J-PARC Muon Science Facility

Y. Miyake

- *International Workshop on* **"Future of Muon Science"**
  (Tsukuba, Japan, 2002, March)
- *International Conference on* **"Muon Spin Rotation, Relaxation and Resonance"**
  (Virginia, USA, 2002, June)
- *Workshop on* **"Muon Science Explored by JPARC "**
  (JAERI, Japan, 2003, February)

- **"The 1st MuSAC" (Chaired by Dr. J. M. Poutissou)**
  (Muon Science Experimental Facility Advisory Committee Meeting)
  (Tsukuba, Japan, 2003, February)

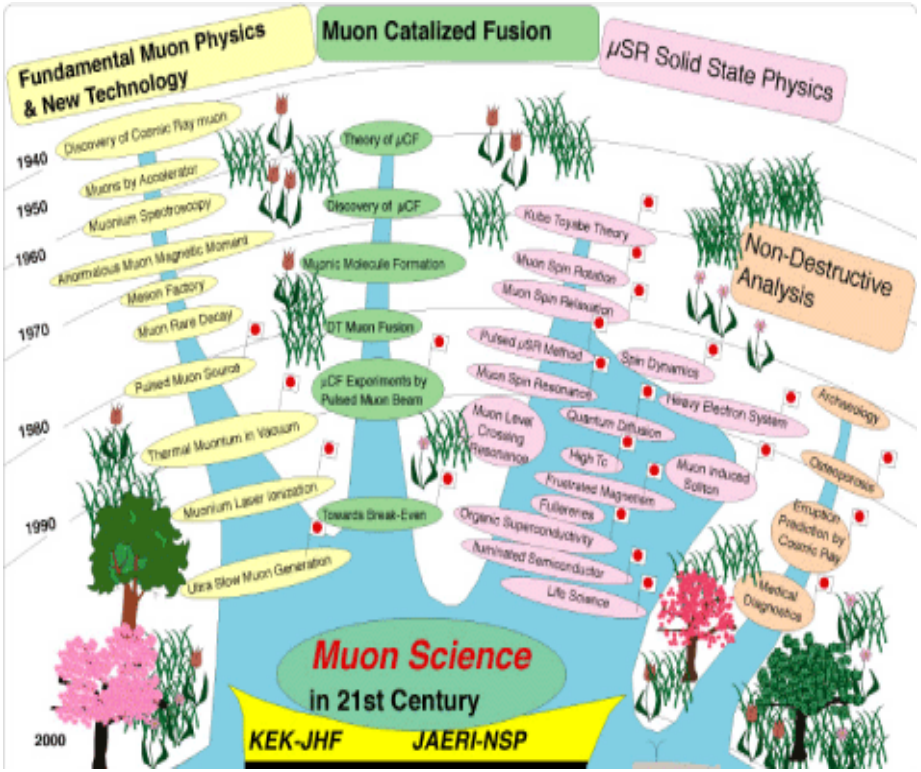
- **Technical Issues of the one year progress**
  - **Design of MLF Building related with the Muon Facility considering maintenance**
  - **Graphite Muon Target & Scrapers**
    - **Static and Dynamic Properties; Stress & Temperature**
  - **Radiation / Ductstreaming for the shield optimization**
  - **Design of the Air Handling System for NO_X, *Ar-41*** etc Production

KEK Proceedings 2002-2
May 2002
M

INTERNATIONAL WORKSHOP ON FUTURE OF MUON SCIENCE

MARCH 7-9, 2002 at KEK & RIKEN

hosted by
KEK (High Energy Accelerator Research Organization)
And
RIKEN (Institute of Physical and Chemical Research)



International Conference on Muon Spin Rotation, Relaxation and Resonance

Date: June 3-7, 2002
Venue: University Center of the College of William and Mary, in Williamsburg, VA, USA

Workshop on the Muon Science Explored by JAERI-KEK Joint Project (JPARC)

