



kongres

**44th HVAC&R CONGRES AND EXHIBITION :
INTEGRATED DESIGN AND HEALTHY ZERO CO₂ EMISSION BUILDINGS**

4 – 6 . XII 2013 . Beograd, Srbija

NATURAL REFRIGERANTS

High pressure compressors in Industrial plants

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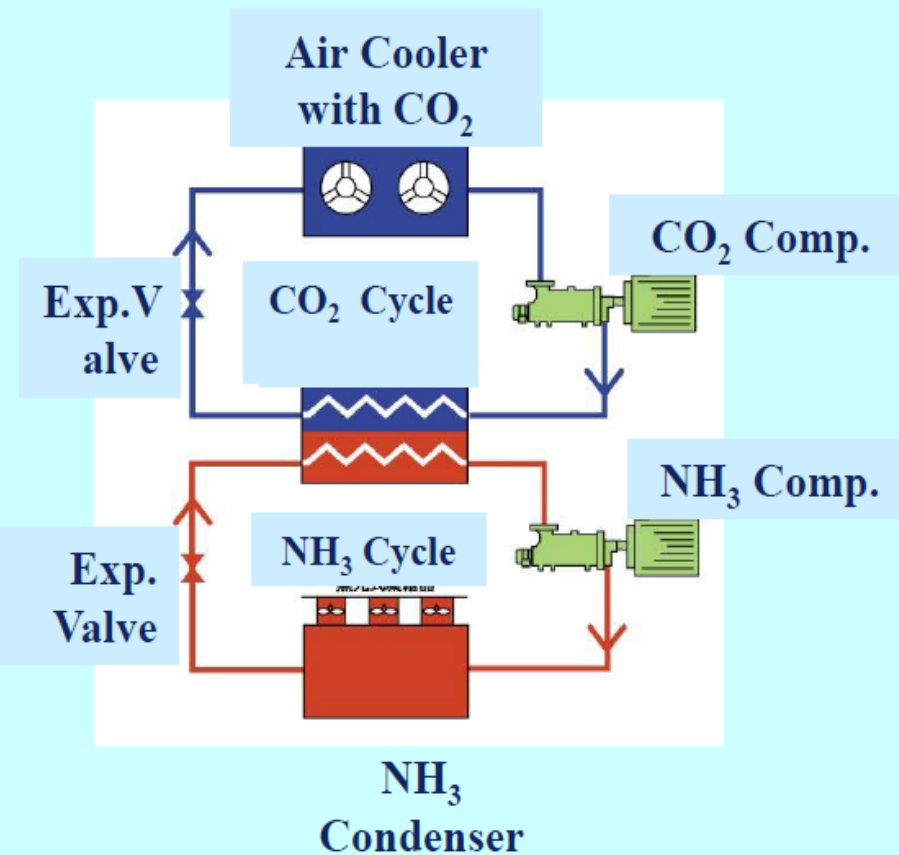
"Natural Five" Refrigerants and Product Solutions

Refrigerant (Natural Five)	NH ₃ R-717	CO ₂ R-744	HC Hydrocarbon	H ₂ O R-718	Air R-728
80°C	Utility hot water Heating	Utility hot water			
60°C			Utility hot water Heating HVAC	Heat recovery	
10°C	Chilled water Ice making	Chilled water Ice making		Chiller	
-15°C	Cold storage, Freezer, Fish boat				
-25°C	Specific Refrigeration needs				
-40°C	Freezer, Freeze-dry, Super Low temp storage				
-50°C			Cryogenics		
-60°C					Cryogenics
-100°C					
Notes	- Conventional system - National Projects	HeatCO₂m	- Nat'l Proj. - Butane + Propane	- Nat'l Proj. - Adsorption - Heat recovery	- Nat'l Proj. - Air-cycle

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CO₂/NH₃ CASCADE COMPRESSION REFRIGERATION



The background of the slide is a faded, grayscale image of a city skyline. In the center, a flag with twelve stars on a blue field (the European Union flag) flies from a tall pole. To the right of the flag, there is a tall, curved building. In the foreground, there are several other buildings of varying heights and architectural styles, including one with a distinctive curved facade on the left. The overall scene is a dense urban environment.

