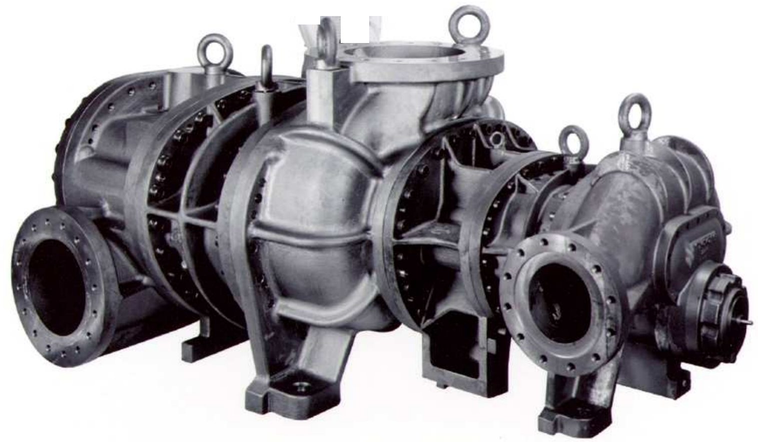


Mayekawa Helium Compressors

about Mayekawa

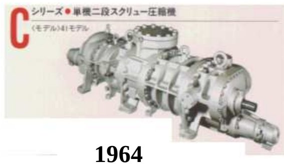
History of Helium Compressor

Mayekawa and Iter


MAYEKAWA

Mayekawa History

1924
First Reciprocating
Compressor



1964
Screw Compressor

1978
4 K Super Low Temp.
Particle Accelerator

1981
Nuclear Fusion

1984
MagLev Train

1989
Rocket Fuel

1993
Super GM
(Super Conductive
Electric Generator)

1958
Multiple Cylinder Reciprocating
Compressor

Ethylene Plant

LNG Tanker

有機(EOEG)

無機(NH_3)

Pharmaceutical

1924 — 1960 — 1970 — 1980 — 1985 — 1990

- Company founded in 1924.
- Over 30.000 screw and reciprocating compressors running in more than 100 countries.
- 40% of the world market share.

