Remote Handling & Shielding at PSI

PSI

Paul Scherrer Institut

5232 Villigen

Switzerland

Eyke Wagner

ICFA-HB2002

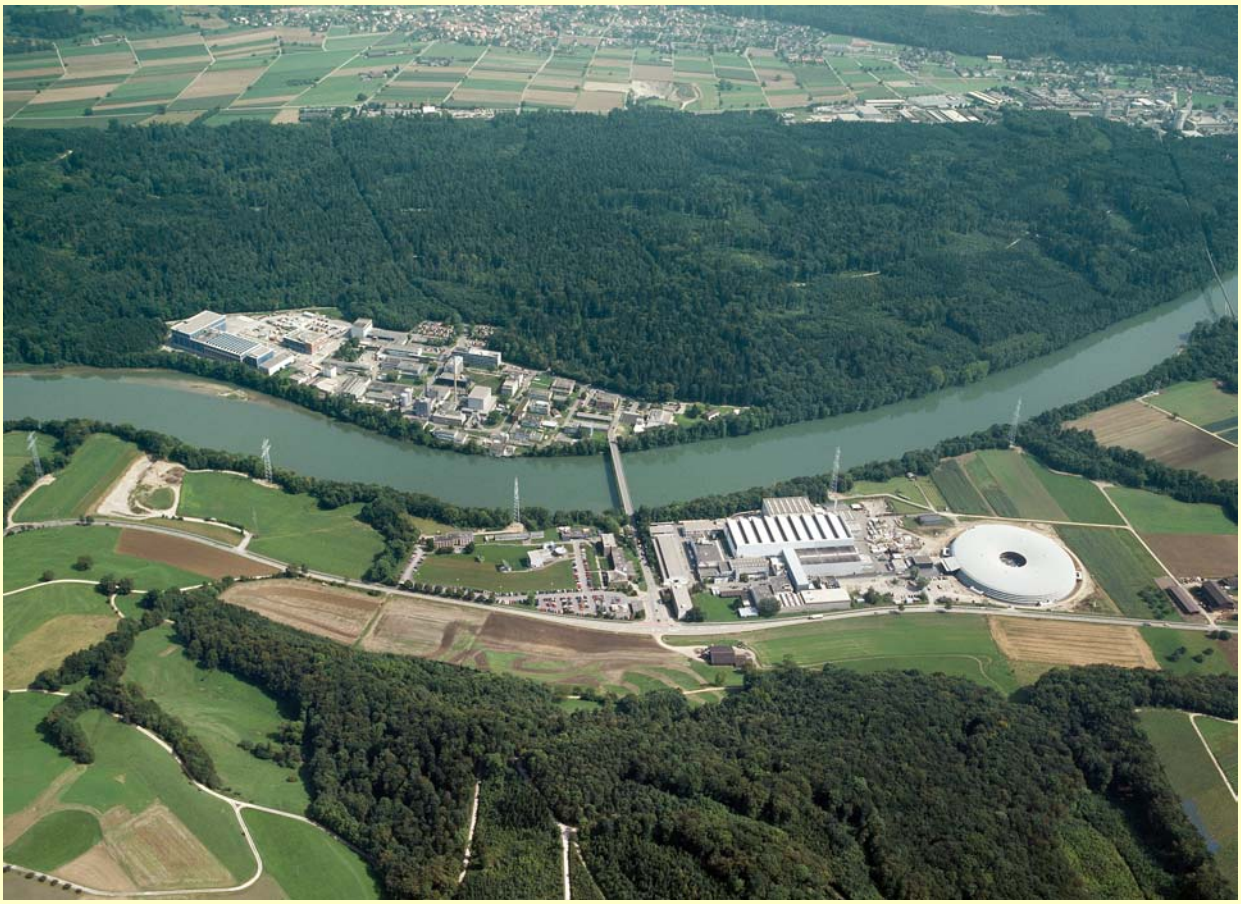
Abstract

The proton accelerator facility at PSI in Switzerland was designed in the late sixties and went into operation at a current of about 10 μA in 1974. The design was to feed two target stations (with thin and thick targets respectively) with a 100 μA beam of 590 MeV protons for meson production; this was achieved by 1980.

After several years of stable operation, an upgrade of the accelerator to give a beam intensity of up to 2 mA was started. This requires a different handling concept because of the increased activation of components, as well as increases of the biological shielding.

The presentation gives an overview of the evolution of remote handling and shielding concepts arising from the higher beam intensity, from the beginning up to the present, gives examples from actual experience and also proposes guidelines concerning radioactive waste.

