



Centre for Energy Research,
Hungarian Academy of Sciences

Budapest Cold Neutron Source

History – Operation – Utilization

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Content

- ❖ **Budapest Research Reactor (BRR)**
 - **History, main technical data**
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- ❖ **Budapest Cold Neutron Source (BCNS)**
 - **History, main technical data**
 - **Operation**
 - **Maintenance**
 - **Future**

Bird's eye view of BRR site

Reactor Hall

Secondary Pump Room

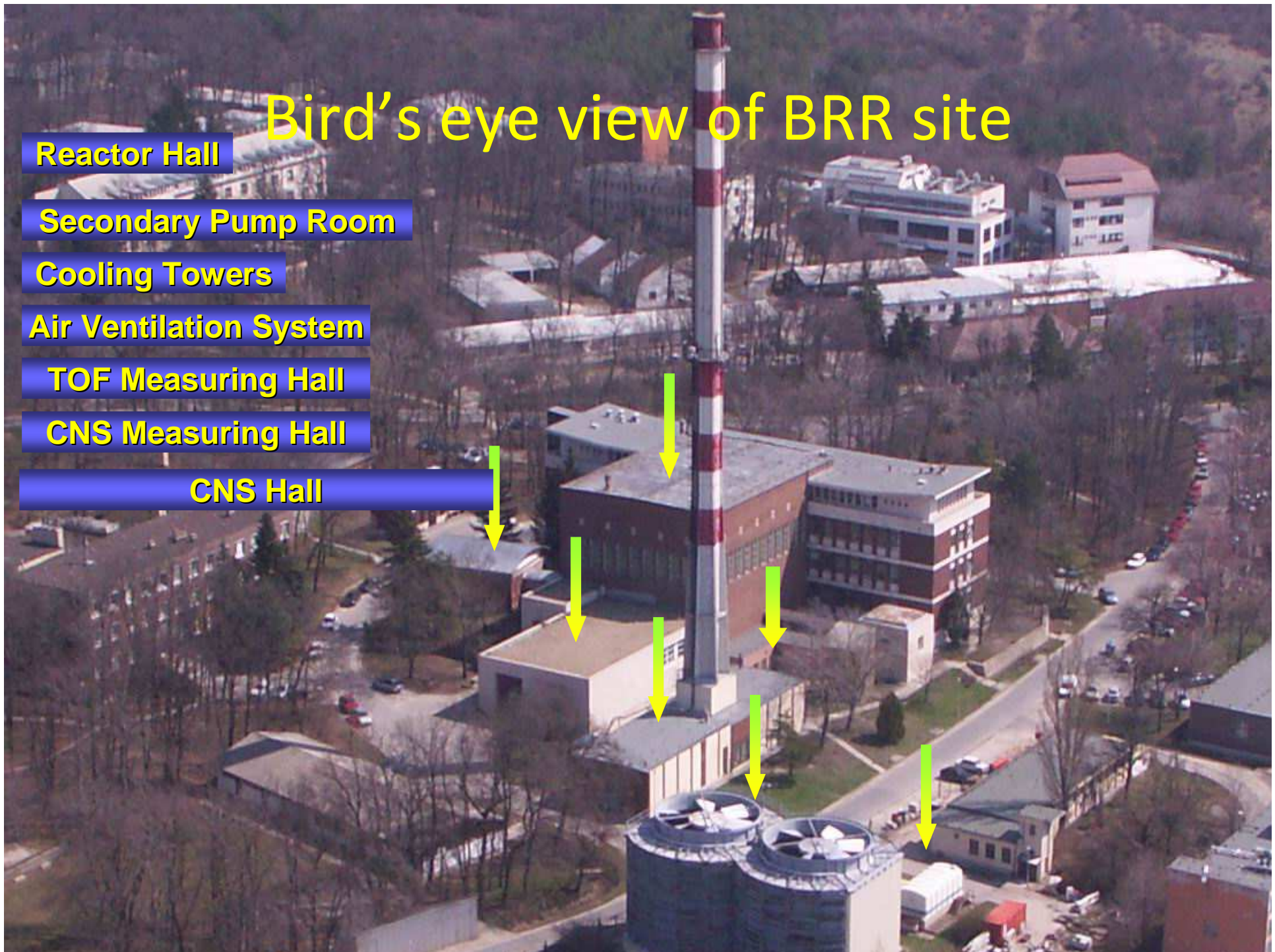
Cooling Towers

Air Ventilation System

TOF Measuring Hall

CNS Measuring Hall

CNS Hall





BRR history

Tank-type reactor, moderated and cooled by light water

- ❖ Went critical in 1959
 - Fuel: EK-10, thermal power: 2 MW
- ❖ 1st Upgrade in 1967
 - Core surrounded with beryllium reflector
 - Fuel changed: EK-10 → VVR-SM, Thermal power: 2MW → 5 MW
 - Stopped for partial decommissioning in 1986
- ❖ 2nd Upgrade (full scale reconstruction) from 1986 ... to 1990
 - With the exception of the civil engineering construction all equipment was replaced