about Mayekawa

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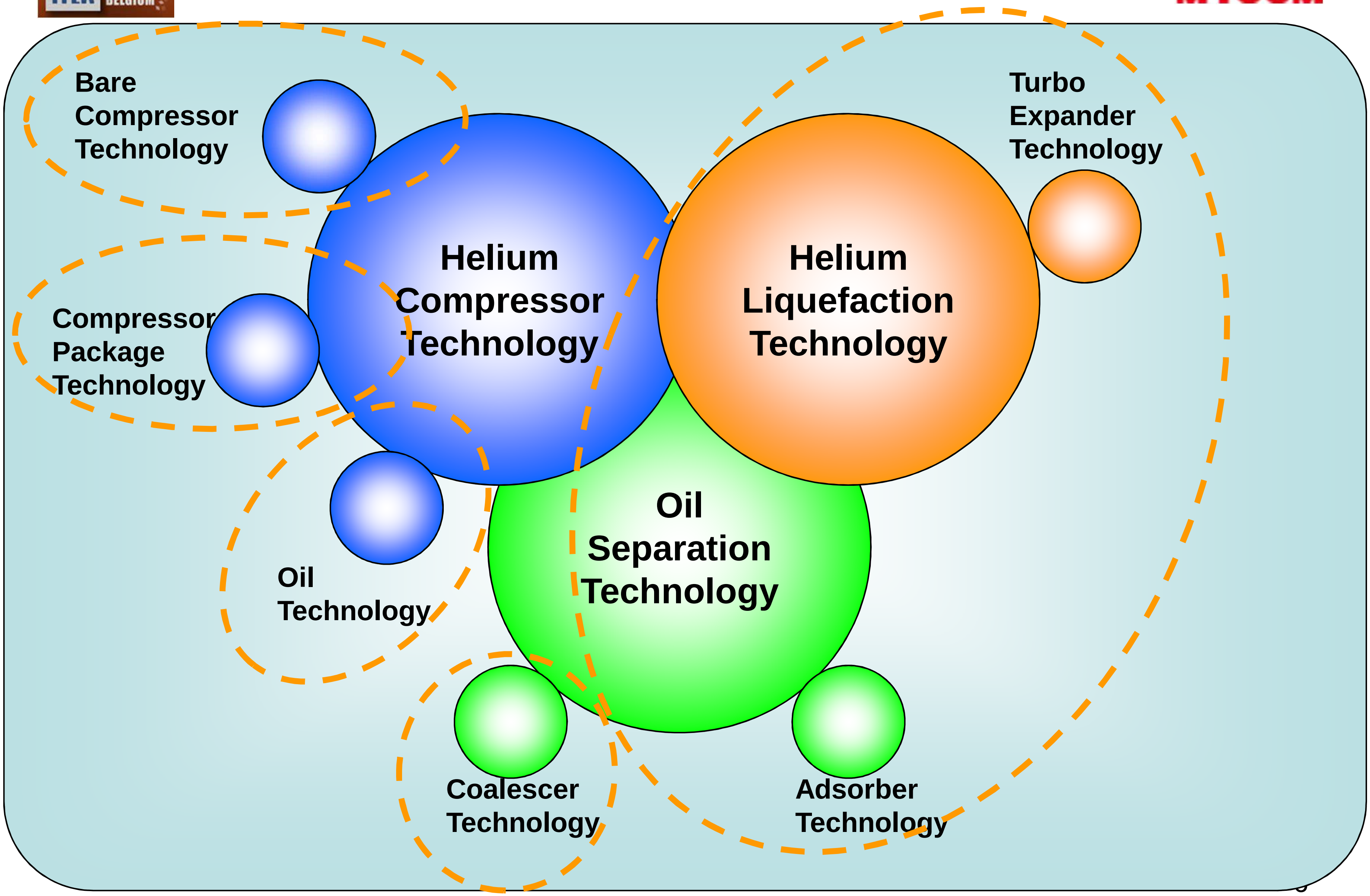
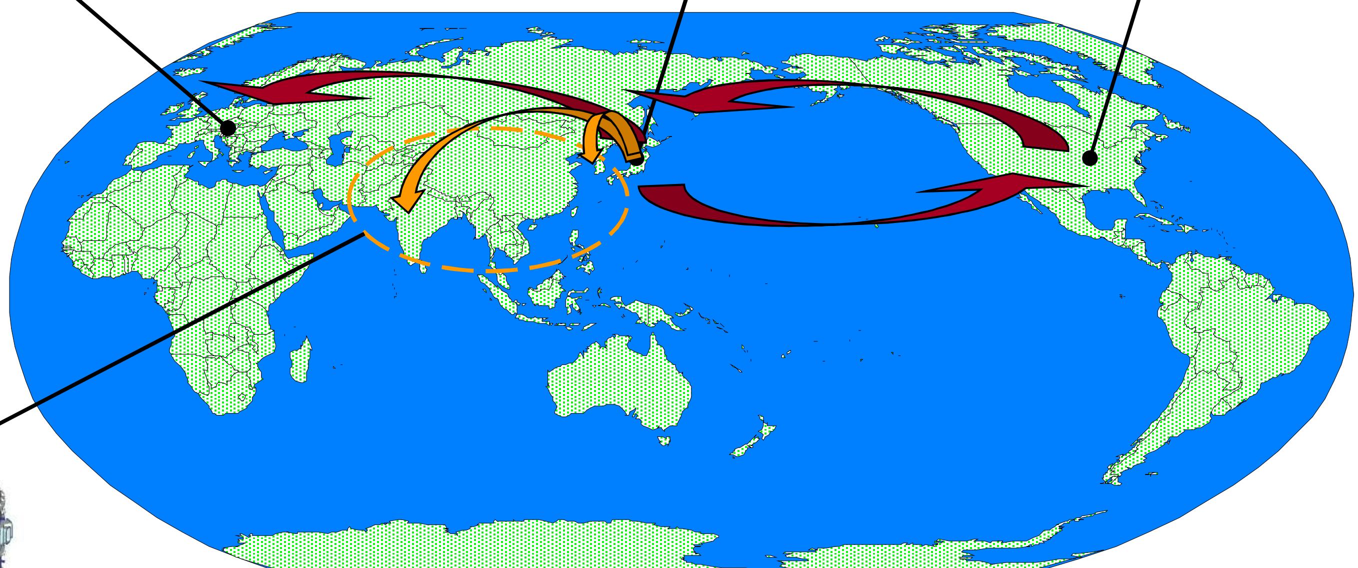
Mayekawa and Iter


Bare Compressor Technology
Helium Compressor Technology
Helium Liquefaction Technology
Turbo Expander Technology
Compressor Package Technology
Oil Technology
Oil Separation Technology
Coalescer Technology
Adsorber Technology

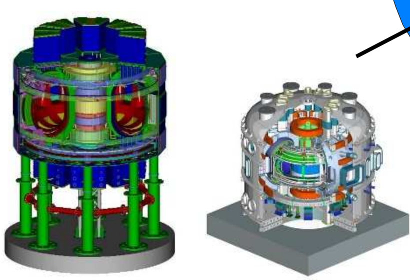
EUROPE: 27 compressors

JAPAN: 126 compressors

USA: 107 compressors



Asia: 8 compressors



ITER BELGIUM

MAYEKAWA MYCOM

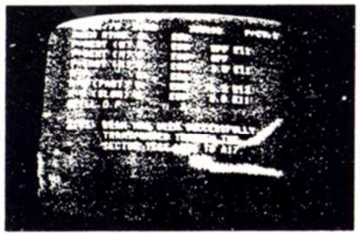
Fermi news(1979)

FERMINEWS

Fermi National Accelerator Laboratory

Operated by Universities Research Association Inc. Under Contract with the United States Department of Energy

Vol. 2, No. 6 February 8, 1979



...Monitor in control room announces successful conclusion of sector run...