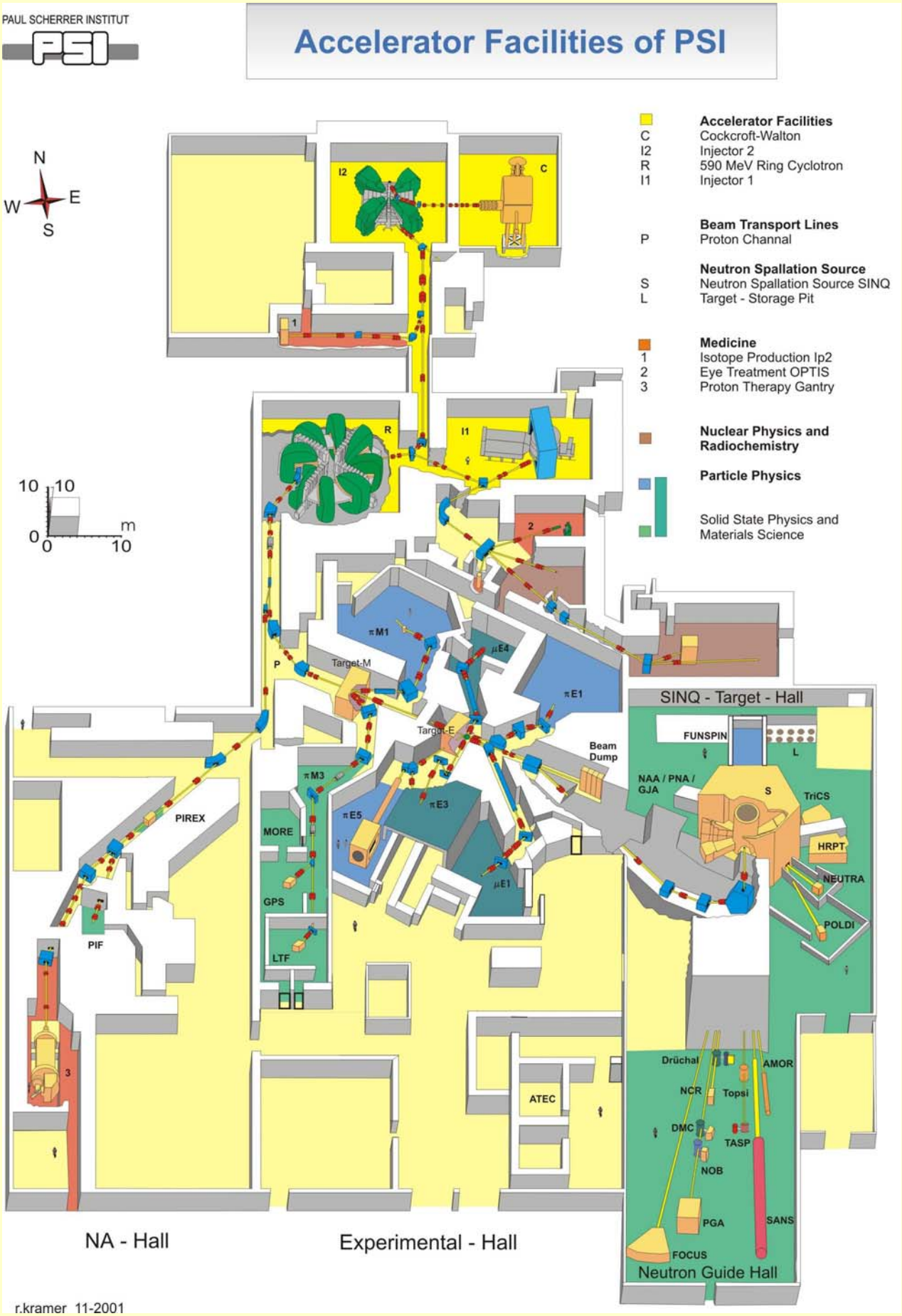
Paul Scherrer Institut



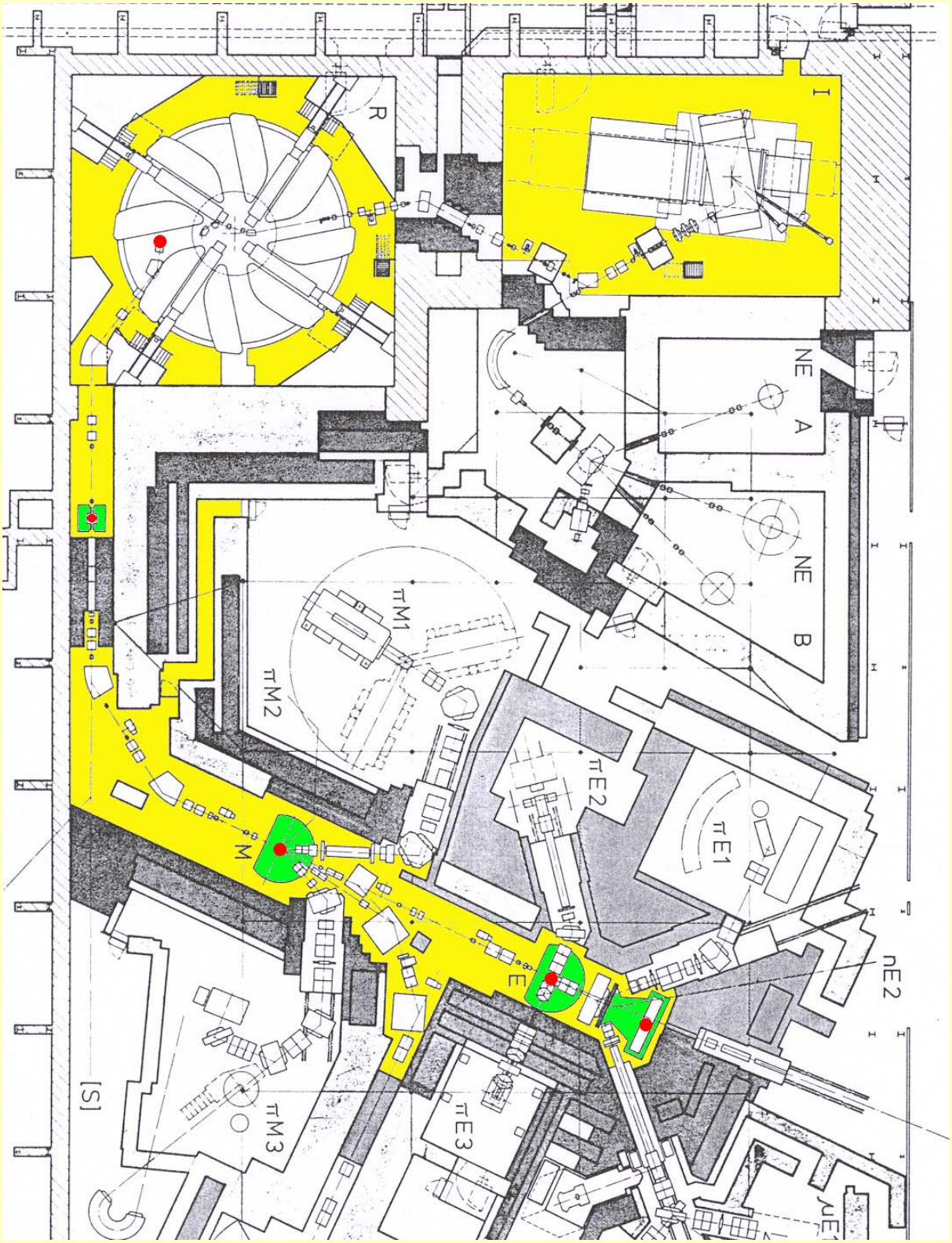
PSI is covering the following areas:

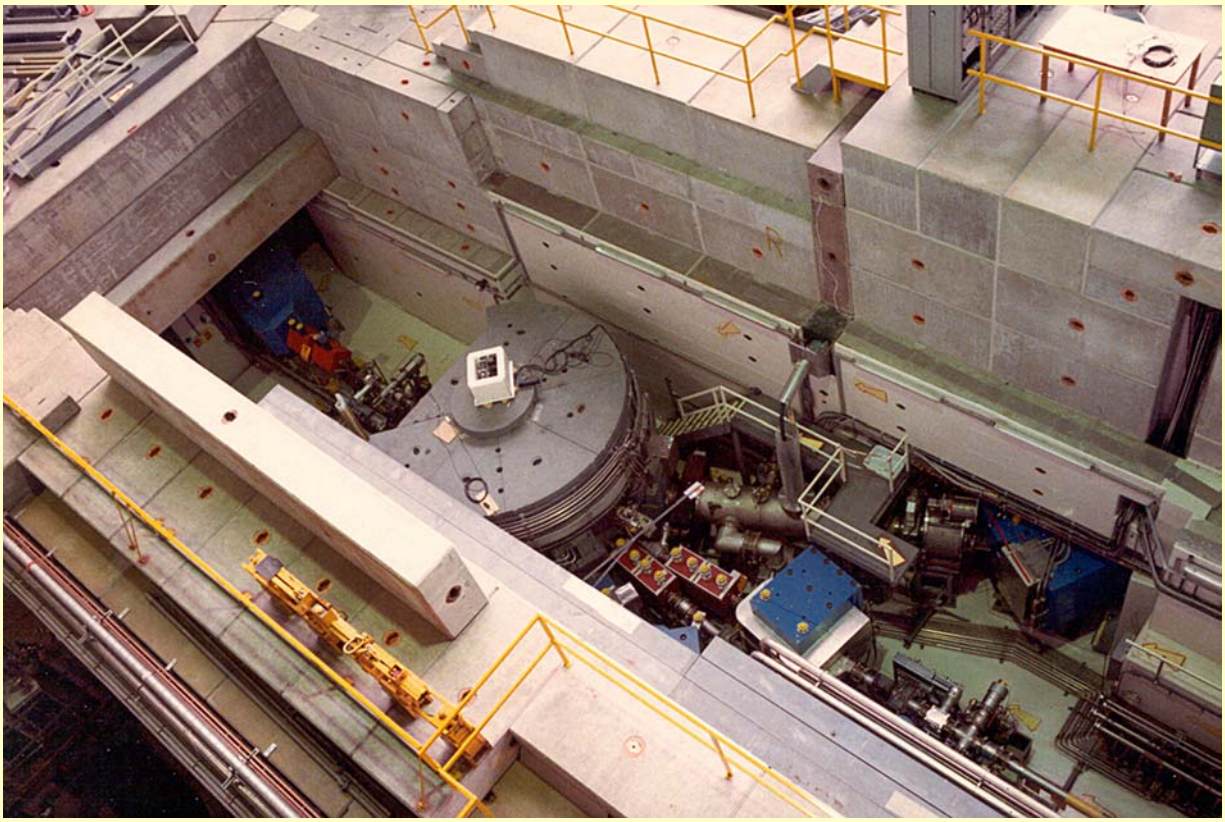
- Solid-state research and material science
- Elementary particle physics
- Energy and environmental research
- Biology and medicine