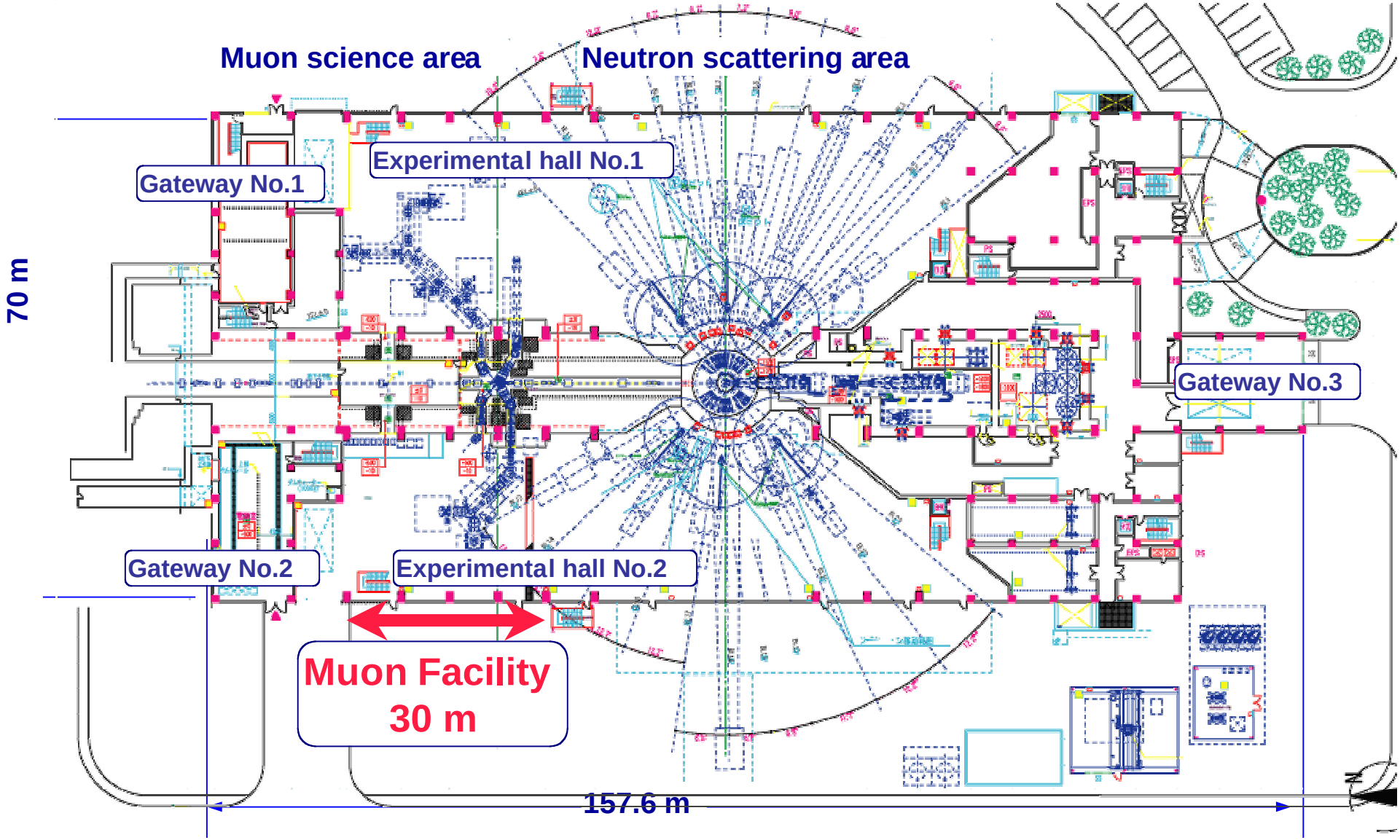
*Condensed Matter Research Using **μSR** as Complementary Technique to **Neutron and NMR***

Date: February 5 -6, 2003
Venue: Advanced Science Research Center,
Japan Atomic Energy Research Institute,

