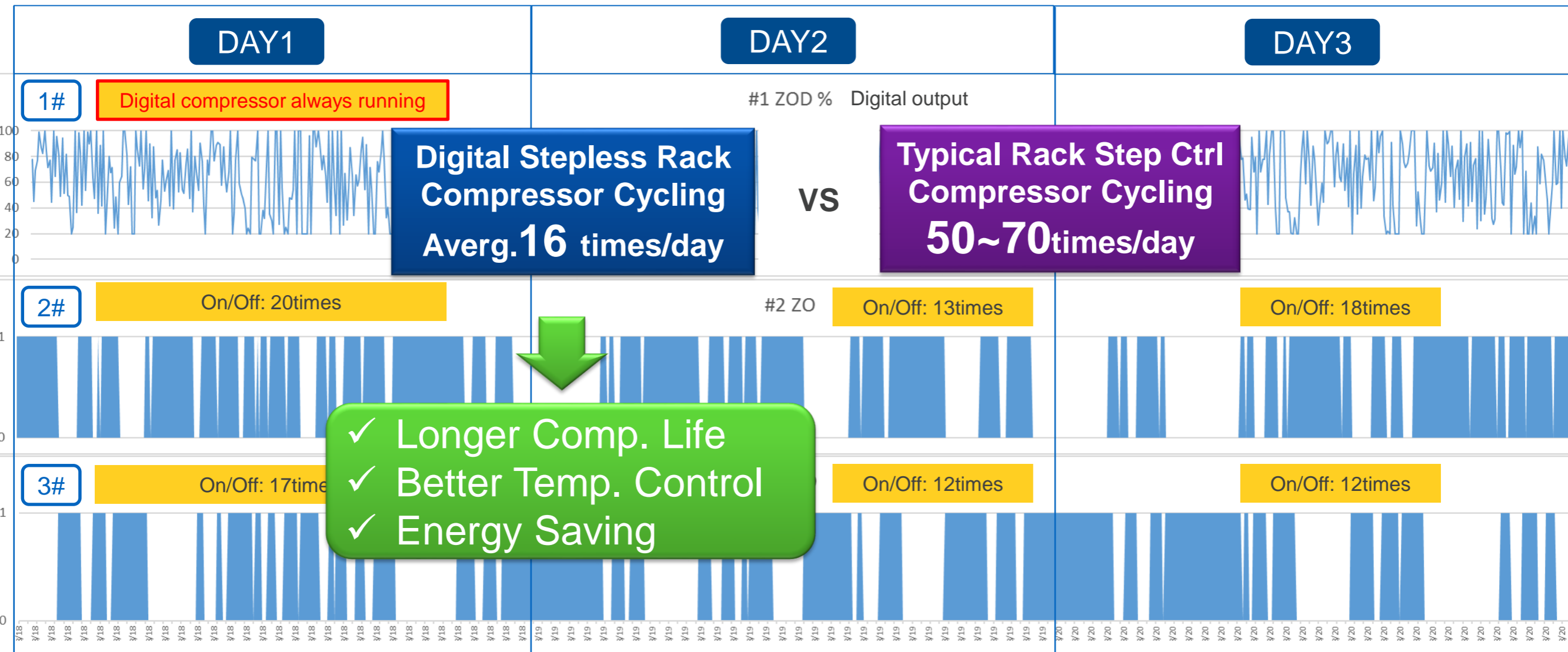


Operation Data_ Digital Rack(LT CO₂ Scroll)

Compressor
Cycling Time
Reduced
(-70%)