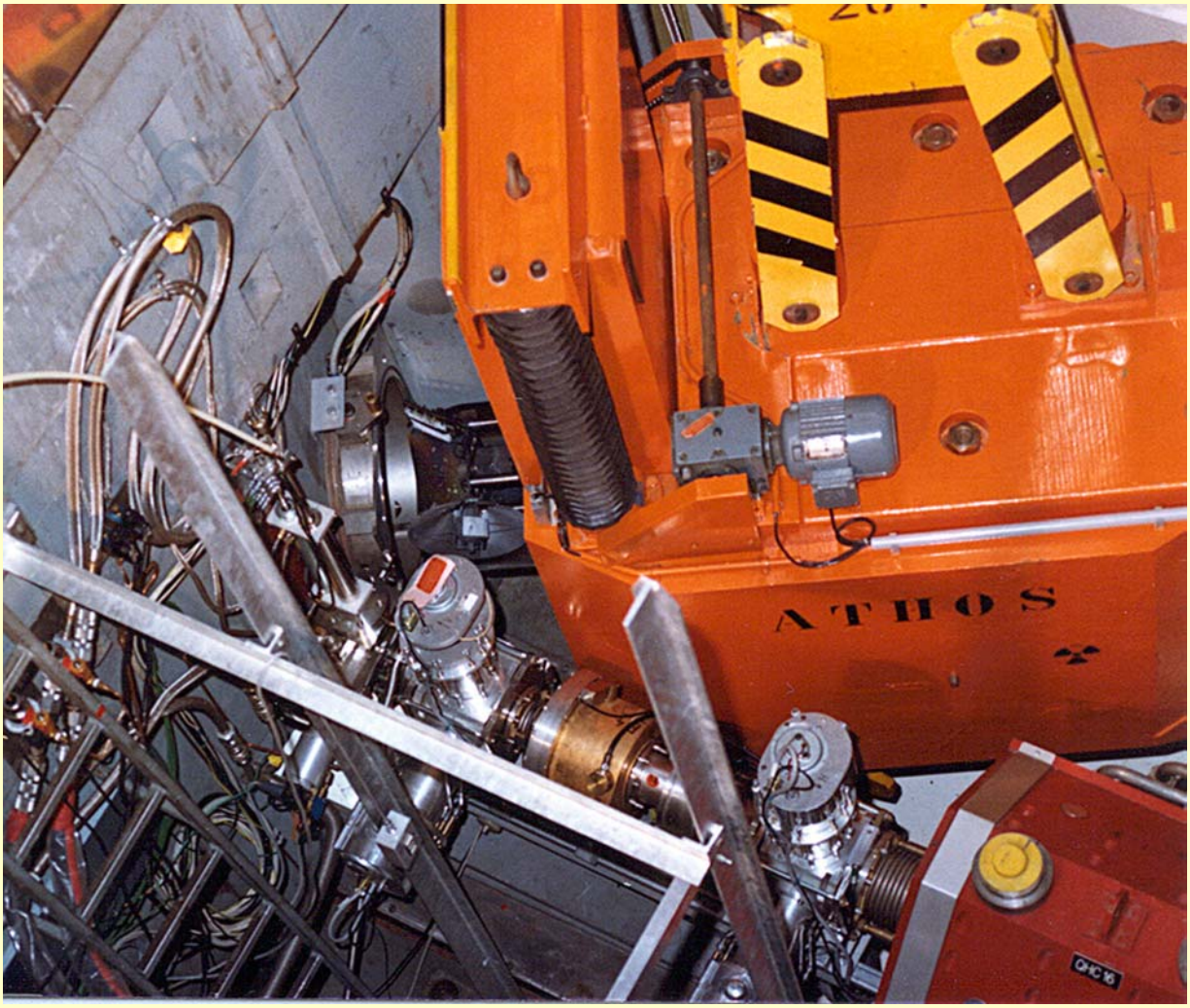
Employee: ~1300 + ~700 guests on experiments


PAUL SCHERRER INSTITUT
Accelerator Facilities of PSI
N
W
E
S
10 10
0 0 m 10
Accelerator Facilities
C Cockcroft-Walton
I2 Injector 2
R 590 MeV Ring Cyclotron
I1 Injector 1
Beam Transport Lines
P Proton Channal
Neutron Spallation Source
S Neutron Spallation Source SINQ
L Target - Storage Pit
Medicine
1 Isotope Production Ip2
2 Eye Treatment OPTIS
3 Proton Therapy Gantry
Nuclear Physics and Radiochemistry
Particle Physics
Solid State Physics and Materials Science
I2
C
1
R
I1
2
πM1
μE4
P
Target-M
πE1
Target-E
Beam Dump
SINQ - Target - Hall
FUNSPIN
L
NAA / PNA / GJA
S
TriCS
HRPT
NEUTRA
POLDI
πM3
πE5
πE3
μE1
PIREX
MORE
GPS
PIF
LTF
3
ATEC
Drüchal
AMOR
NCR
Topsi
DMC
TASP
NOB
PGA
SANS
FOCUS
Neutron Guide Hall
NA - Hall
Experimental - Hall
r.kramer 11-2001