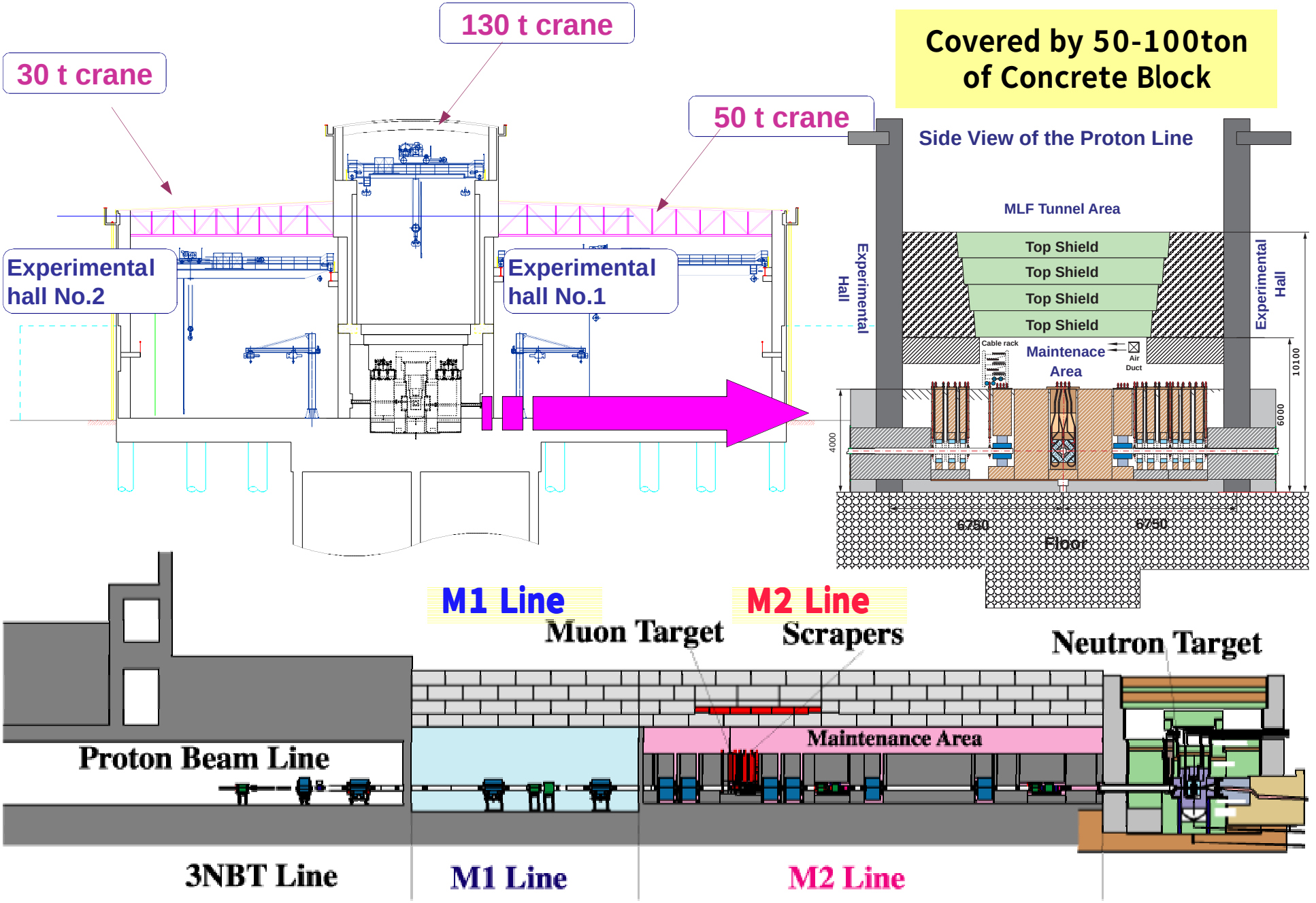
Material and Life Science Experimental Facility