...Their faces show how the test run went. (l-r) G. Tool, M. Harrison, R. Orr...

PROTON BEAM SUCCESSFULLY SAILS THROUGH SUPERCONDUCTING MAGNETS!

For the first time in history -- the night of Feb. 1 -- scientists successfully guided a beam of high energy protons through a string of 25 superconducting magnets.

It was a crucial test of Fermilab's Energy Doubler, the accelerator that in tandem with the existing accelerator will push protons to 1,000 BeV (1 TeV). It also tested the knowhow and teamwork of a multi-disciplinary staff led by Rich Orr, assistant head of the Accelerator Division.

He and his team showed the world that the technology of superconducting magnets -- the heart of the Energy Doubler -- is feasible and within reach of Fermilab's experts. Now a new dimension in high energy physics has opened with greater certainty than ever before, and, looking ahead to the time when the project is finished, Orr said, "I have a hunch the high energy physics world will be beating at our doors to get in here to do experiments that require 1,000 BeV."

It was the long-awaited outcome of years of planning and a series of three tests in rapid succession that began on Dec. 21 when the first attempts were made to operate the string of 25 magnets in the main ring tunnel. Then on Jan. 11 came Roger Dixon's successful switchyard test, and finally on Feb. 1, the crucial break-through, again in the main ring tunnel.

But that did not come easily. A problem with a traditional electromagnet becomes a super problem with a superconducting magnet, and Orr and his team had enough of those problems and others to keep their anxiety level high going into the final moments of the countdown. Yet with caution, and certainly with optimism, they injected a proton beam into the string of 20 dipoles and five quadrapoles that stand in an arc 500 feet long between the A-12 and A-17 stations of the main ring tunnel.

And it worked...beautifully. Much to the surprise of nearly everyone, who had expected to be resolving difficulties for many hours into the night before the run was successful.

Looking back on their unexpected ease of success, Orr said, "We had experienced accelerator people. Everybody knew what to do and they did it -- and it worked."

Extremely critical to the success of this run through the 25 magnets was the knowledge Roger Dixon and his group gained when they were experimenting with two

(Continued on Page 2)

Fermi National Accelerator Laboratory

about Fermilab

Beginning of the large scale refrigerator and long time operation

フェルミ ニュース：レシプロ コンプレッサーをスクリューにおきかえたことが載っています。

superconducting magnets in the switchyard beam line on Jan. 11. They found the magnets worked better when the cooling coils about them are as full as possible o liquid helium--the coolant. Orr credits this observation as one of the major reasons for the success of the Feb. 1 test

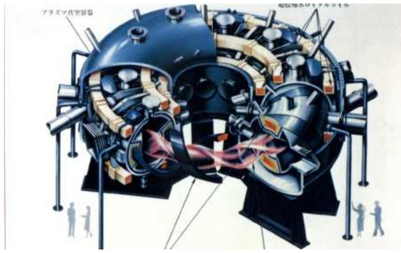
Receiving high praise for their contribution were John Paulk and his Site Services crew, who during some of this area's most severe weather, helped Claus Rode's cryogenic systems group replace two helium reciprocating compressors with a two-stage screw compressor of the type that will go into the final Doubler.

So out of all of this comes "a whole new breed of cat," said Orr. "A super-conducting magnet accelerator that nobody has ever built before. Yet this is only an intermediate step which will help us solve many more anticipated problems. What we have really is a research and development project."

From this experiment over the past eight months, the team learned:

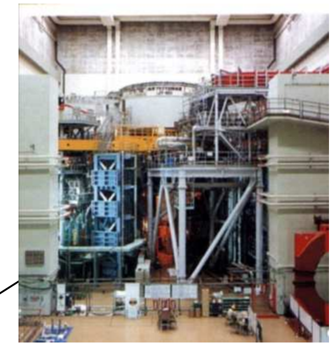
1--How to install superconducting magnets in the main ring tunnel.
2--How to make a leak-tight system 500 feet long ("No one's done that before," said Orr.)
3--How to cool down a string of magnets and maintain them at the temperature of liquid helium (-443°F).
4--How to tune the beam into the magnets without any disasters happening.