Layout before upgrade
1985

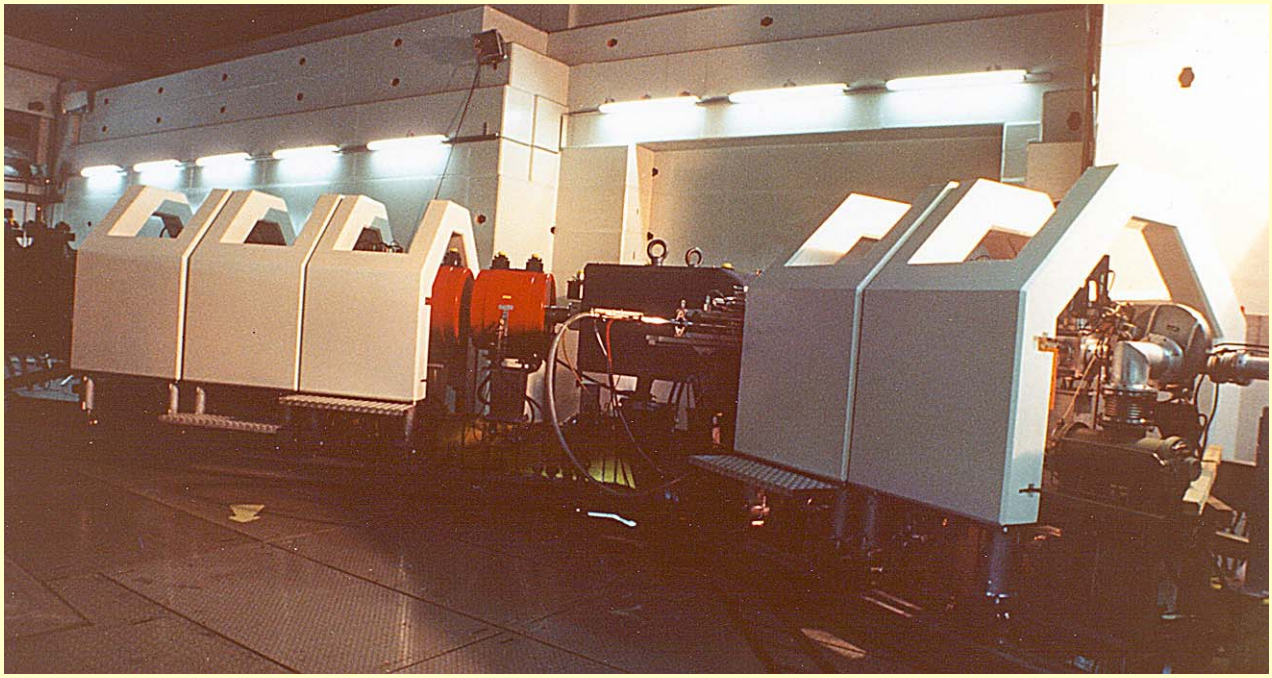


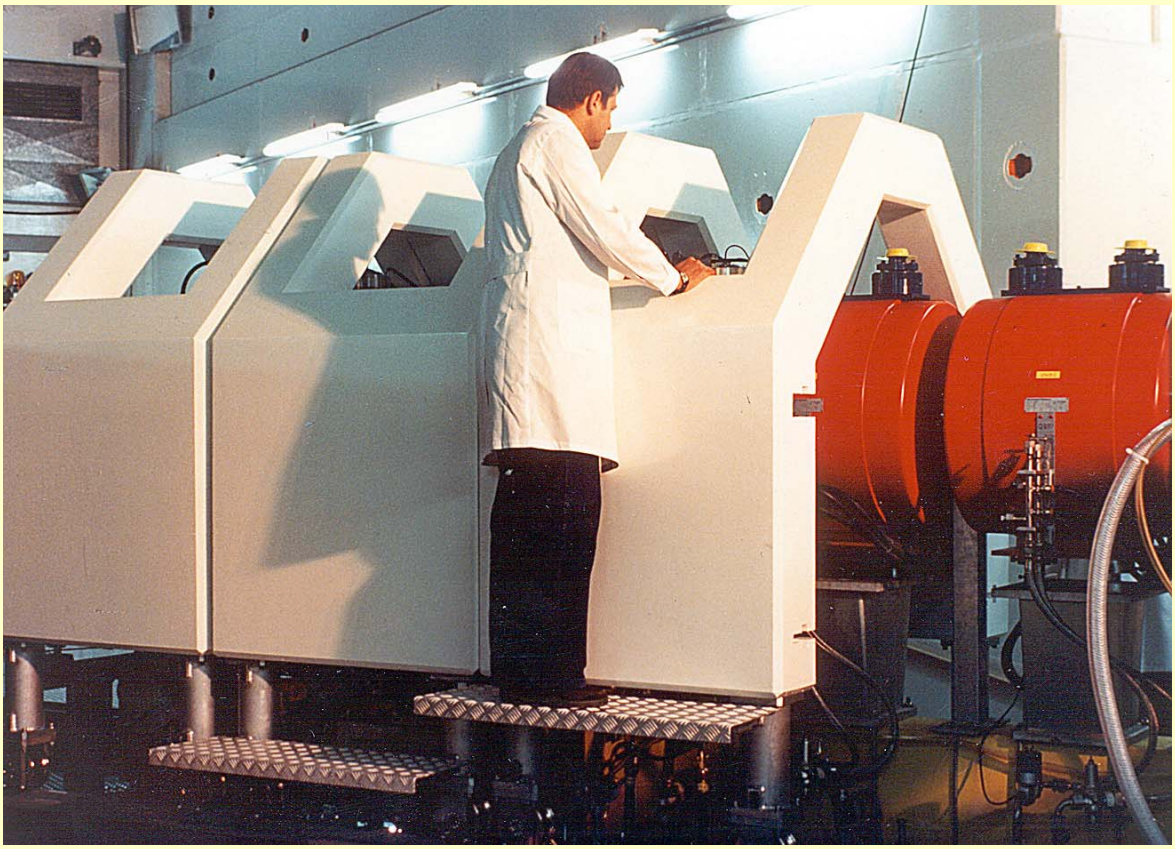


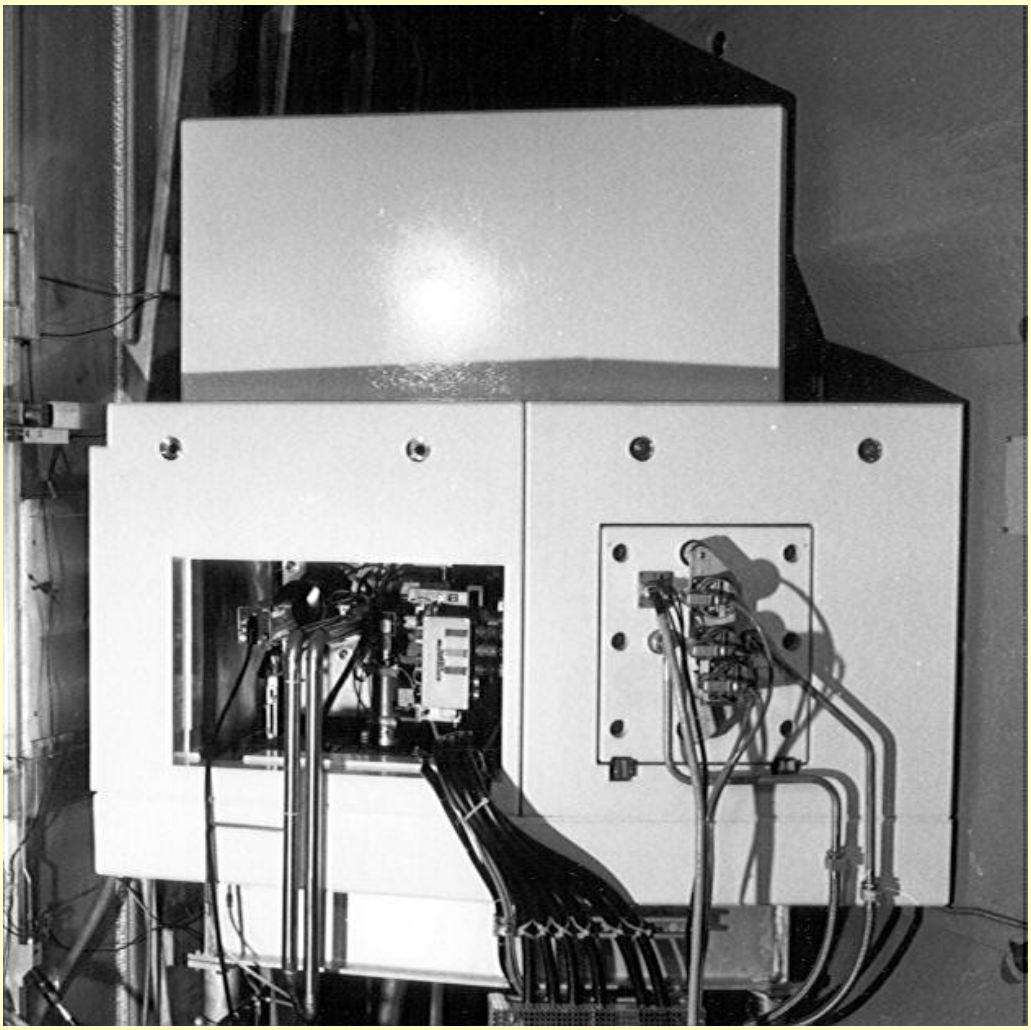

ATHOS

Additional local shieldings

Local shielding & handling concept for proton activated components by use of materials with low activation like **MARBEL & PURE LEAD**.







Dismanteling of Target-E and Beamdump area

- Total mass: ≈ 500 tons
- Total activity: ≈ 1.5E15 Bq
- Dose rate up to: ≈ 4 Sv/h at 1m
- Duration: ≈ 6 months
- Collective Dose: ≈ 500 mSv

Main Problems:

Contamination

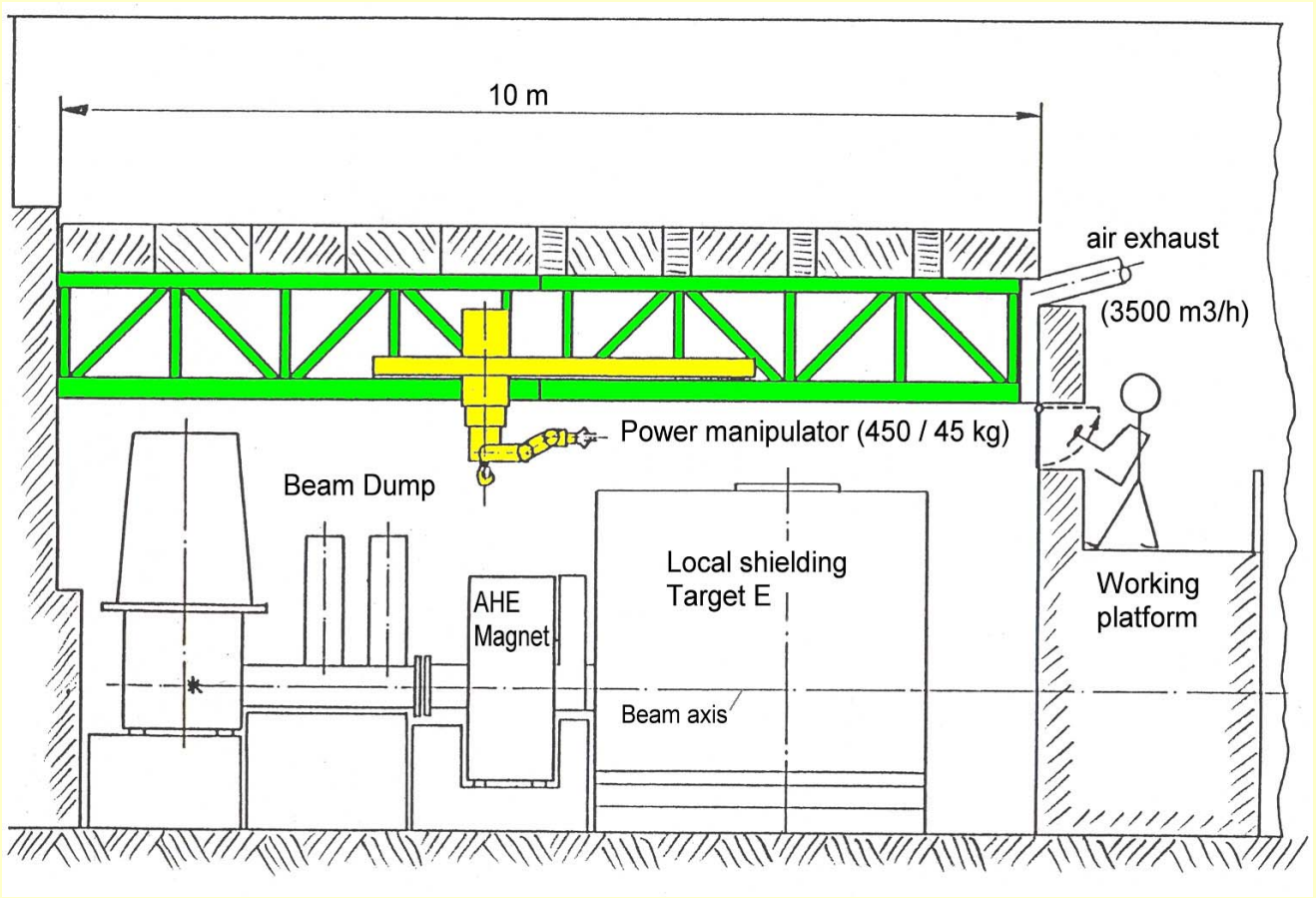
Documentation

Crane-hooks

Conditioning of waste

Dismanteling concept

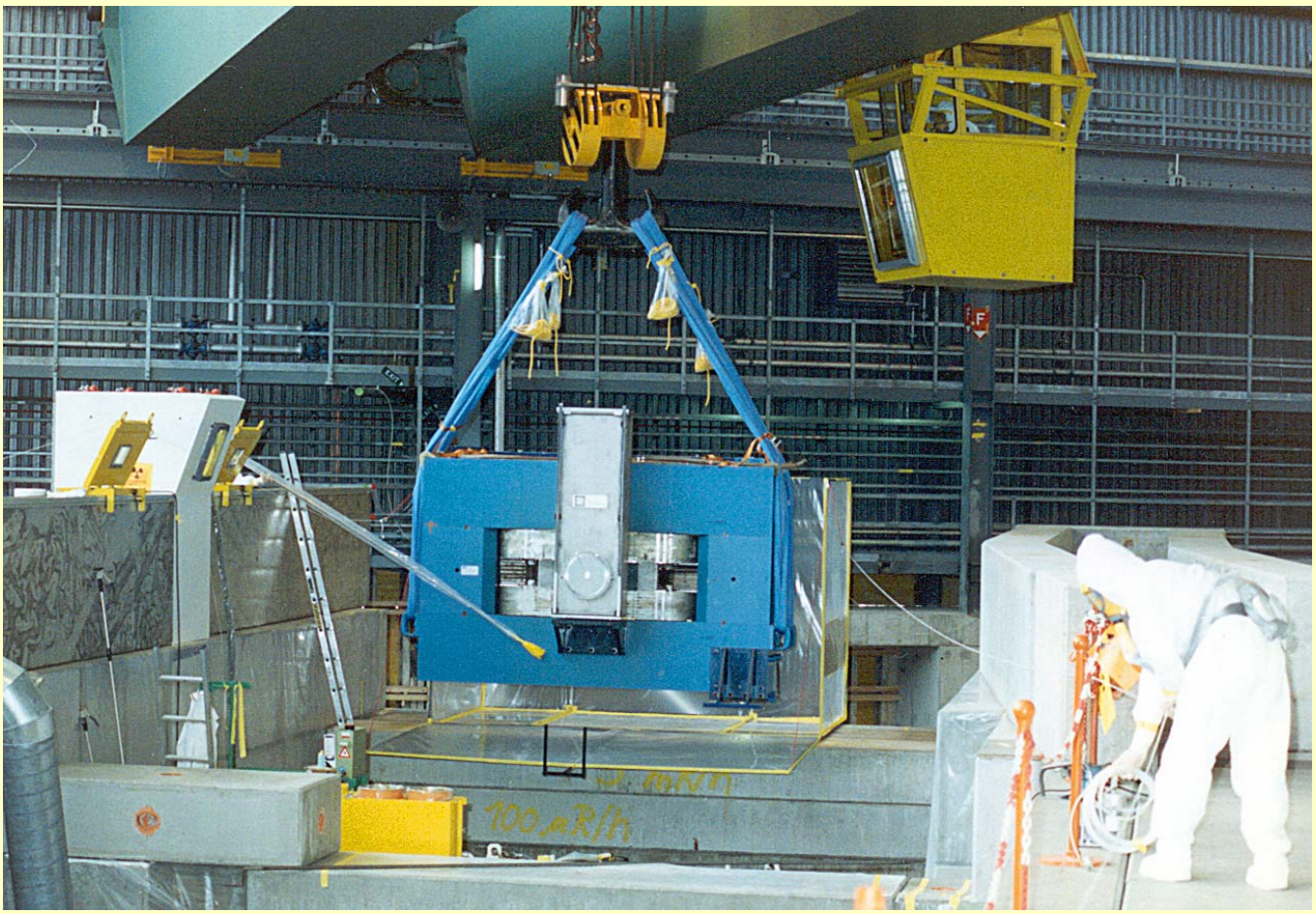
Installation of an improvised bunker with ventilation system and power manipulator



Installation of Power-Manipulator unit

Power manipulator in action

Crane transportation with contamination-protection



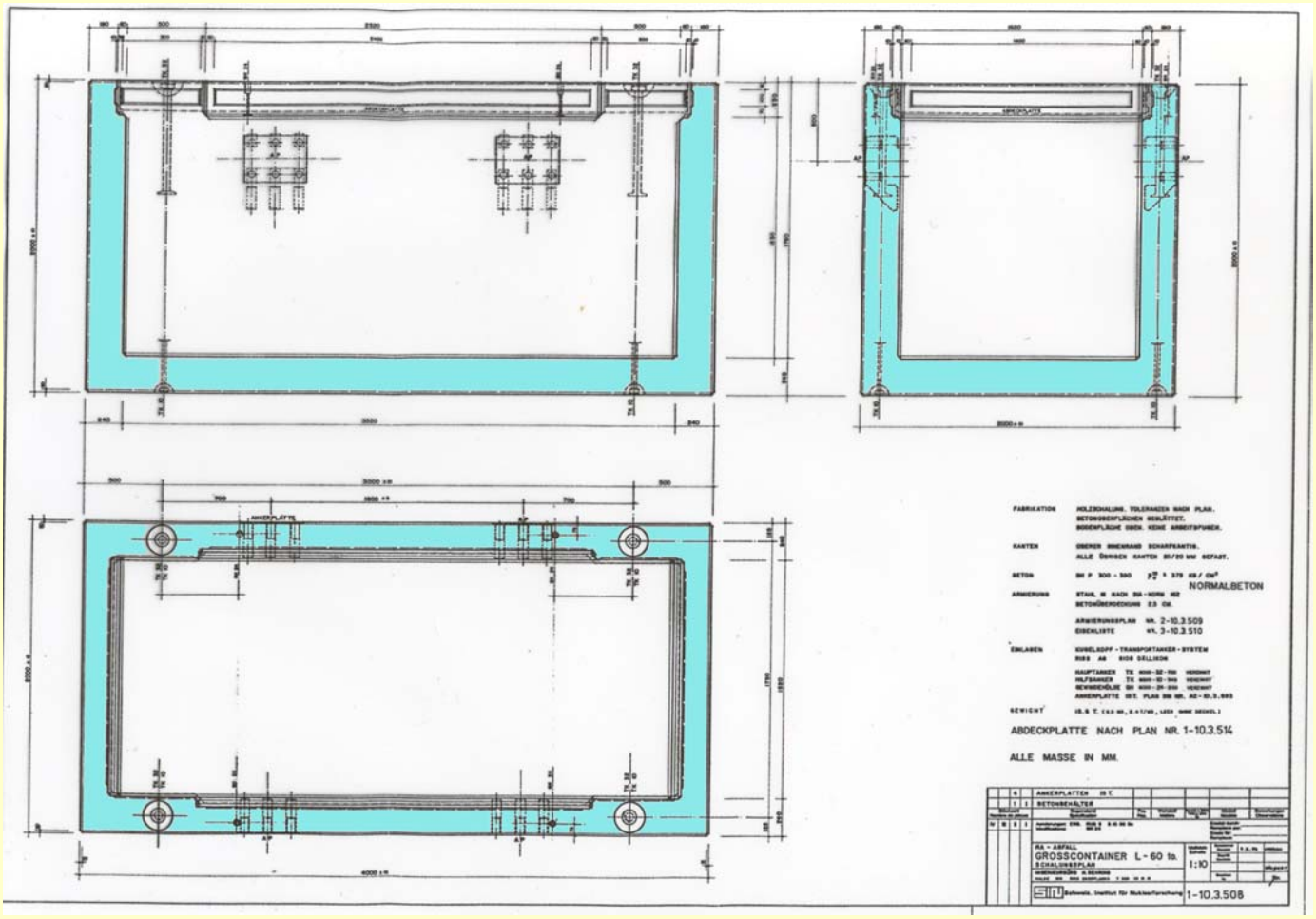
Conditioning in concrete container for final disposal