 - Physical start-up in December 1992
 - Energetic start-up procedure from March to October 1993
 - Operating licence: 25 November, 1993
 - From that time the BRR operates on average ≈3500 hours/year.
 - Nowadays BRR operates in 10 day cycles
- ❖ HEU-LEU conversion started (15 September, 2009)
- ❖ HEU-LEU conversion finished (03 November, 2013)



Main technical data

Reactor type:	Tank-type with beryllium reflector, cooled and moderated with light water
Vessel:	Al-alloy (height: 5685 mm; Ø2300 mm)
Core geometry:	Hexagonal (length: 600 mm; Ø1000 mm)
Fuel:	VVR-M2, 19.75% enrichment
Equilibrium core	190 fuel elements (5×38 age-group FAs)
Control:	3 safety rods (B₄C); 14 control rods (B₄C); 1 automatic control rod (SS)
Thermal power:	10 MW
Main power density:	61.2 kW/litre (in the core)
Neutron flux density in the core:	2.5×10¹⁴ (thermal in flux traps) E_n<0.625 eV 1×10¹⁴ (in fast channels) E_n>0.5 MeV
Cooling systems:	Two closed loops (primary and secondary loops)
Pr.cooling water:	Q_{nominal}: 1650 m³/h; T_{inlet}: 45 °C; T_{outlet}: 50 °C