状态:	42.01	ON	ON
容量:	3750	3750	3750
今日周期数:	0	11	10
油压:			
状态:	1#	2#	3#

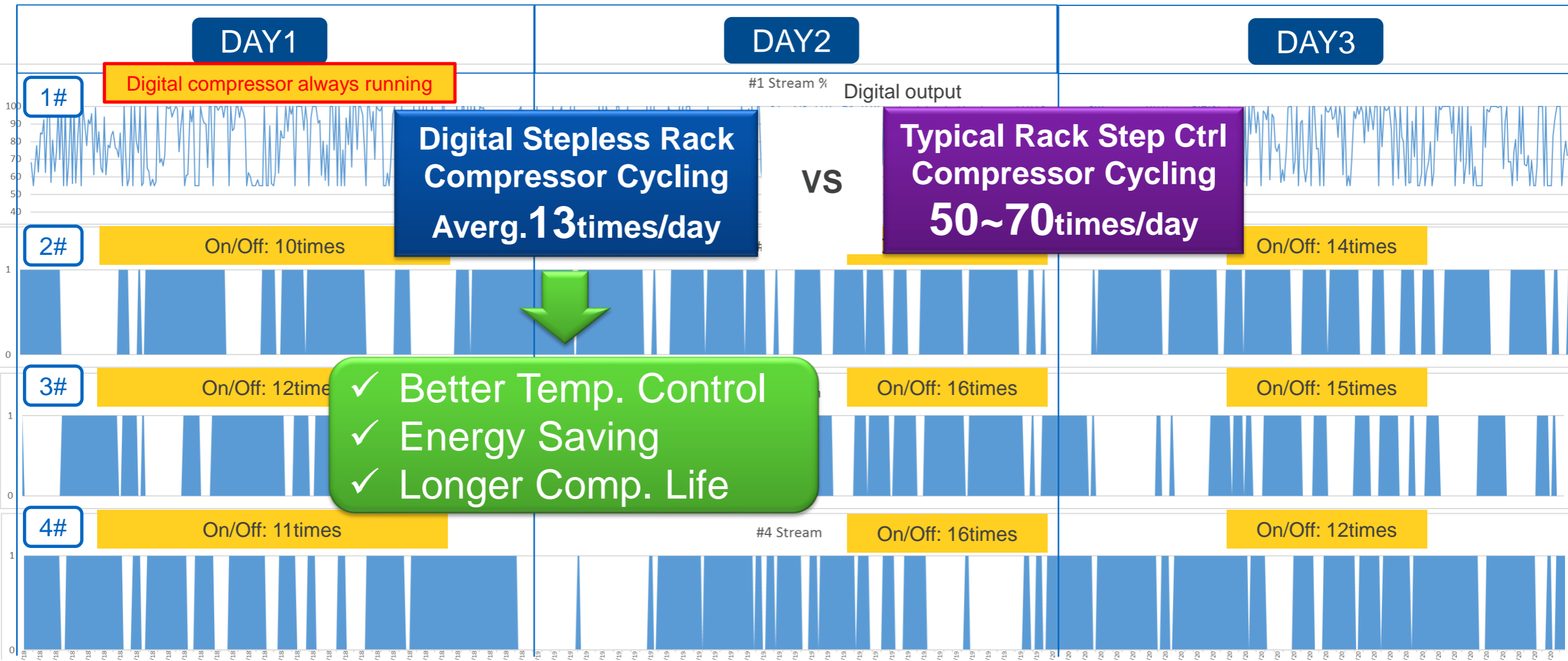


Operation Data_ Digital Rack(MT R134a Stream)

Compressor
Cycling Time
Reduced
(-70%)