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FIELD CASE

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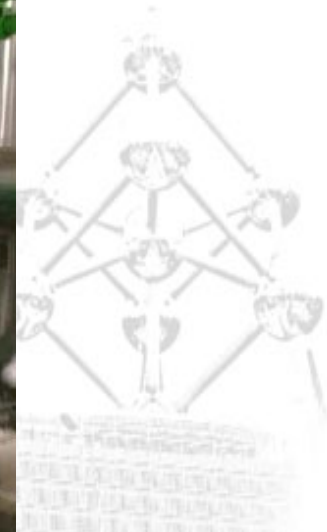
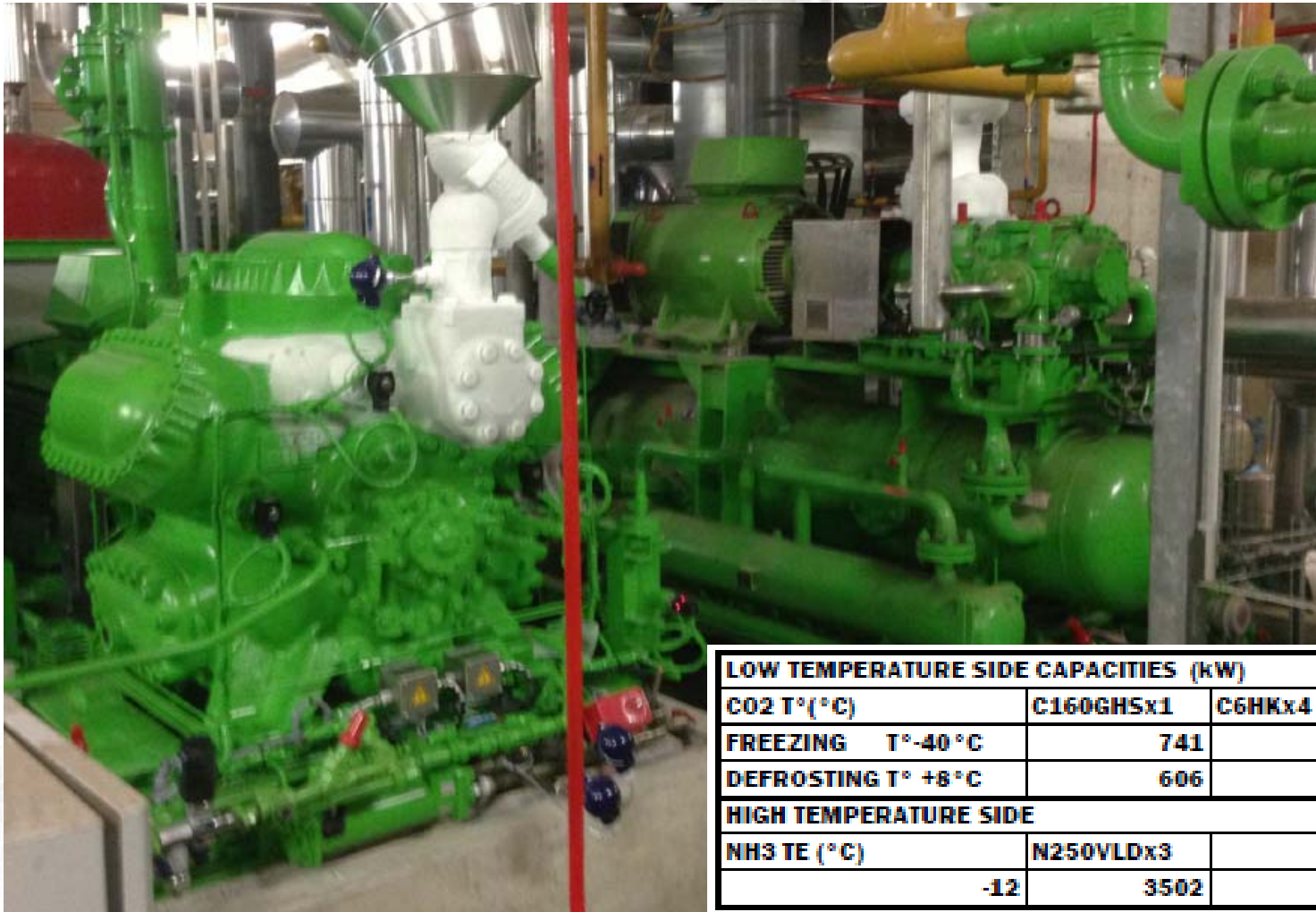
INTRODUCTION

STARTING POINT 3 Mw -35°C	freezing plant for bakery products requiring -35°C product temperatures for nominal 3000 kW to be realised in 2 phases contractor : Cofely Axima refrigeration France
CHOICE CO2 -40°C N5 direct charge compressors	CO2/NH3 cascade system CO2 at -40°C (9,8 bara) to obtain production t° -35°C CO2 as natural refrigerant CO2 for direct cooling on the freezers applied in a cascade system with limited NH3 qty as natural refrigerant only used for the high t° side high pressure compressors suitable for hot gas defrosting operation design pressures up to 50bar, resp. 66bar in f(compressor model) defrosting at +8°C (42,8 bara)
TIME FRAME	new plant : phase 1 : 2011 followed by 2: 2013

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EQUIPMENT



LOW TEMPERATURE SIDE CAPACITIES (kW)			
CO2 T° (°C)	C160GHSx1	C6HKx4	C6HSx1
FREEZING T° -40 °C	741	1196	940
DEFROSTING T° +8 °C	606	696	
HIGH TEMPERATURE SIDE			
NH3 TE (°C)	N250VLDx3		
-12	3502		

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EQUIPMENT



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EFFICIENCY ANALYSIS

CO ₂ /NH ₃ CASCADE		RT	BKW	THR	COP _C -each	COP _C -total
TE=-40°C	TC=+35°C	kW	kW	kW		
CO ₂ LS	C160GHS	741	200	941	3,7	
	C6HK	1196	289	1485	4,1	
	C6HS	940	212	1152	4,4	
	total	2877	701	3578	4,1	
NH ₃ HS	N250VLDx2	3502	1006		3,5	
	N250VLD					
TOTAL		2877	1707			1,68

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CONCLUSION

1	NATURAL REFRIGERANTS are the main trend for refrigeration in food industry	
2	CO2	- low temperature at usefull pressures (-40°C 10bara) - defrosting temperature (10°C 45bara, 20°C 58bara) - maximised COPc - direct use in the freezing equipment - low cost - smaller size equipment - less risc for food safety - cascade with minimised NH3 charge - low insurance costs - low CO2 emmision

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COMBINED NH₃ CHILLER / HOT WATER HEAT PUMP



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CHILLER

compressor model		piston N8M
cooling output		
water temperature	°C	1,5
capacity	kW	1000
bkw	kW	250
COP-c		4,0

HOT WATER HEAT PUMP

compressor model		piston N6HS
heating output		
water temperature	°C	90
capacity	kW	1500
bkw	kW	250
COP-h		6,0
COP-total		5,0



Thank you very much!

MARKET AVAILABILITY

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