- First floor -

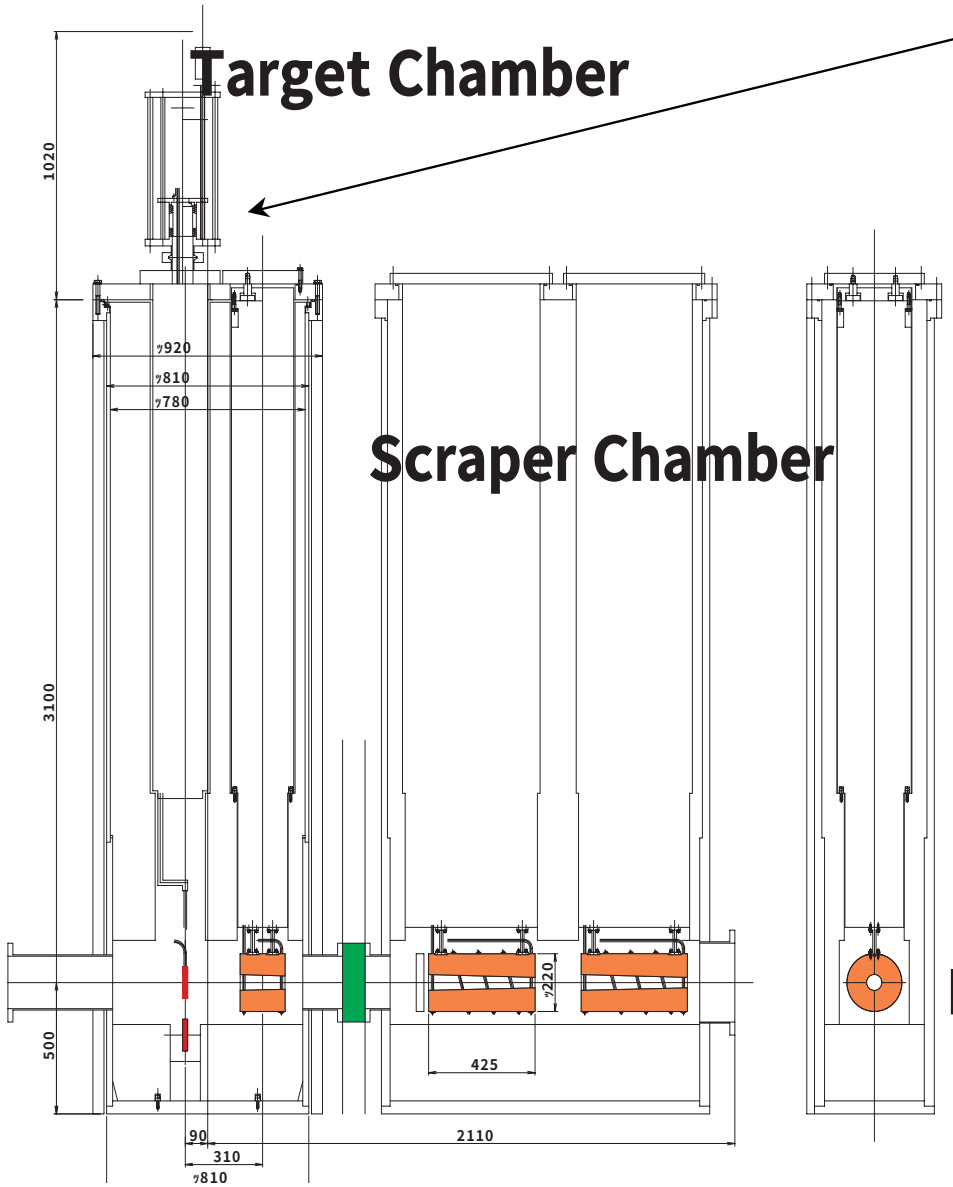
strong focusing on muon target --> ϕ 24mmrectangular profile on neutron source W130mm/H50mm

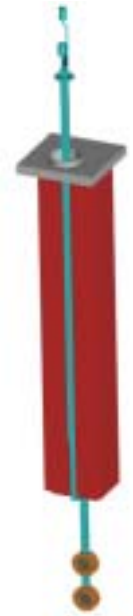


MLF Tunnel Structure I (Crossed View)