Container outside dimensions: 2 x 4 x 2 m

Total weight max.: 60 tons

Accepted by „NAGRA“ (Swiss authority for final disposal)

Concrete Container for RA-Waste



Dimensions: 4 x 2 x 2 m

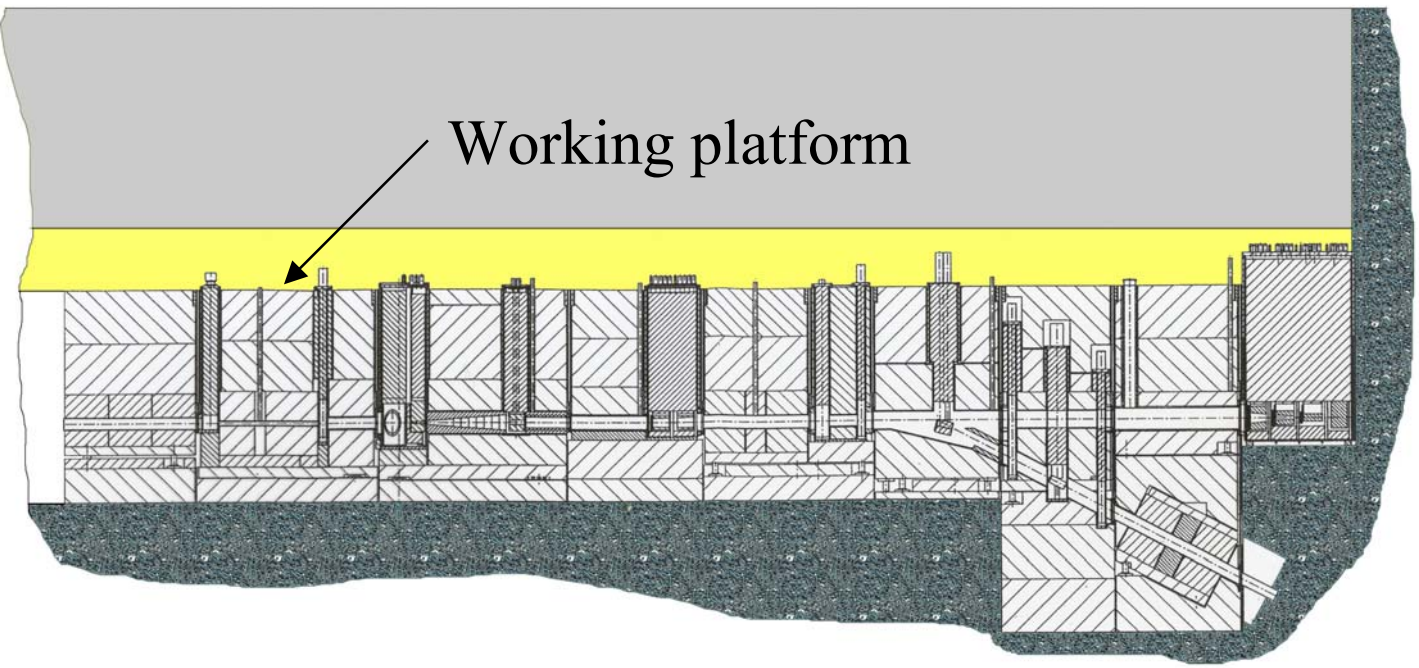
Total weight: 60 tons

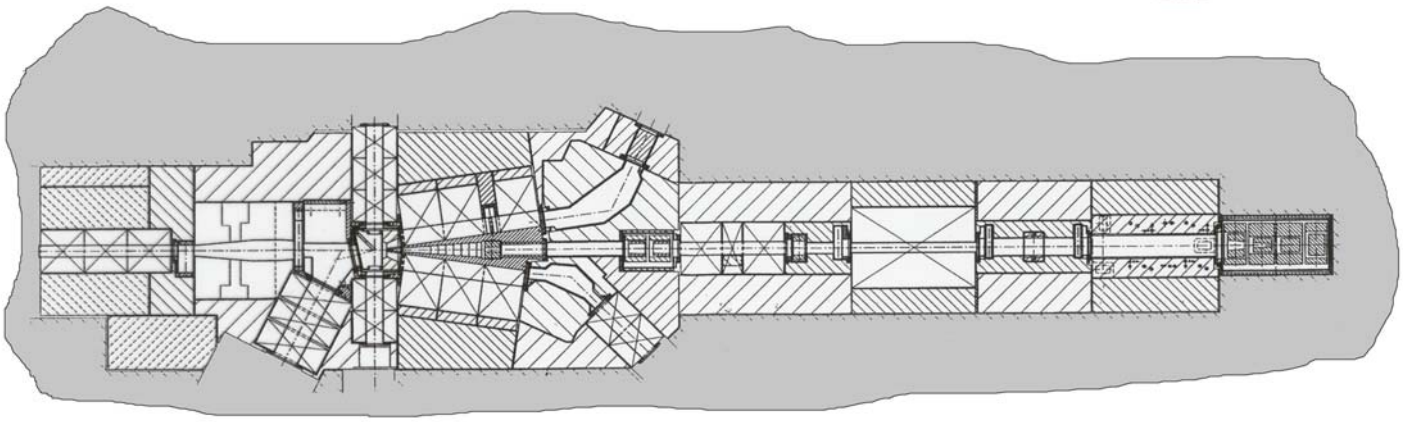
Facts we have learned:

- Surface-protection for water leaks and NO_x attack. Proper ventilation is important
- Remotely controlled crane attachment
- Path for disposal of radioactive waste should be clear before design