* * * * * * * * * *



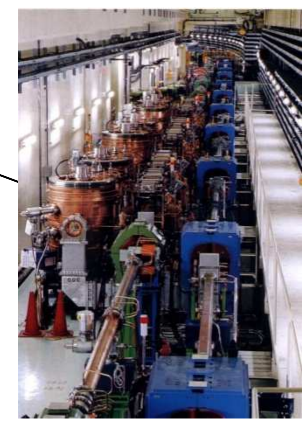
NIFS/LHD

RIKEN/RIBF



JAEA/JT60

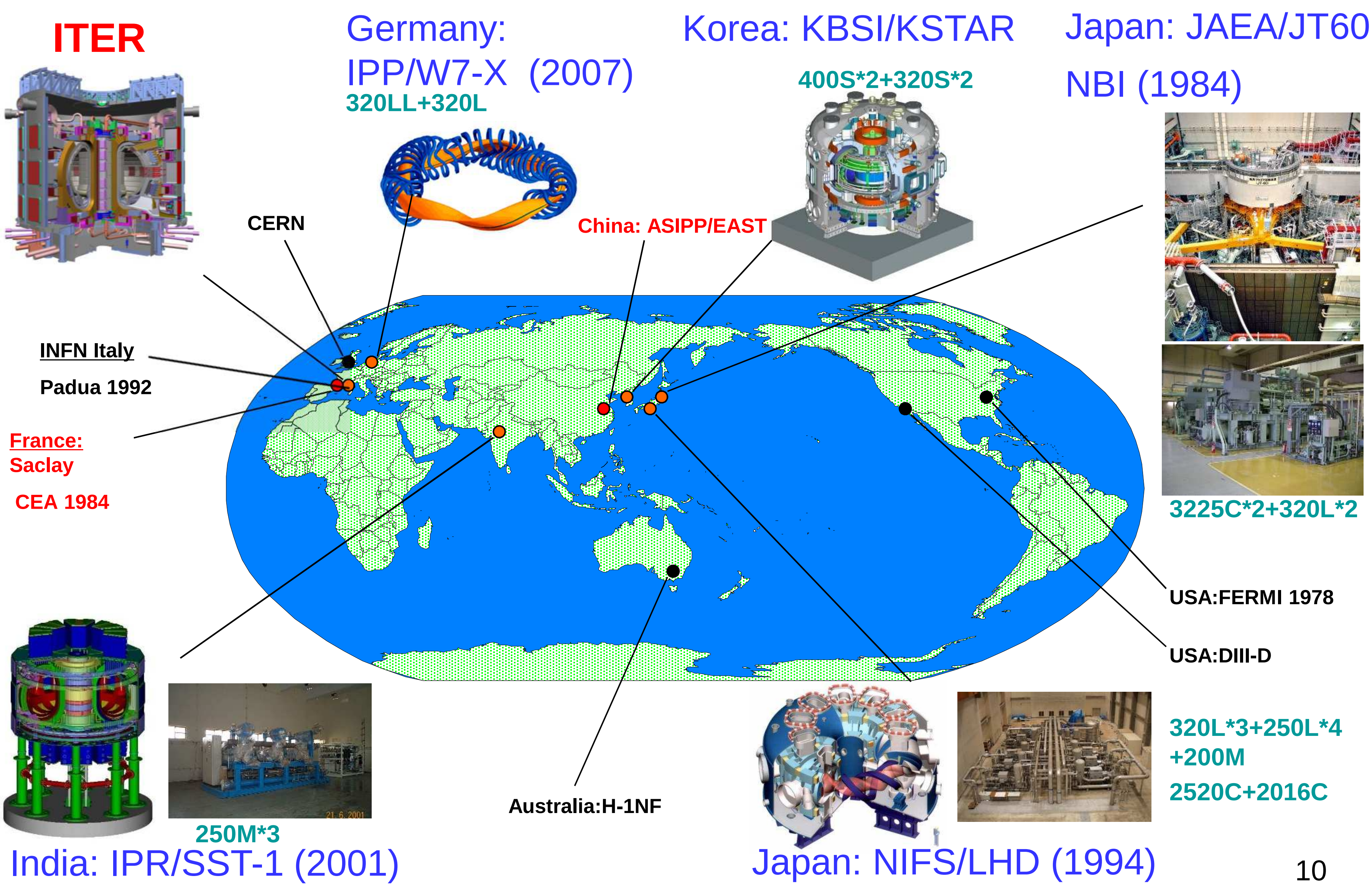
Super-GM



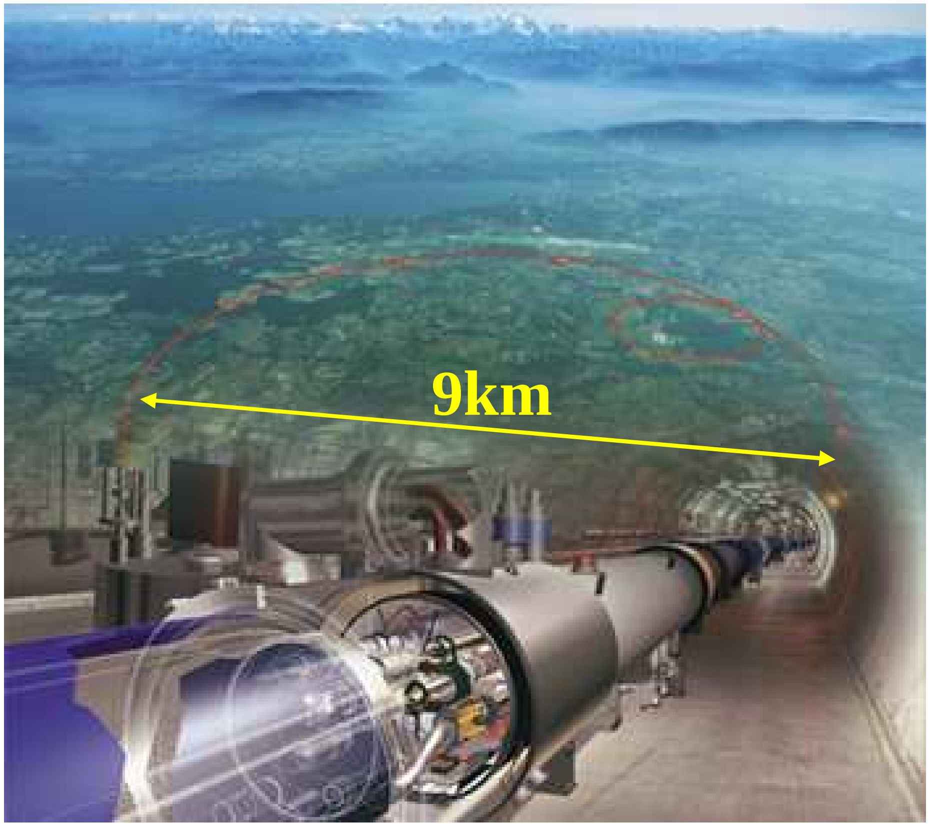
KEK/KEK-B

NASDA/H-2 rocket

