

A Member of
The Linde Group

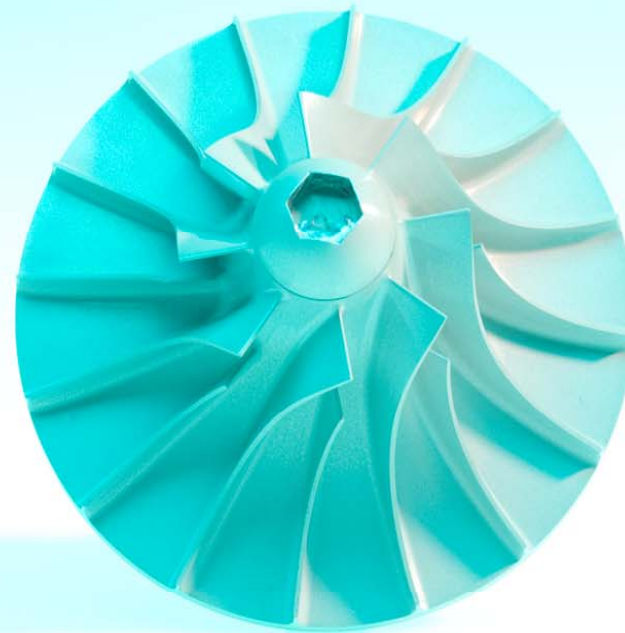
KRYOTECHNIK

Linde Kryotechnik AG
Ohlig / Clausen
September 28th, 2009
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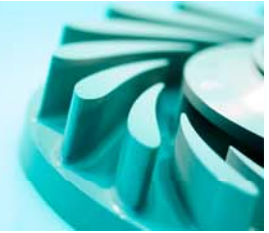
Klaus Ohlig / Jürgen Clausen
Berne, September 28, 2009

ITER For Swiss Industry

Linde Kryotechnik AG's Expertise & Involvement

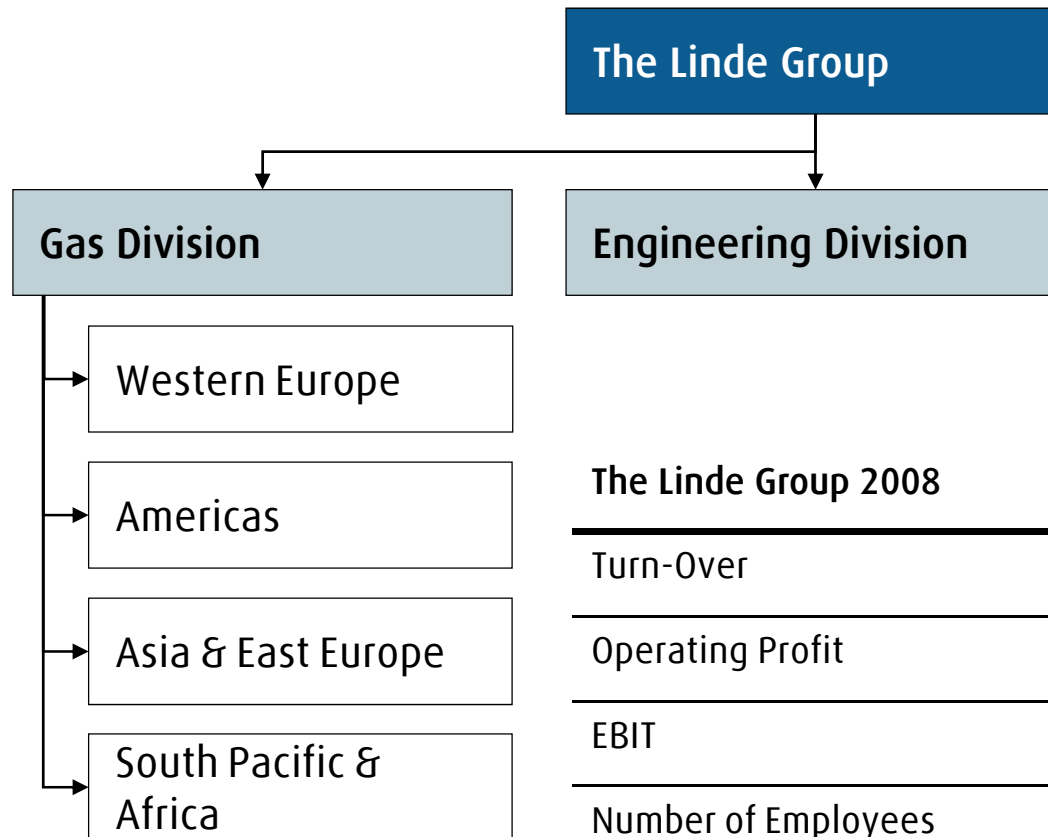
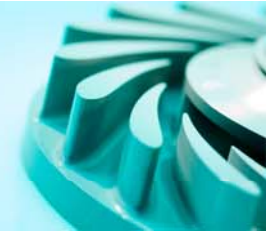