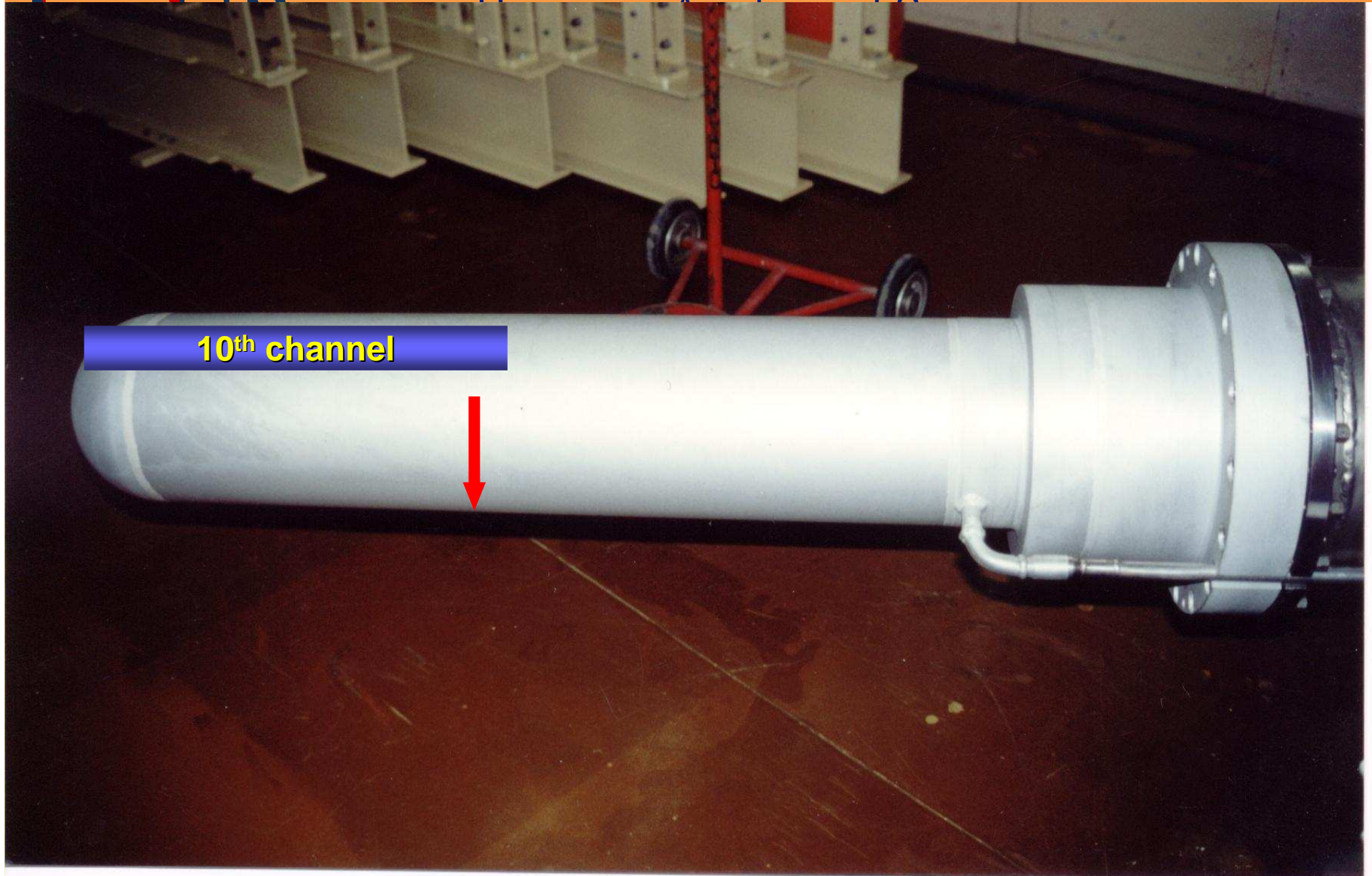
Budapest CNS Building

Hydrogen Room

Compressor Room

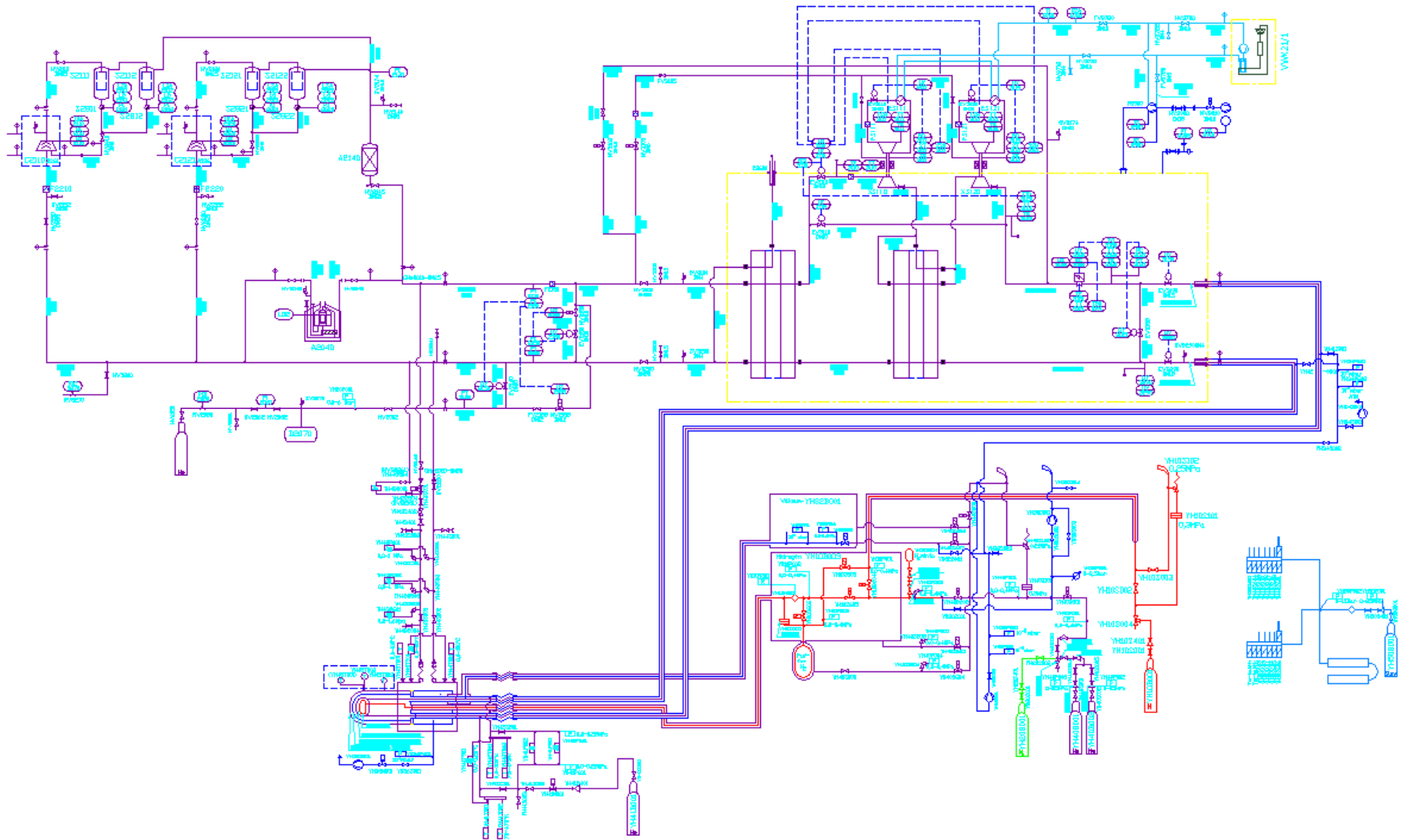
Refrigerating Room





10th channel

BCNS System





Main technical data I

Moderator type:	Liquid Hydrogen type, cooled with Helium
Kryo Tubes	Double wall, insulated with vacuum
Refrigerator	Linde TCF50 300W with siemens PLC
Compressors	Kaeser AS36, BS 61

	NO	SO	Cold down	Warm up
PI2150	10,98 bara	11,04 bara	11,03 bara	11,02 bara
PI2250	1,04 bara	1,05 bara	1,05 bara	1,05 bara
PI2155	3,6 bara	3,91 bara	5,17 bara	5,16 bara
PI3185	1,46 bara	1,54 bara	1,47 bara	1,54 bara
PI3905	1,86 Volt	6,3 Volt	1,88 Volt	6,3 Volt



Main technical data II

	NO	SO
TI3110	61,7 K	303,1 K
TI3126	15,0 K	303,1 K
TI3111	53,8 °C	27 °C
TI3121	49,7 °C	27 °C
TI3180	15,2 K	303,1 K
TI3280	23,8 K	303,1 K



Operation

❖ Reactor operation

- Nowadays BRR operates in 10 day cycles
- The reactor operation cycle begins on Tuesday at 11 A.M.
- The reactor stops on Friday next week at 12 P.M.

❖ Work in NO

- Helium purification happens on Monday
- BCNS starts on Tuesday 8.00 A.M.
- The He will be liquid about 7 P.M.
- The warm up of the CNS begins on Friday at 12.30 P.M.
- Stops about at 6.30 P.M.