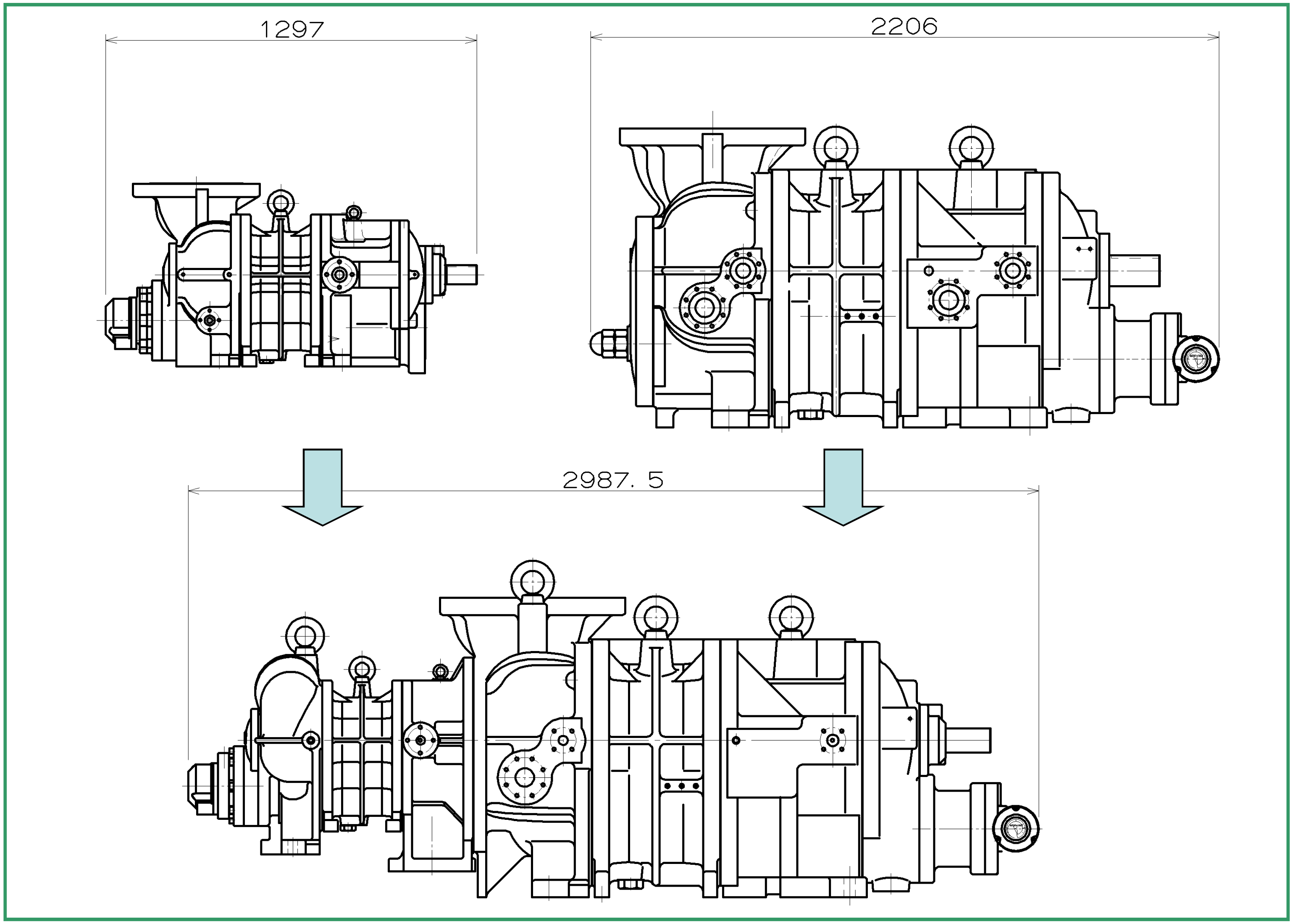
JR/Linear motor car

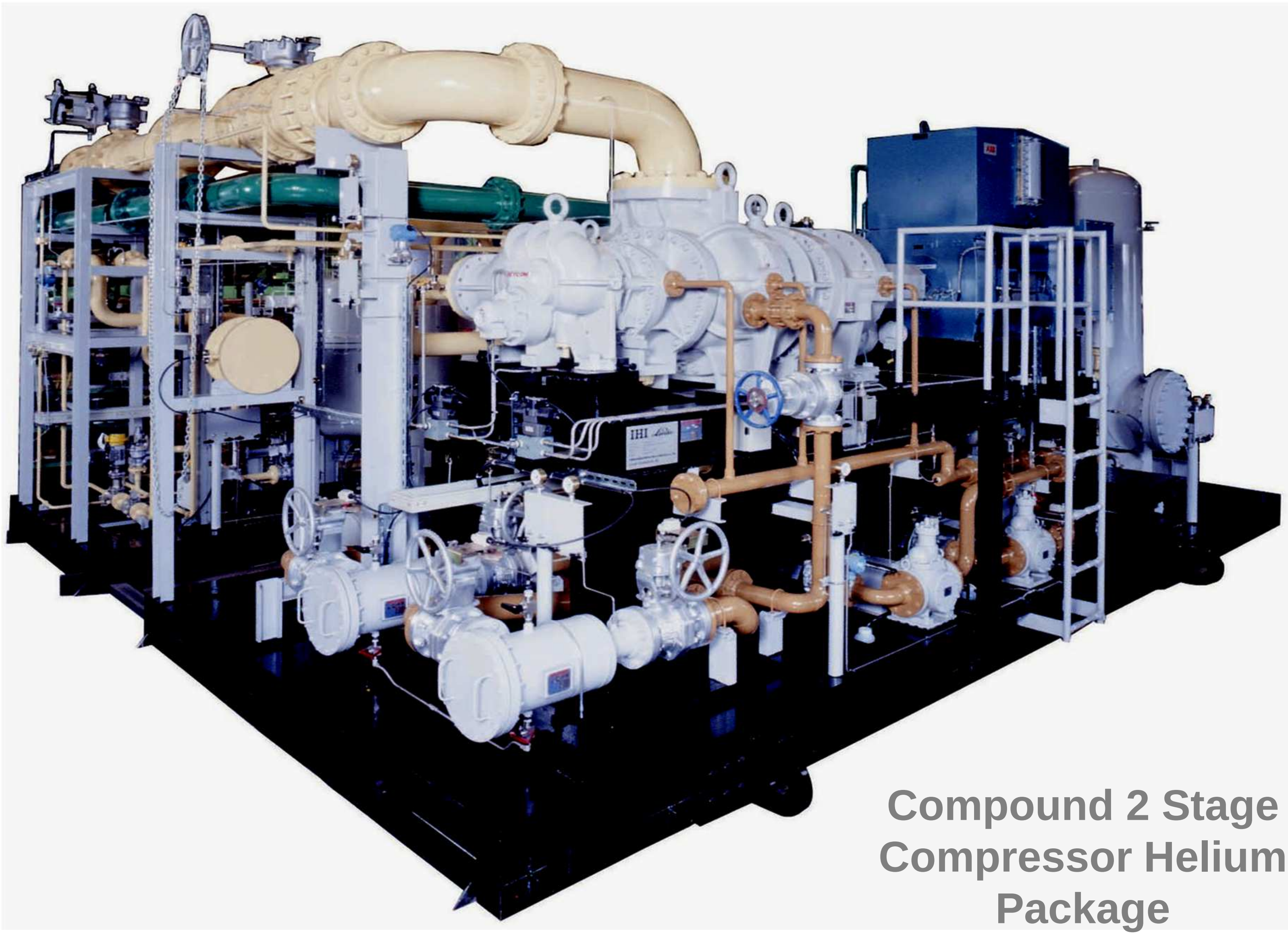

ITER
Germany:
IPP/W7-X (2007)
320LL+320L
Korea: KBSI/KSTAR
400S*2+320S*2
Japan: JAEA/JT60
NBI (1984)
CERN
China: ASIPP/EAST
INFN Italy
Padua 1992
France:
Saclay
CEA 1984
3225C*2+320L*2
USA:FERMI 1978
USA:DIII-D
320L*3+250L*4
+200M
2520C+2016C
Australia:H-1NF
250M*3
India: IPR/SST-1 (2001)
Japan: NIFS/LHD (1994)