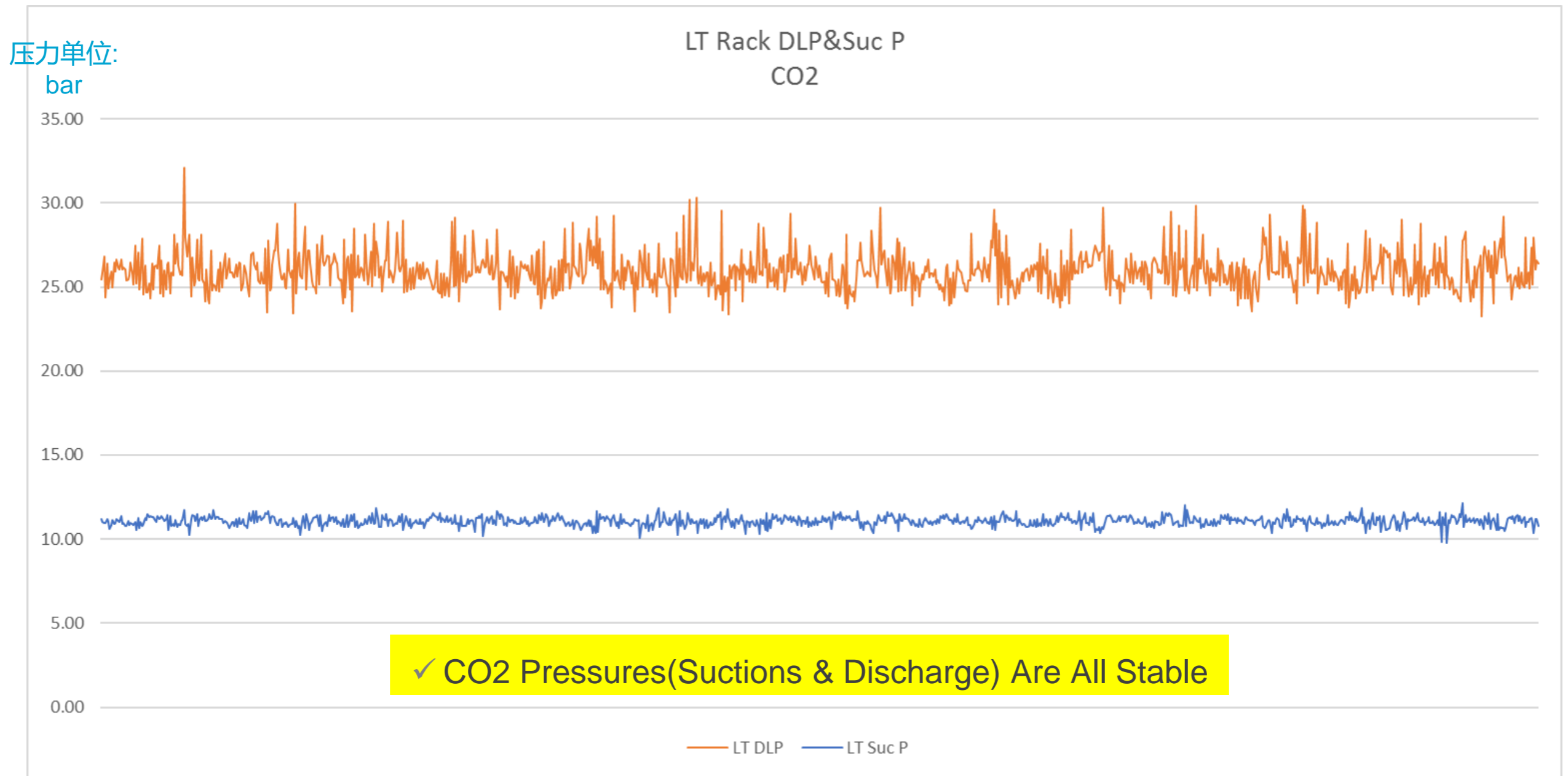
状态:	80.63	OFF	ON	OFF
容量:	2500	2500	2500	2500
今日周期数:	0	7	7	7
油压:				
状态:	1#	2#	3#	4#