❖ Work in SO

- SO starts half an hour before the reactor starts
- Than the emergency cooling is opened
- SO stops 20 minutes after the reactor is stopped
- Finaly the emergency cooling is shut



Planned maintenance

❖ Maintenance method

- Maintenance methods are based on the manuals of CNS
- We plan the maintenance according to the number of operating hours and the long term outage in summer
- Exceptions: the sudden malfunctions or oil change in compressors

❖ Some examples for exceptional cases

❖ Every day

- Supervising Pressure of Helium blanketing subsystem
- PLC

❖ Before system starting

- Supervising compressors, refrigerating system
- PLC



Planned Maintenance

❖ Compressor BS61

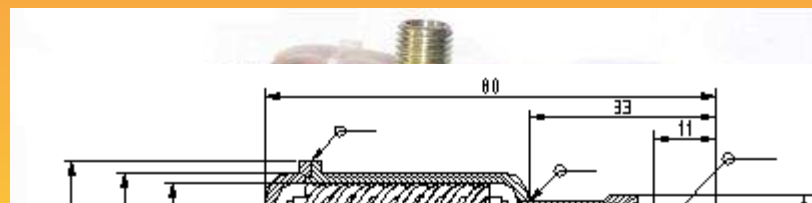
Weekly	Check oil level Check oil leak
500 hours	Check tension of Fan belt
About indication Kaeser control	Change oil filter Change oil remover patron
1000 hours	Check of the oil and the purity of the gas cooler
2000 hours or once a year	Greazing ball bearings of fan
8000 hours or once a year	Change oil Change oil filter
6000/12000 hours or three years	Change ball rings of fan





Some interesting pictures

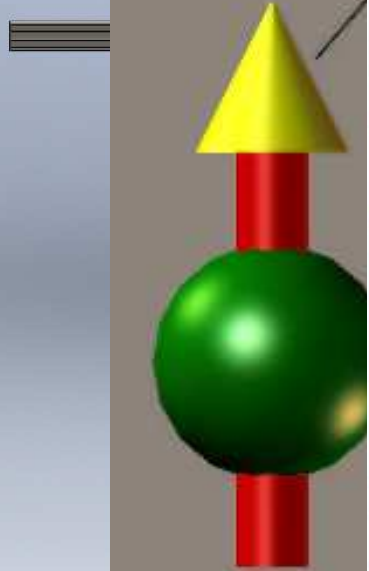
- ❖ Engine Valve
- ❖ Moderator cell
- ❖ Turbines