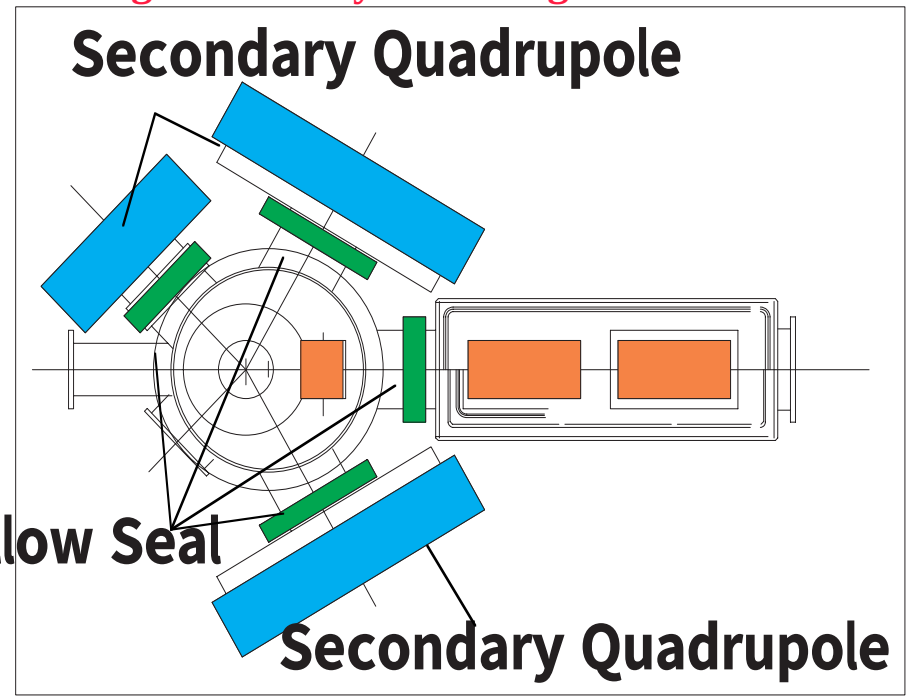


Target chamber

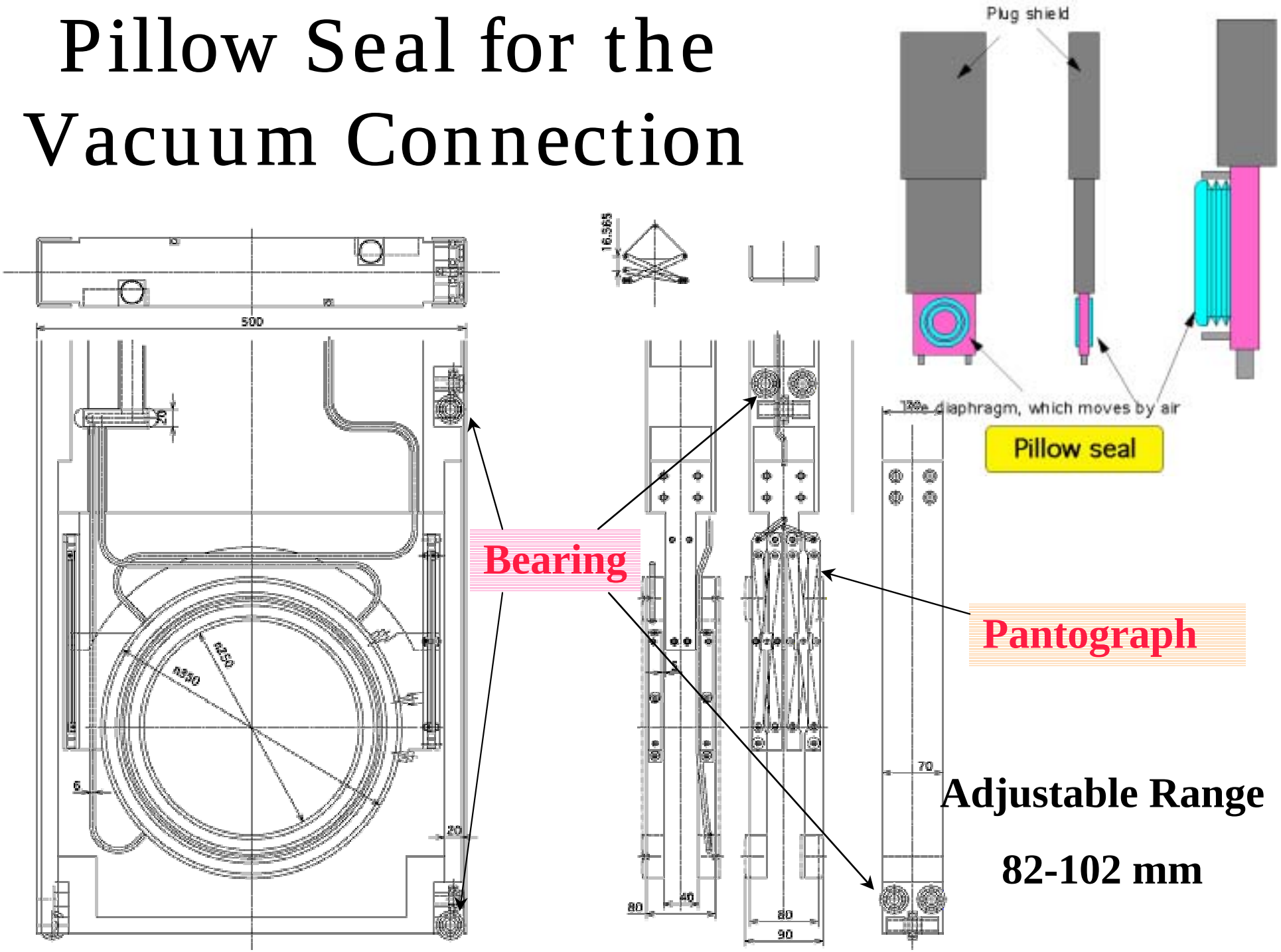




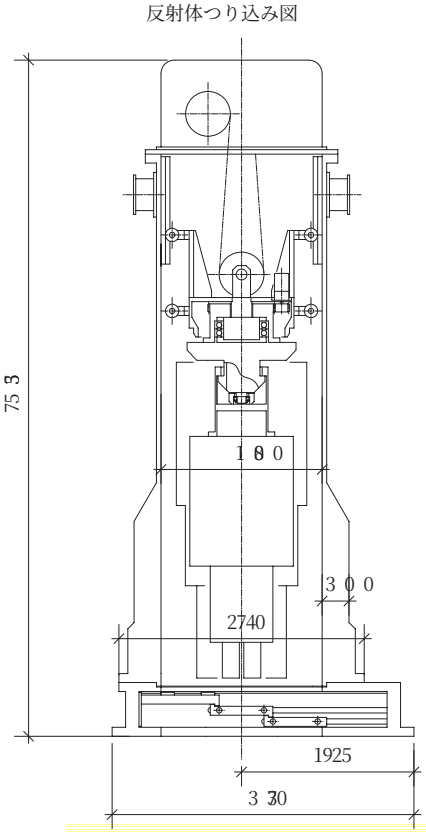