Operation Data_ LT CO₂ System Pressures

- Suction Pressure: 11±1 barg
- Discharge Pressure: 27±3 barg

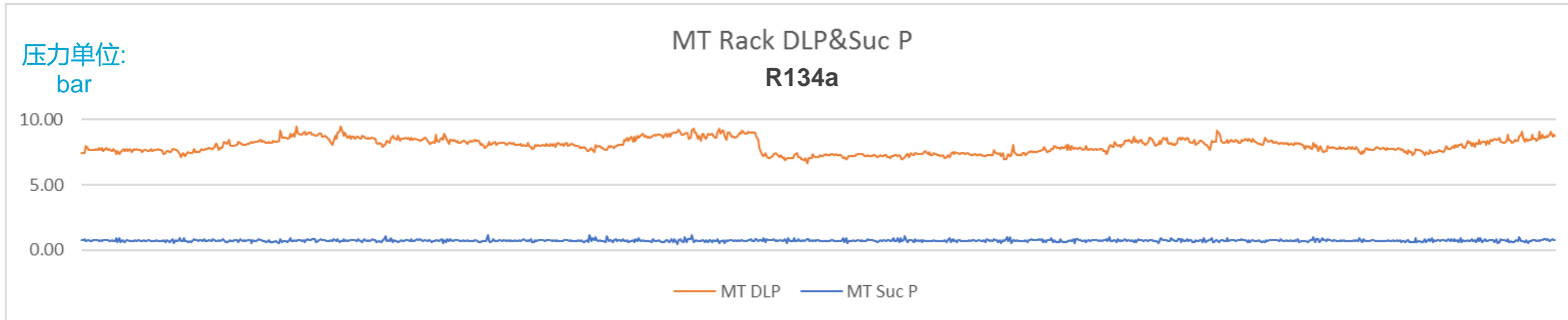
System
Pressure
Stable(CO₂)
(Safe)



Operation Data_ MT R134a System Pressures

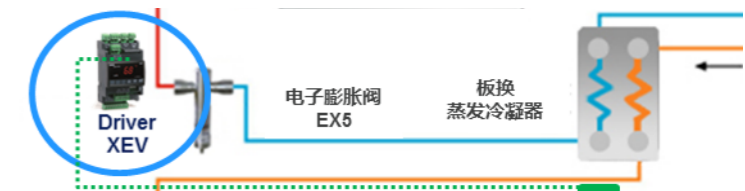
System Pressure Stable (Safe)