Layout for 2 mA

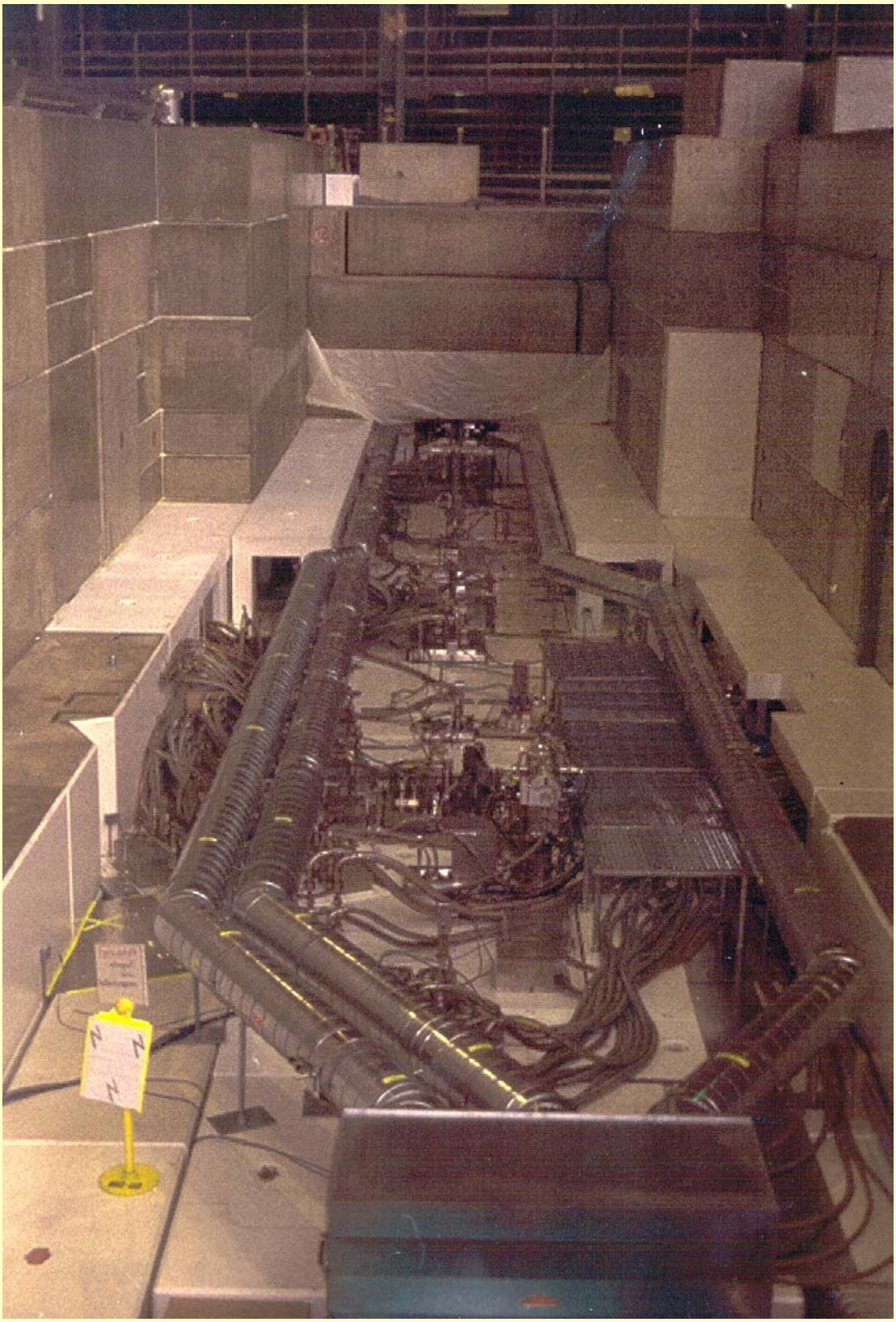
Vertical cut of the proton-channel



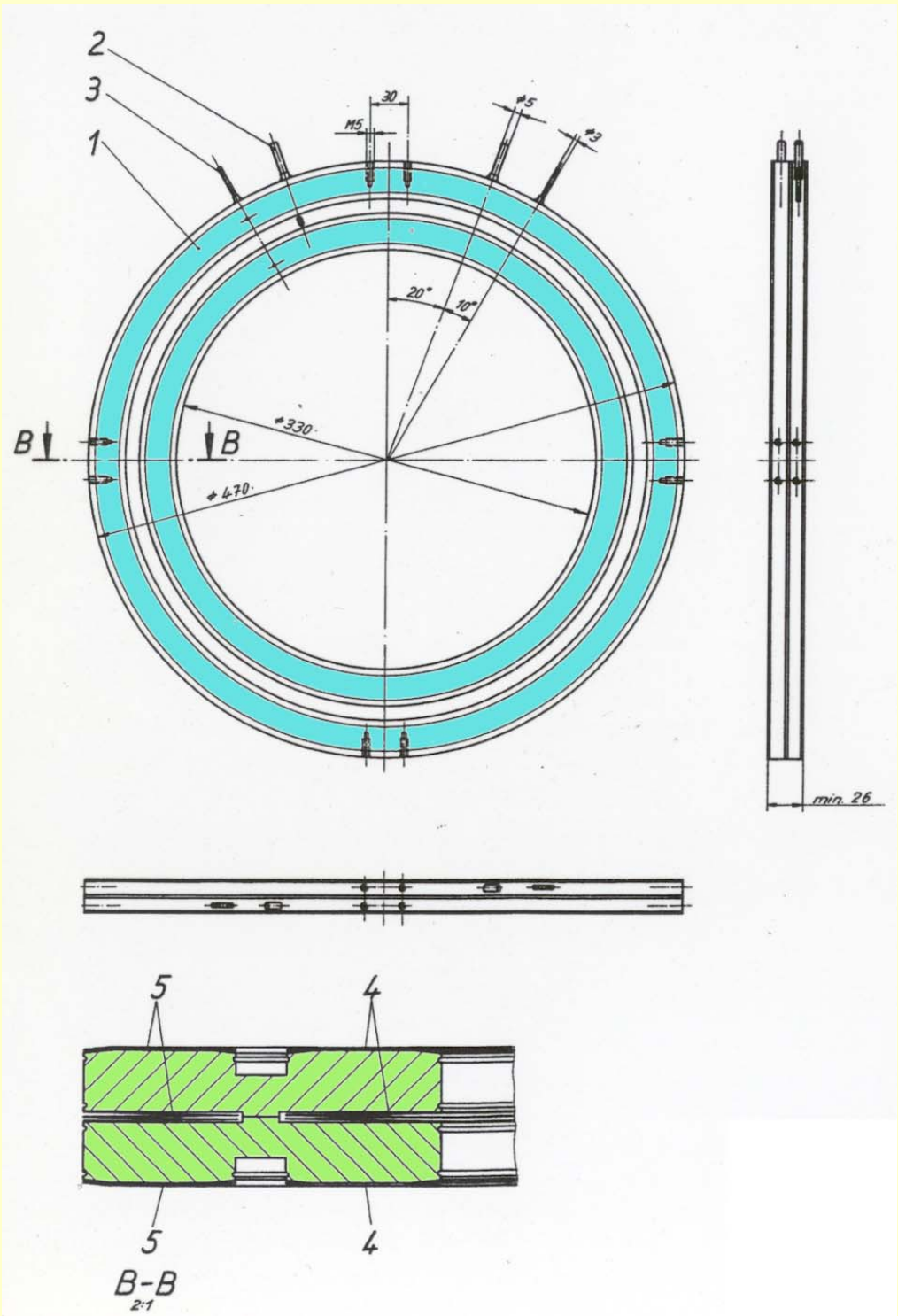


Horizontal cut of the proton-channel

Working platform on top of the local shielding



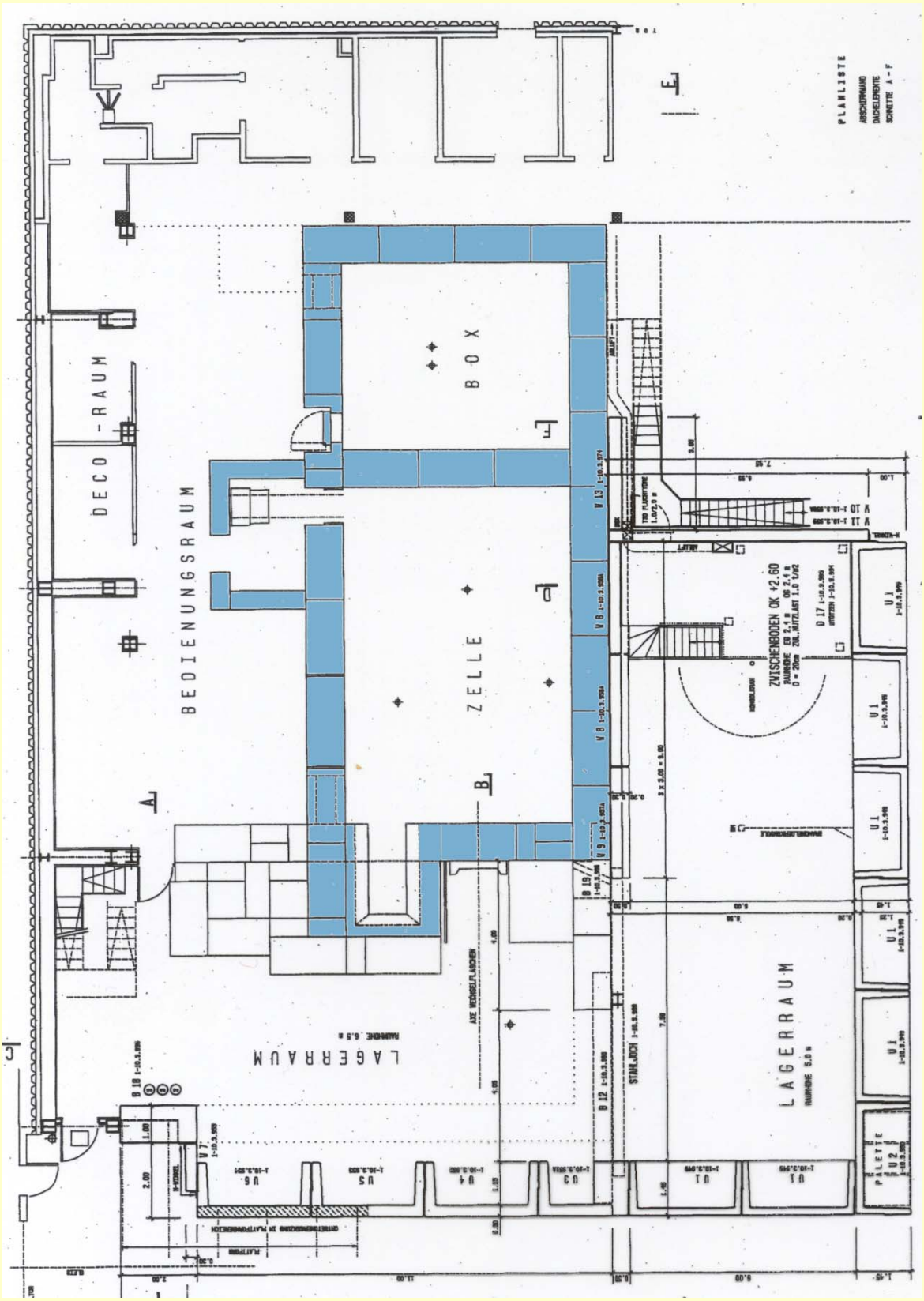
Inflatable sealing (radiation resistent)