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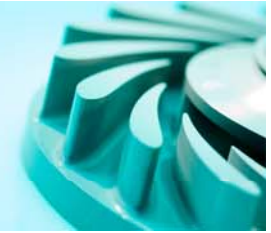
The Linde Group



The Linde Group 2008

Turn-Over	12,663	€ million
Operating Profit	2,555	€ million
EBIT	1,391	€ million
Number of Employees	51,908	

The Linde Group Linde Engineering



Olefine Plants

- Ethylene
- Propylene
- Butadiene
- Aromatics
- Polymers



Natural Gas Plants

- LNG
- NGL
- IFC
- Helium



Air Separation Plants

- Oxygen
- Nitrogen
- Rare Gases



Hydrogen and Synthesis Gas Plants

- H₂/CO/Synthesis Gas
- Gas Separation
- Gas Purification

Linde Kryotechnik AG, Switzerland,
is a member of
Linde Engineering

Linde Kryotechnik AG

Product Range



Helium Solutions

Purification - Liquefaction -
Reliquefaction - Refrigeration Systems



Hydrogen Solutions

Purification - Liquefaction



Special Solutions

Special Cryogenic Plant Engineering



Storage and Distribution Solutions

Distribution Systems - Storage Tanks -
Dewars

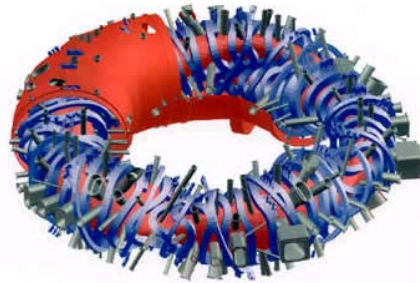


Customer Service Solutions

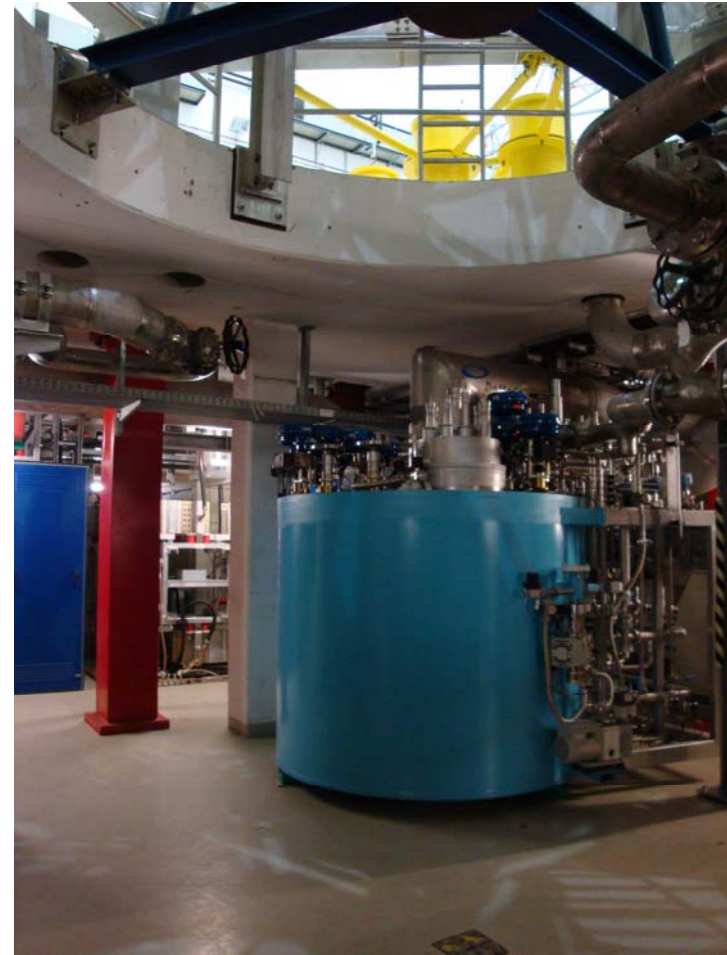
Installation & Maintenance - System Operation-
Refurbishment - Spare Parts