- Suction Pressure: 0.7 ± 0.2 barg
- Discharge Pressure: 8 ± 1 barg

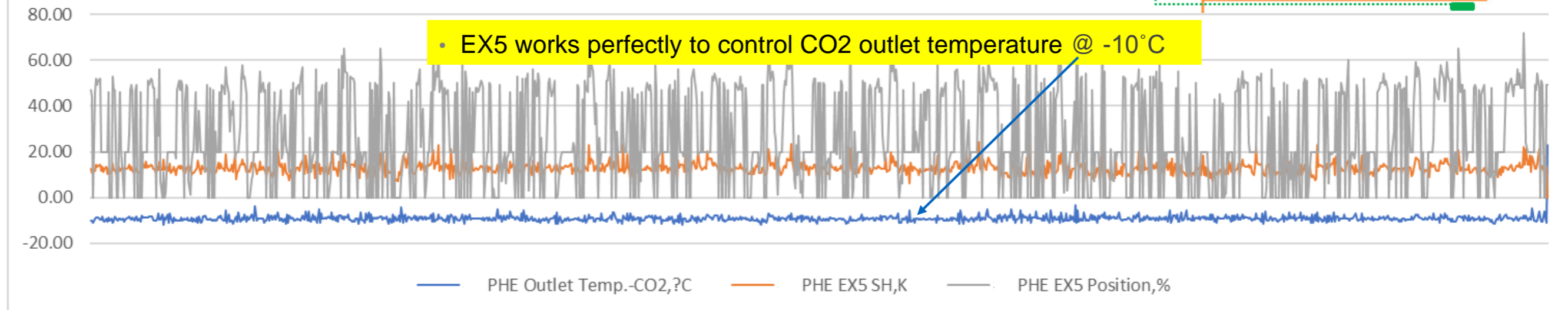


Operation Data_ PHE w/ EX5

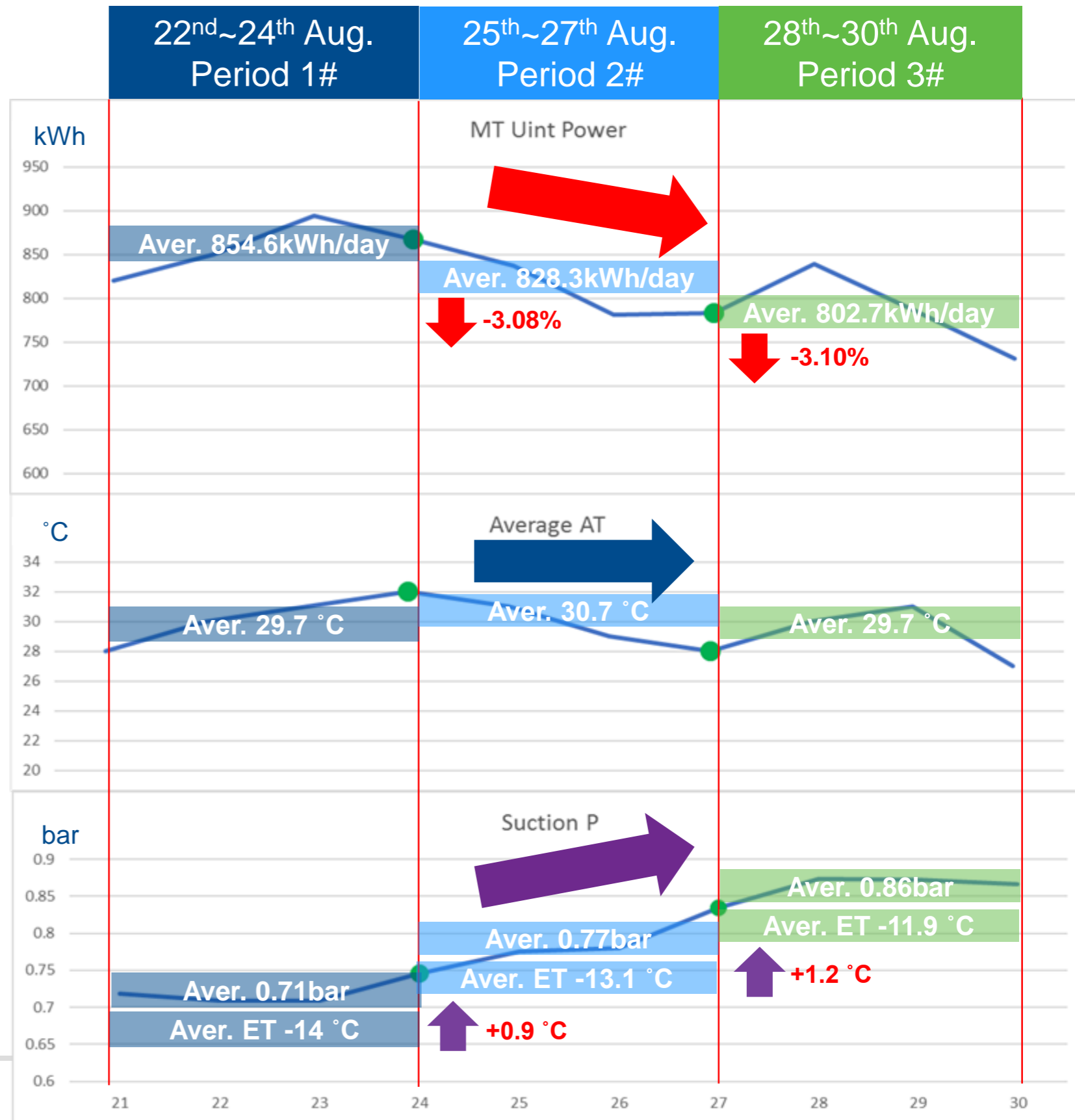
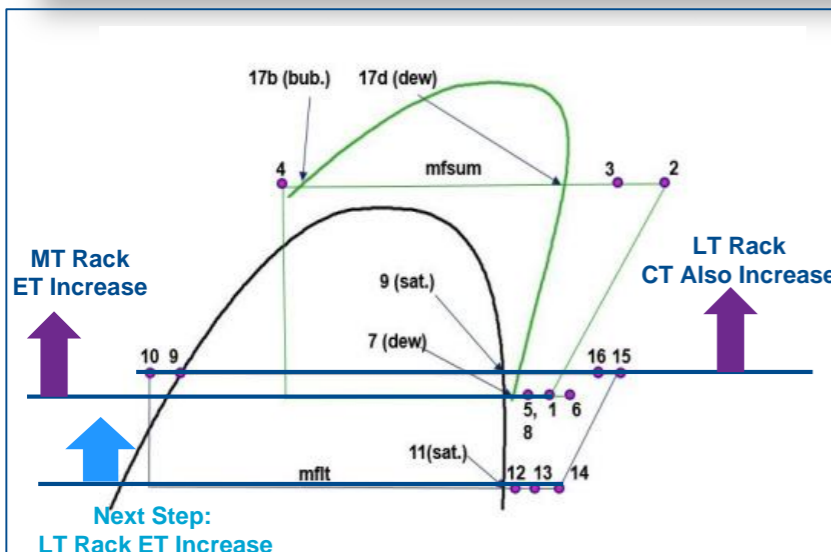
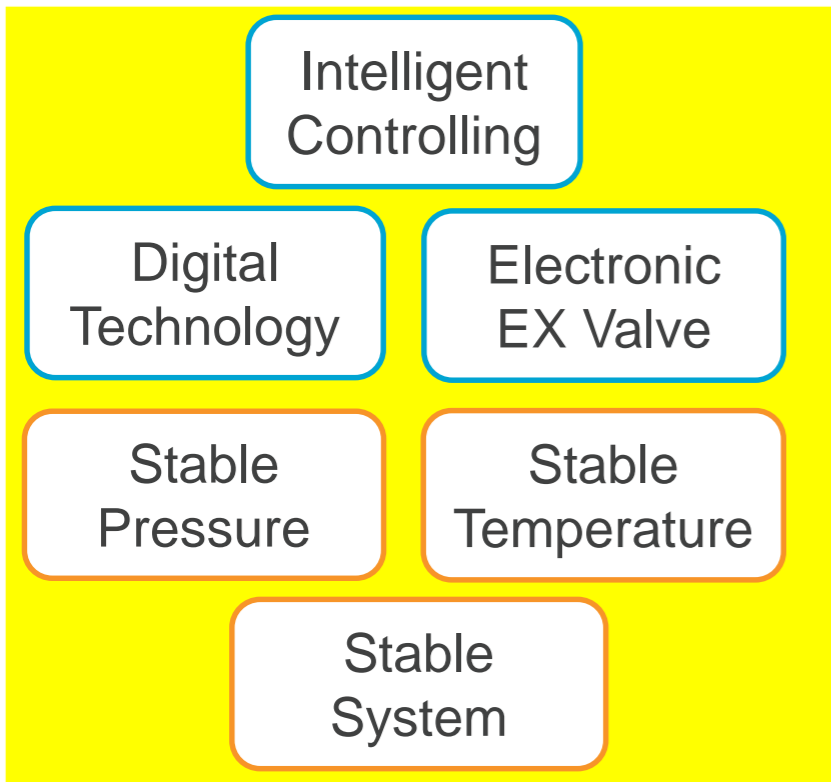
PHE