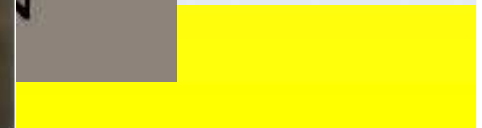
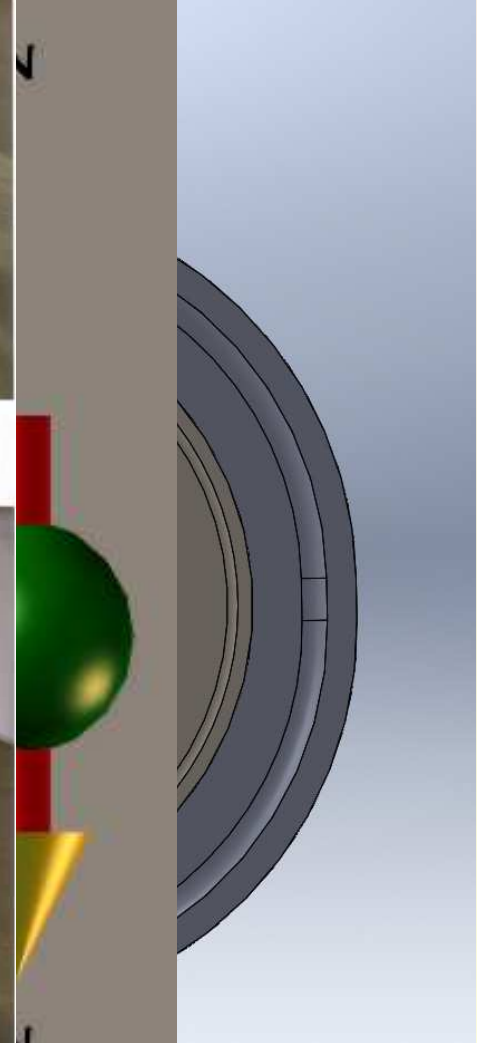
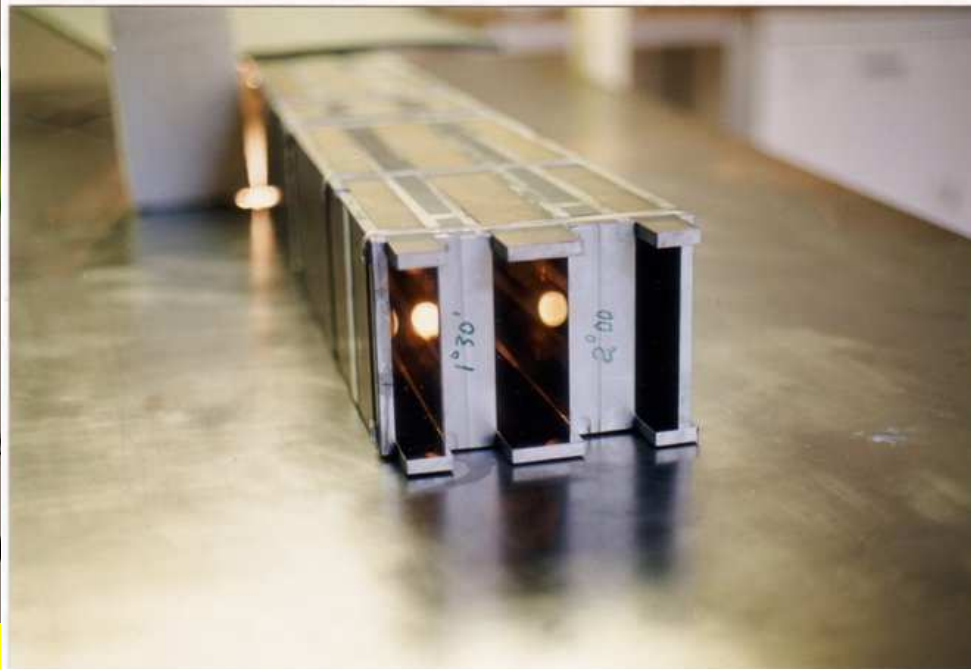
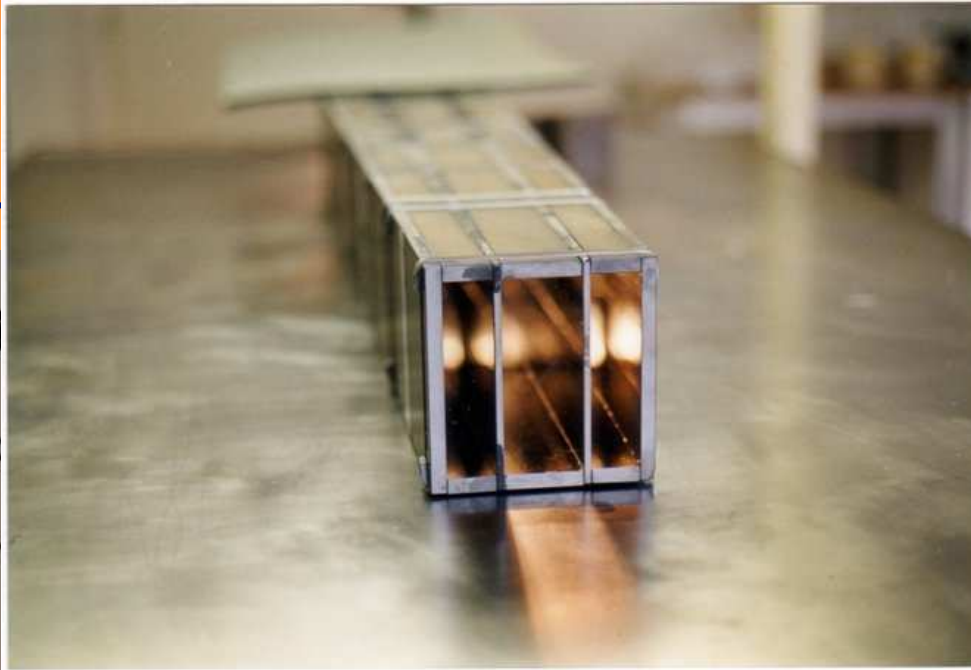