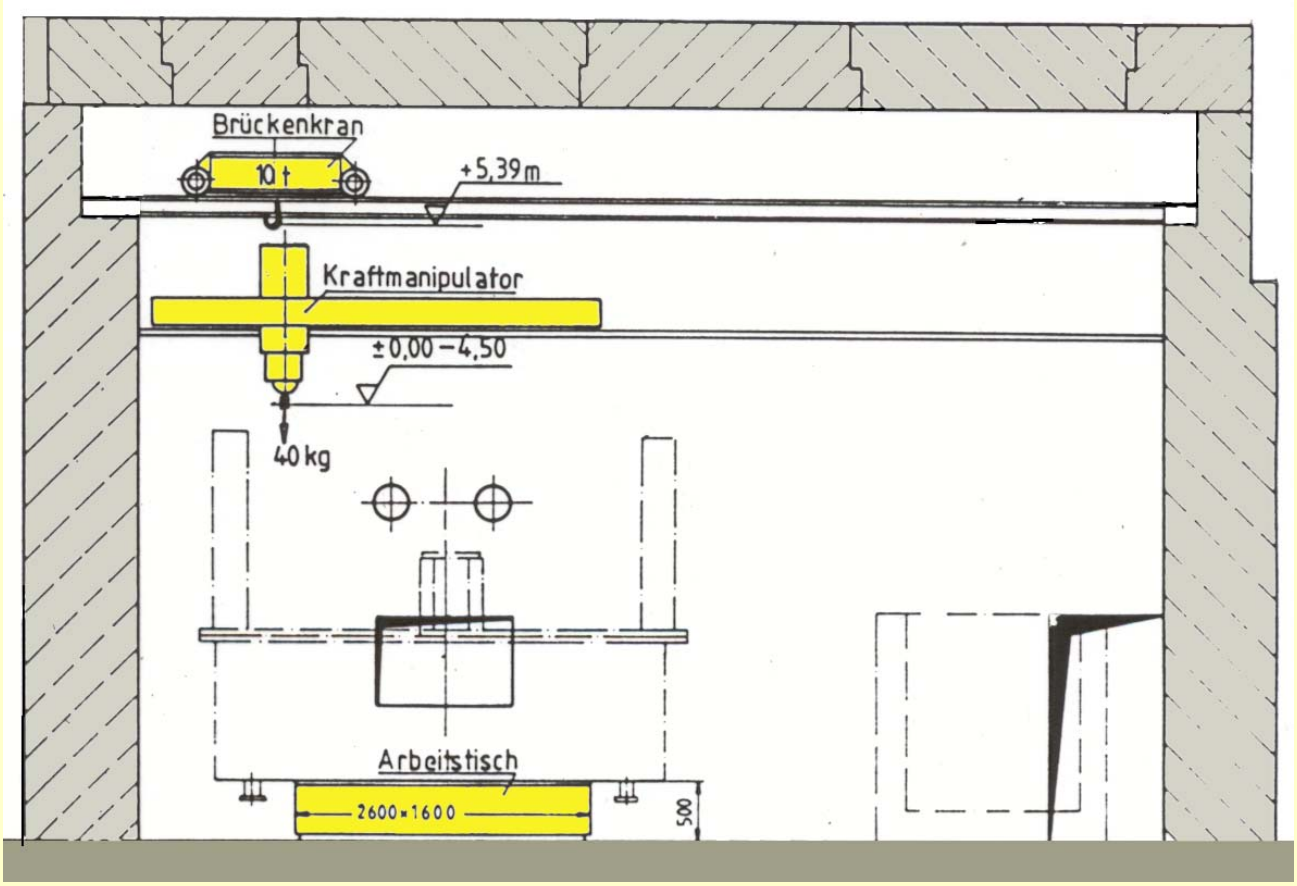
Key – points for higher beam intensity (~20x)

- No direct access to the beam line
- High density shielding around the beam line
- Adjusted design for electrical-, cooling water- and diagnostic connections (by hand)
- Remotely controlled crane hook devices
- Self-positioning system for all of the „PUZZLE“- components
- Hot cell area designed for existing dimensions and loads
- Surface protection and ventilation
- Shielded changing flask

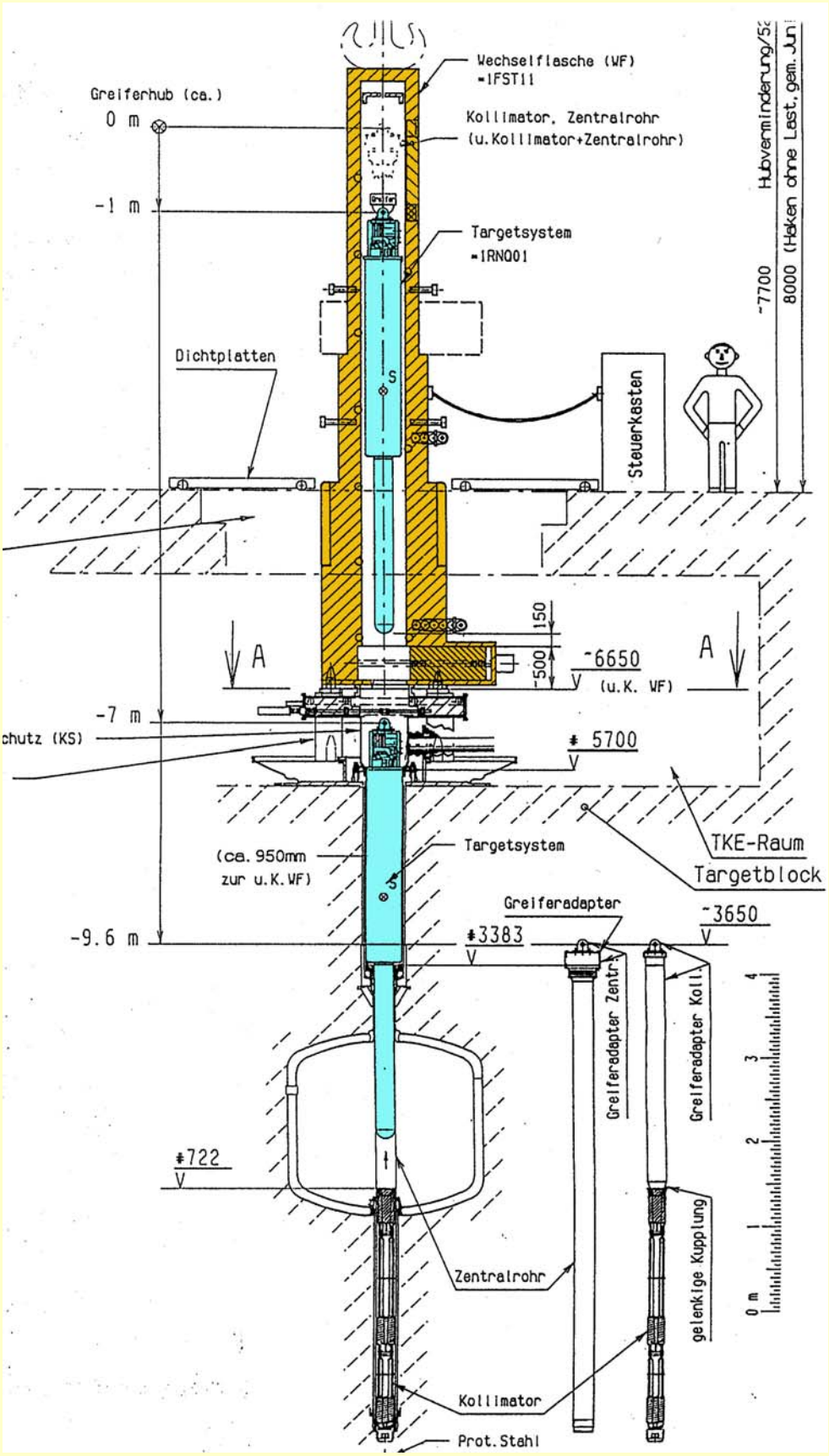
Hot-Cell Facility



Hot Cell
Cross-section



Changing flask for SINQ



Shielded flask for SINQ-Target