• EX5 works perfectly to control CO2 outlet temperature @ -10°C



Energy Saving By Floating Evap. Pressure



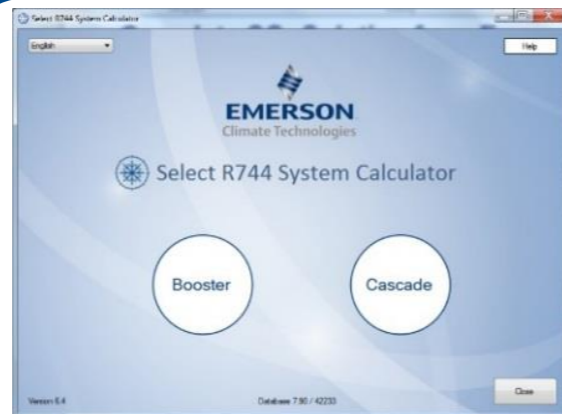
Project Summary & Good Points

System Pressure Stable(CO₂) (Safe)

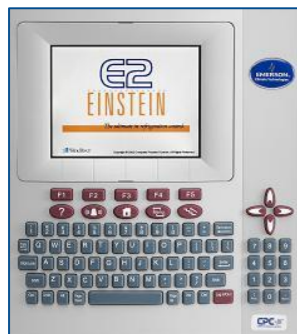
Showcase Temperature Accurate ($\pm 0.5^{\circ}\text{C}$)