Target Assembly Target Chamber

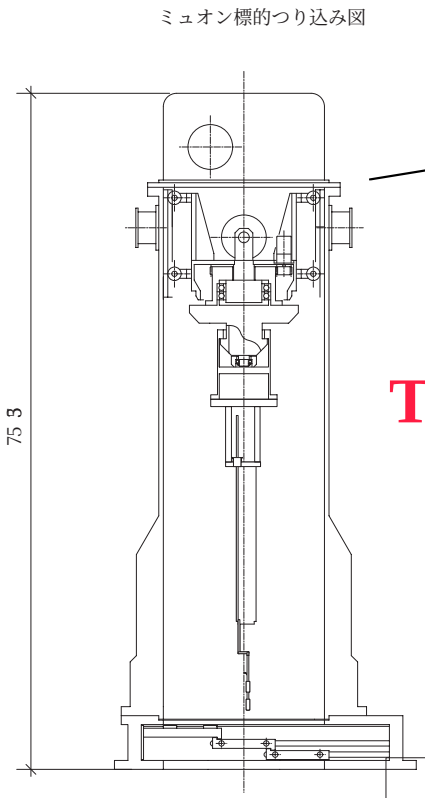


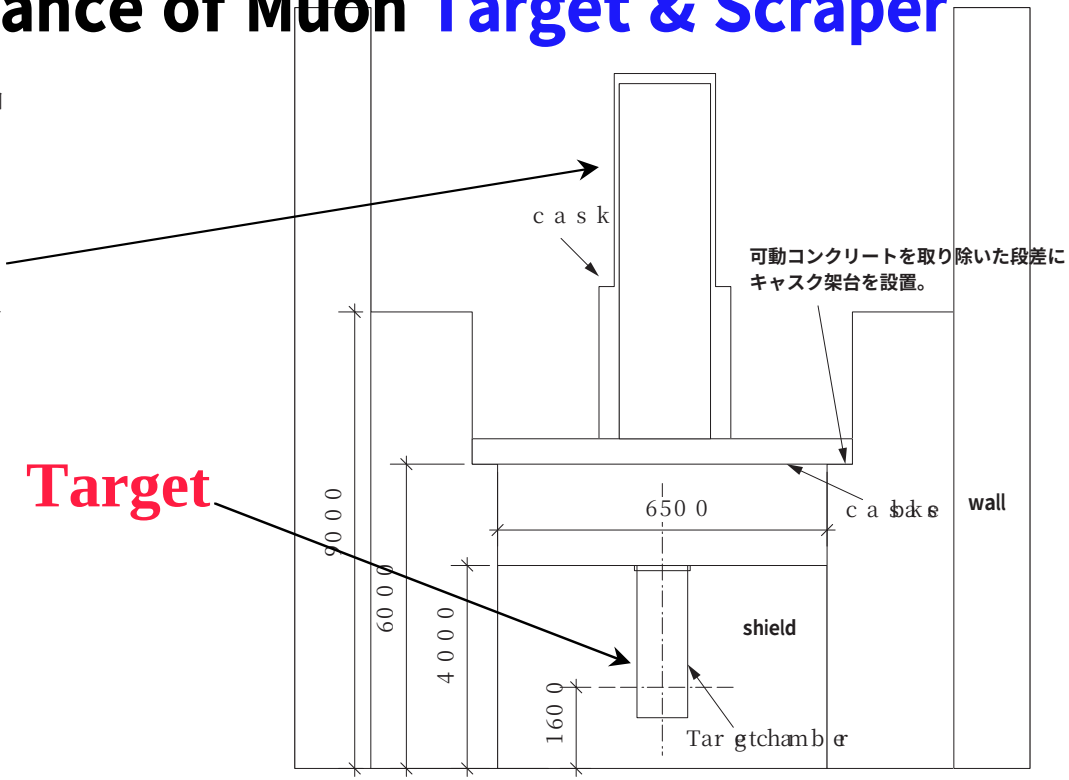
Pillow Seal for the Vacuum Connection