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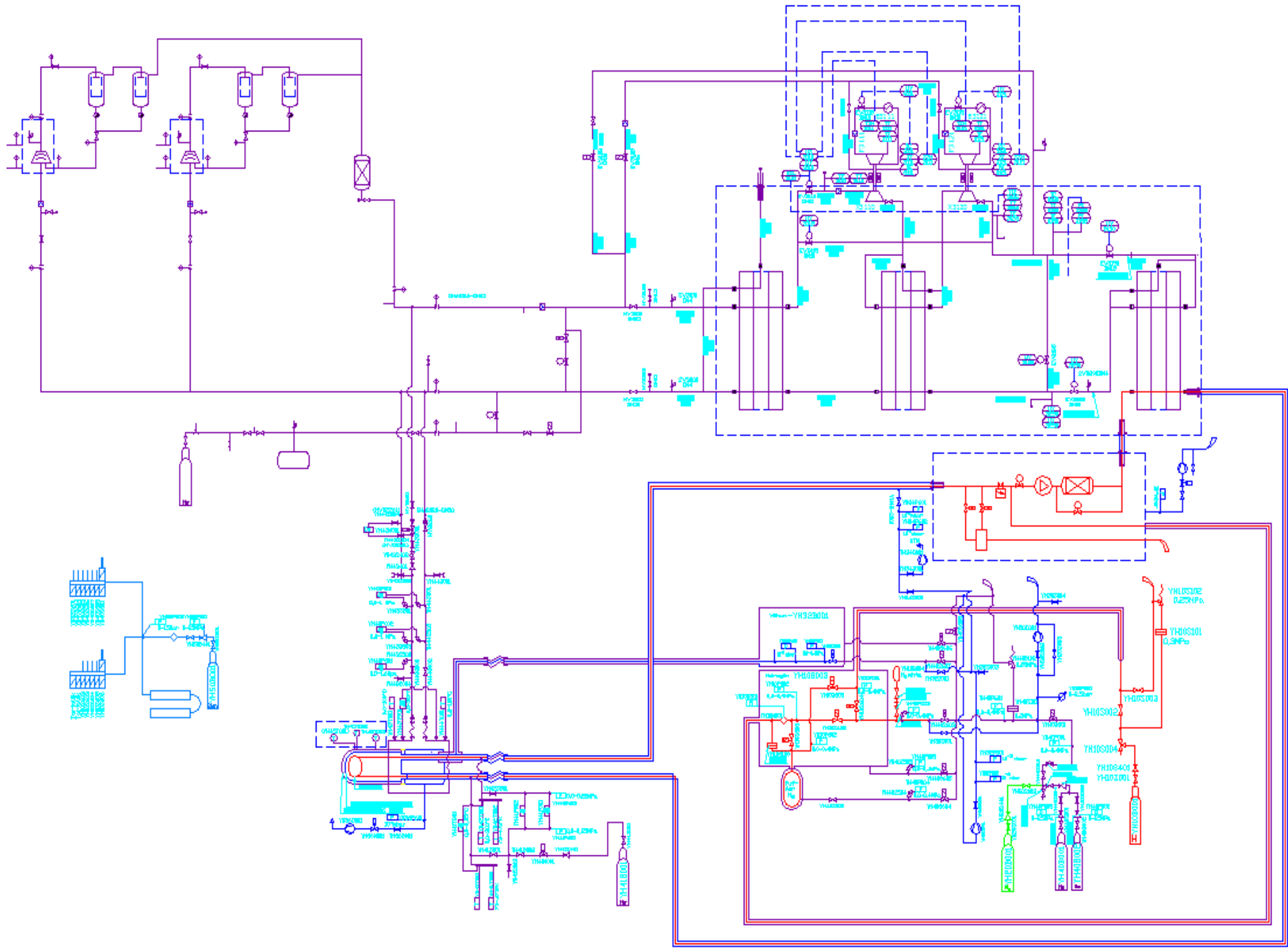
PRO



COVA

ORTH







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Thank you for your attention!