CERN LHC
2.4kW@1.8K refrigeration system



Mayekawa Large Compound Screw Compressors





Compound 2 Stage Compressor Helium Package

about Mayekawa

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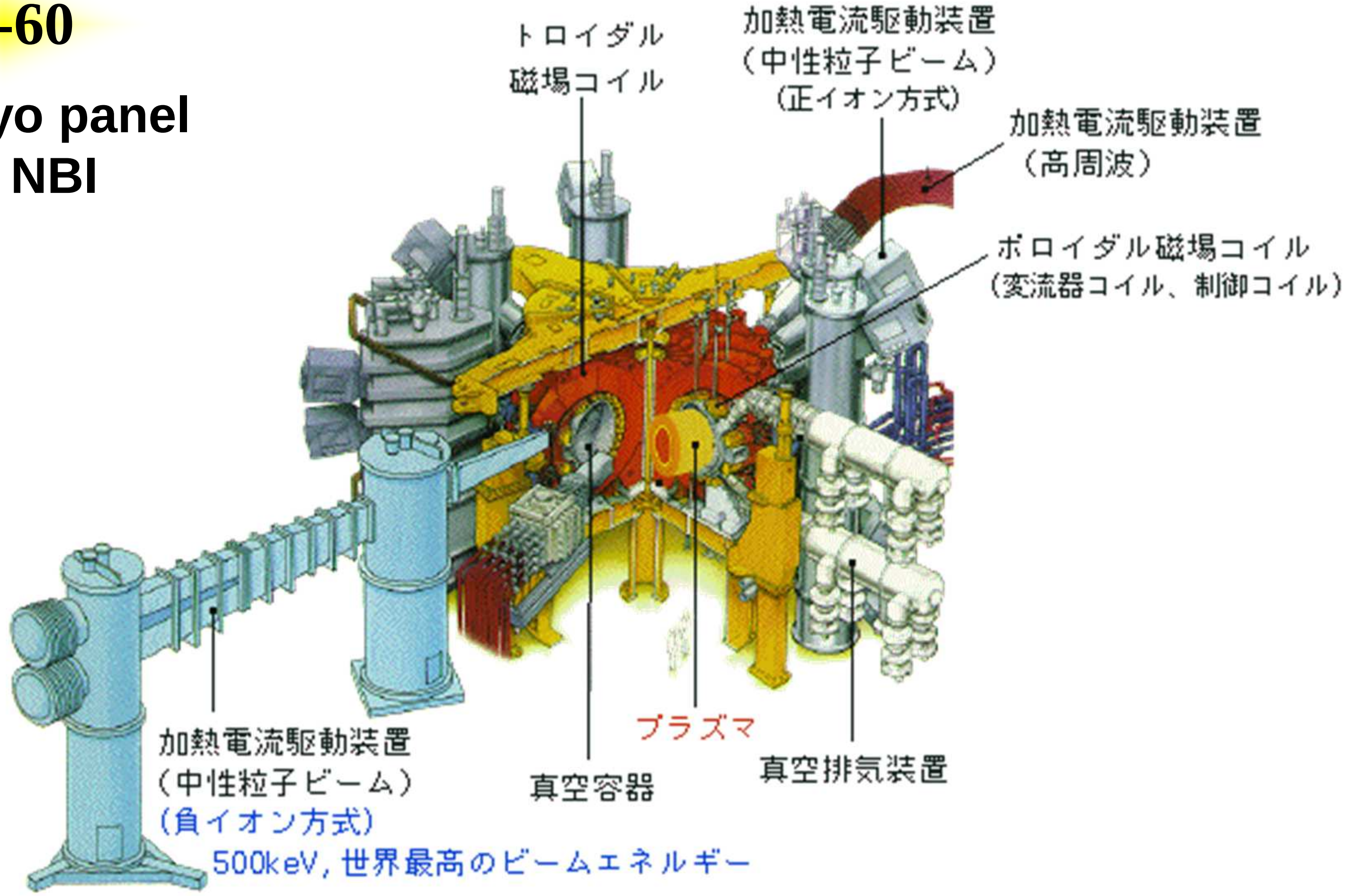
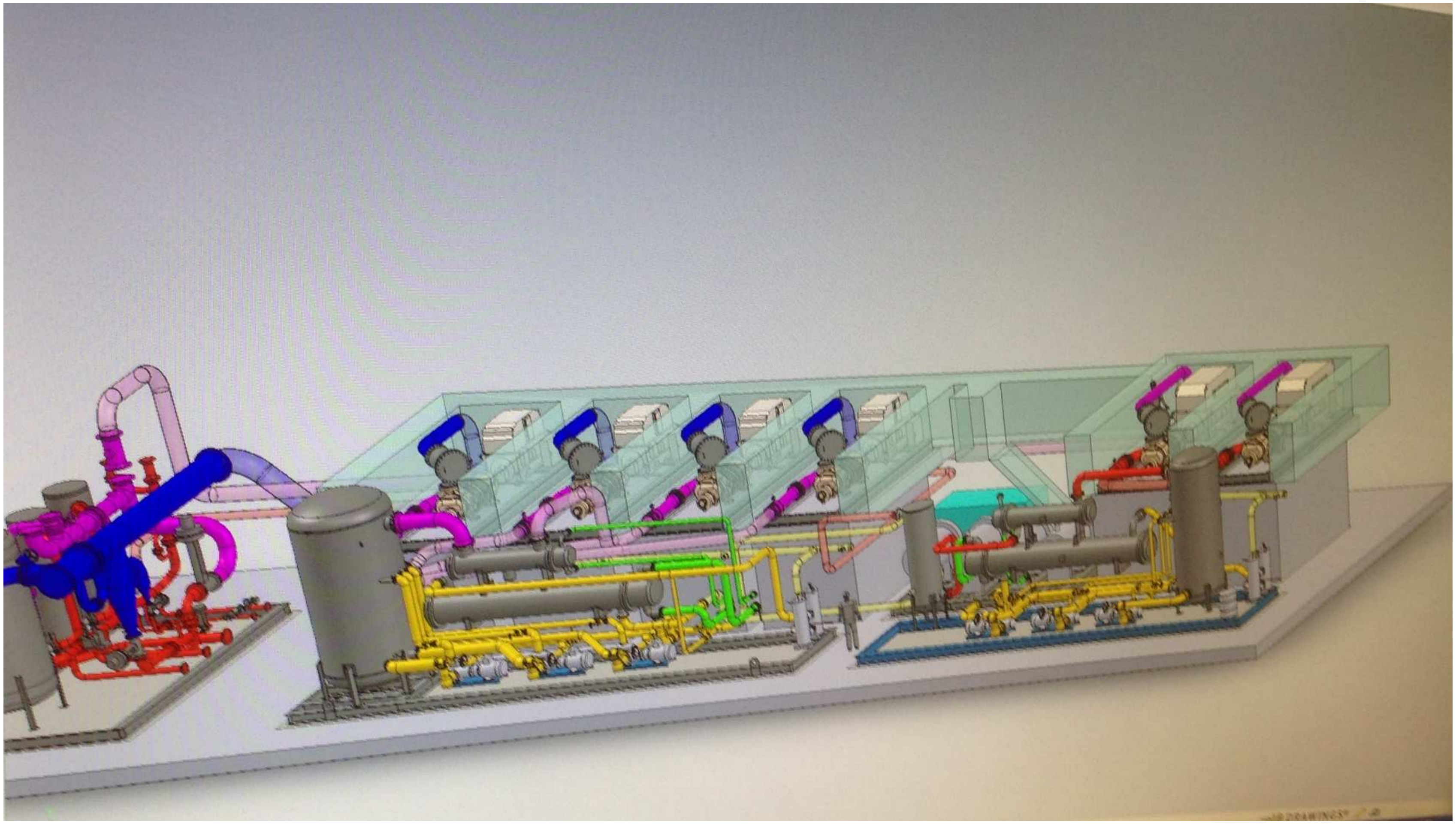
JT-60