Compressor Cycling Time Reduced (-70%)

Floating ET Applicable For Energy (Saving)



- ✓ Right Selection On Compressors(HP&Qty)
- ✓ **Digital & EXV Tech.**
- ✓ Software Helps On System Design



E2 Controller



Stream



Stream (Digital)



ZO



/ ZO(Digital)



EXV

Emerson Different System Offerings Could Fit Different Scales

Cost

Low → High

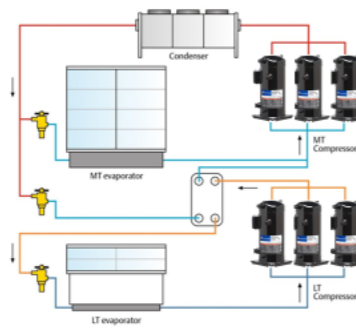
Pressure / Technology

Low

Cascade System

1

Emerson Compact Cascade Scroll Packs
混合复叠系统R134a/CO₂
— a) 艾默生涡旋紧凑型解决方案



Scroll ZB(D) With R134a (Low-GWP)
涡旋ZB(D) R134a应用 (低GWP)

- 10 kW to 100 kW Packs
可搭建10kW ~ 100kW机组
- 3 to 5 compressors
每个机组3 ~ 5台压缩机
- Includes 10...100 % Digital
可采用10% ~ 100%数码调节技术
- 39 to 66 kg / Compressor
压缩机重量仅39 ~ 66kg

Scroll ZO(D) With CO₂ 涡旋ZO(D)

- 5 kW to 66 kW Packs
可搭建5kW ~ 66kW机组
- 1 to 3 compressors
每个机组1 ~ 3台压缩机
- Includes 10...100 % Digital
可采用10% ~ 100%数码调节技术
- 20 to 40 kg / Compressor
压缩机重量仅20 ~ 40kg

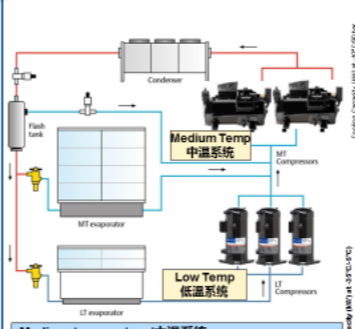
Opportunity To Limit The Economical Impact Of Going From R404A/R404A System To R134a/CO₂ Cascades
Ideal Cost Position For CVS, Small Supermarkets
从传统的R404A/R404A系统切换到R134a/CO₂复叠系统时, 艾默生涡旋紧凑型方案可降低系统切换成本
特别适合便利店以及中小型超市应用

High

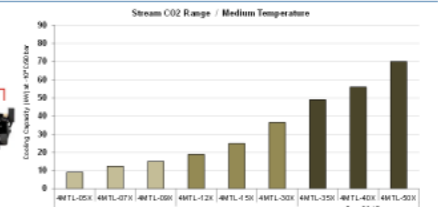
Booster System

3

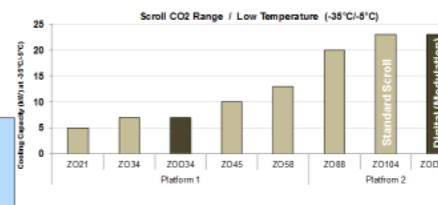
Emerson Solutions For Booster CO₂/CO₂ Stream / Scroll Systems
跨临界增压系统——艾默生解决方案
a) 半封Stream + 涡旋ZO



Stream CO₂ Range / Medium Temperature



Scroll CO₂ Range / Low Temperature (-35°C/-31°C)



Medium temperature/中温系统:

- Stream Covers From 9 to 70 kW – 9 Models
半封Stream: 9个型号, 冷量范围9 ~ 70kW;
Inverter Release 25Hz - 70Hz
变频应用: 25Hz ~ 70Hz;

Low Temperature/低温系统:

- Scroll Covers From 5 to 23kW – 8 Models
涡旋ZO/ZOD: 8个型号, 冷量范围5 ~ 23kW

High

Small ↓ Big

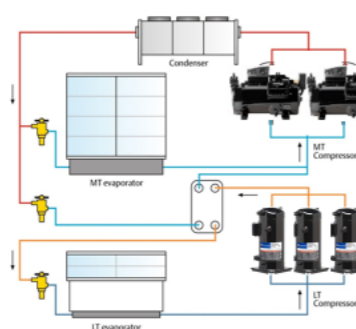
Store Size

Low

Cascade System

2

Emerson Cascade Stream+Scroll Packs
混合复叠系统R134a/CO₂
— b) 艾默生Stream碟阀+涡旋ZO(D)解决方案



Stream With R134a (Low-GWP)
碟阀半封活塞 R134a应用 (低GWP)

- 60 kW to 260 kW Packs
可搭建60kW ~ 260kW机组
- 3 to 5 compressors
每个机组3 ~ 5台压缩机
- Includes 33/55...100 % Digital
可采用33/55% ~ 100%数码调节技术
- Or with Inverter, 25Hz-75Hz
或者变频应用, 25Hz-75Hz

Scroll ZO(D) With CO₂ 涡旋ZO(D)

- 5 kW to 66 kW Packs
可搭建5kW ~ 66kW机组
- 1 to 3 compressors
每个机组1 ~ 3台压缩机
- Includes 10...100 % Digital
可采用10% ~ 100%数码调节技术
- 20 to 40 kg / Compressor
压缩机重量仅20 ~ 40kg

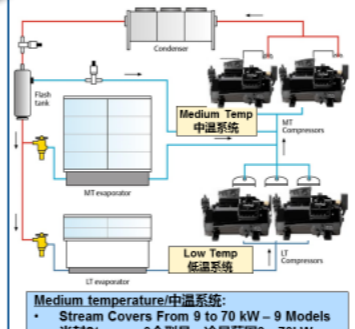
Fit For Supermarket and Hypermarket R134a/CO₂ Cascades System With Ideal Cost
特别适合中型超市以及大卖场R134a/CO₂复叠系统应用, 性价比高, 有利于降低初投资

High

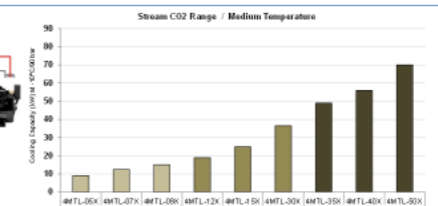
Booster System

4

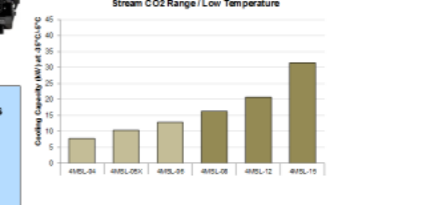
Emerson Solutions For Booster CO₂/CO₂ Stream / Stream Systems (High Standstill Pressures)
跨临界增压系统——艾默生解决方案
b) 半封Stream + 半封Stream (高静置压力)



Stream CO₂ Range / Medium Temperature



Stream CO₂ Range / Low Temperature



Medium temperature/中温系统:

- Stream Covers From 9 to 70 kW – 9 Models
半封Stream: 9个型号, 冷量范围9 ~ 70kW;
Inverter Release 25Hz - 70Hz
变频应用: 25Hz ~ 70Hz;

Low Temperature/低温系统:

- Stream Covers From 8 to 31kW – 6 Models
半封Stream: 6个型号, 冷量范围8 ~ 31kW;

60 - 90Bar Systems 低温系统高静置压力 采用高设计压力的亚临界压缩机, 可以延迟系统因为故障停机时为保障系统安全而必须放空系统内CO₂的时间
60 Bar系统设计压力, 可允许在环境温度高达21°C的条件下, 仍然可以保留系统内的CO₂, 无需放空;

ATMOsphere China / Beijing / 11-12 April, 2018



Business Case for
Natural Refrigerants

11-12/04/2018 – Beijing

Thank you very much!