Selected References

Fusion Experiment Wendelstein 7-X



Fusion Experiment Wendelstein 7-X



Selected References

Wendelstein 7-X



MPI Greifswald - Wendelstein 7-X		MPI Greifswald - Wendelstein 7-X	
General information of project		Process Data	
<ul style="list-style-type: none"> Technical feasibility study Linde Start 1997 Placing the order at Linde End of 2003 Scope of work Turnkey Scheduled handover Mid of 2009 Present state of project Commissioning 		<ul style="list-style-type: none"> General Exergetic equivalent refrigeration capacity 7 kW @ 4.5 K Max. electrical power consumption 1.64 MW Consumers of cryogenic power in W7-X <ul style="list-style-type: none"> Coils Coil support structure Current leads Heat radiation shield of the W7-X cryostat Divertor cryo-vacuum pumps Shields for the divertor cryo-vacuum pumps Automation level / Main operation modes <ul style="list-style-type: none"> Standard refrigeration Peak power refrigeration Short standby refrigeration Long standby refrigeration with/without liquefaction Warming up cold plant Warming up W7-X Cool-down time of W7-X from ambient temperature < 2 weeks 	
Technical equipment		Compressor unit	
Machines 14		<ul style="list-style-type: none"> Max. 1st stage compressor shaft power 600 kW Max. 2nd stage compressor shaft power 1250 kW 1st stage compressor discharge pressure 5.35 bara (peak power refrigeration mode) 2nd stage compressor discharge pressure 17.5 bara (short standby refrigeration mode) 	
<ul style="list-style-type: none"> Warm screw compressors 2 Expansion turbines 7 Cold compressors 2 Cold circulators 4 		Plate fin heat exchanger	
Plate fin heat exchangers 10		<ul style="list-style-type: none"> Min. heat transfer rate of one plate fin heat exch. 0.94 kW (cooling from 5.4 to 4.5 K) * Max. heat transfer rate of one plate fin heat exch. 686 kW (cooling from ambient temp. to 93 K) * * standard refrigeration mode 	
<ul style="list-style-type: none"> Max. block length / volume / weight 4.75 m / 3.56 m³ / 4'100 kg 		Helium process	
Measuring device 404		<ul style="list-style-type: none"> Lowest Helium temperature 3.3 K (supercritical Helium) Helium separators temperature 3.3 K @ 0.366 bara 3.8 K @ 0.662 bara 4.4 K @ 1.19 bara Helium filling capacity 2.7 tons (@ 15 bara in buffer-tanks) 	
<ul style="list-style-type: none"> Temperature sensors 166 Pressure & differential pressure sensors 201 Flowmeasurement 37 			
Valves 998			
<ul style="list-style-type: none"> Warm & cold manual on/off valves 758 Warm pneumatic control & on/off valves 92 Cold pneumatic control valves 80 Safety valves 68 			
Coldboxes 4 (+2 testboxes)			
<ul style="list-style-type: none"> Coldbox 1 ø 3.2 m, length 5.6 m / 45 m³ Coldbox 2 ø 3.2 m, length 6.2 m / 50 m³ Sub-cooler box ø 2.3 m, length 6.5 m / 27 m³ Magnet valve box ø 2.0 m, length 1.6 m / 5 m³ 			
Helium purification-system with 3 coalescers in serial, 1 oil adsorber			
2 alternating adsorbers for moisture (dryer)			
2 alternating adsorbers @ 80 K, 1 adsorber @ 20 K			
Transferlines 5 lines, the longest with ca. 54 m / DN400			
Quenchline ca. 134 m / DN 200			

Selected References

CERN LHC Linde Helium Plants



Selected References

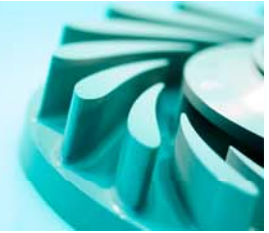
CERN LHC Linde 18 kW He Refrigerator Plant






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ITER Cryogenics Procurement Package Cryo Plants

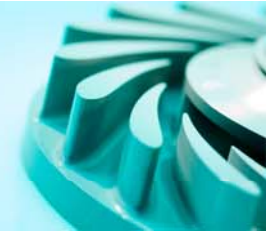


34 - CRYOPLANT & CRYODISTRIBUTION		
2	Cryolines	
3	Cryodistribution Components	
34-1	Cryoplant	

Linde interest in:

- Procurement package 34-1 Cryoplants

Example: 4 boxes



Supply of Cryo Plants for the ITER project is characterized by:

- TKLS approach, i.e. engineering, supply & installation
- total contract volume in the range of approx. € 150 to 200 million

Linde Kryotechnik AG is a company with

- an annual sales of approx. € 40 million,
- excellent expertise in cryogenics, but
- limited TKLS capability for project with size of ITER Cryo-plants

Special and dedicated approach to project execution required reflecting

- cryogenic expertise of Linde Kryotechnik AG
- TKLS expertise of experienced engineering company
- construction expertise of contractor

ITER Cryogenics

Linde Kryotechnik Scope of Supply



Cryo Plants

- Conceptual design
- Process design
- Basic and detailed plant engineering
- Fabrication of cryogenic coldboxes
- Procurement of compressors & auxiliary systems
- Supply of cryogenic refrigeration/liquefaction systems
- Erection and installation supervision
- Commissioning and start-up
- Operation and maintenance

Linde Kryotechnik AG

Contact



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Thank you for your attention.