Cryo panel for NBI





				Max Case	Min Case
STAGE :	**LOW PRESSURE STAGE (LP)**				
TYPE :	SCREW COMPRESSOR (OIL FLOODED)				
AL-AT PROCESS IMPOSITIONS (1 Compressor Station)				**Max Case**	**Min Case**
Fluid:	Helium	He		100%	100%
	R	J/(mol.K)		8,314	8,314
	M	g/mol		4,0026	4,0026
	r	J/(g.K)		2,077	2,077
Isothermal Power		kW		1640	1188
Inlet Pressure (1)		bar abs		1,05	1,05
Inlet Temperature		K		307	307
Outlet Pressure (2)		bar abs		5,00	4,24
Flowrate		g/s		1648	1335
Flowrate		m3/h		36 047	29 197
Flowrate		Nm3/h		33 246	26 928

STAGE :	HIGH PRESSURE STAGE (HP)			
TYPE :	SCREW COMPRESSOR (OIL FLOODED)			

AL-AT PROCESS IMPOSITIONS (1 Compressor Station)			Max Case	Min Case
Fluid:	Helium	He	100%	100%
	R	J/(mol.K)	8,314	8,314
	M	g/mol	4,0026	4,0026
	r	J/(g.K)	2,077	2,077
Isothermal Power		kW	2140	2010
Inlet Pressure (1)		bar abs	5,00	4,24
Inlet Temperature		K	309	309
Outlet Pressure (2)		bar abs	23,40	23,40
Flowrate		g/s	2160	1833
Flowrate		m3/h	10 006	10 010
Flowrate		Nm3/h	43 585	36 986

Thank you

Daniel Dick

Mayekawa France