CASK for the maintenance of Muon Target & Scraper

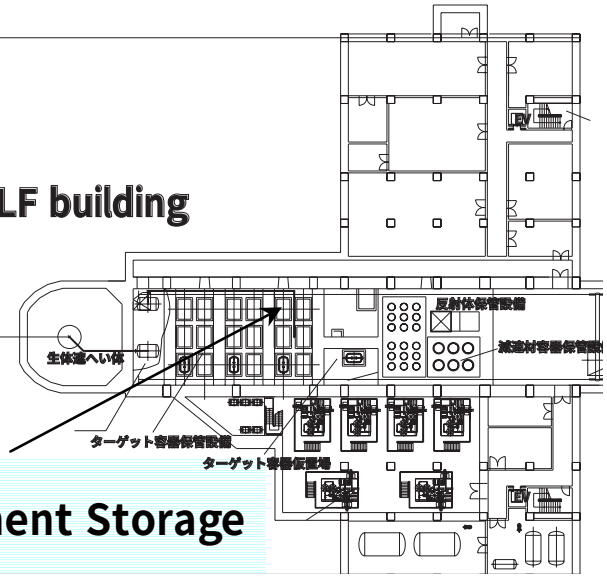






Dedicated for the maintenance of Moderator!
Prepared by Neutron Group

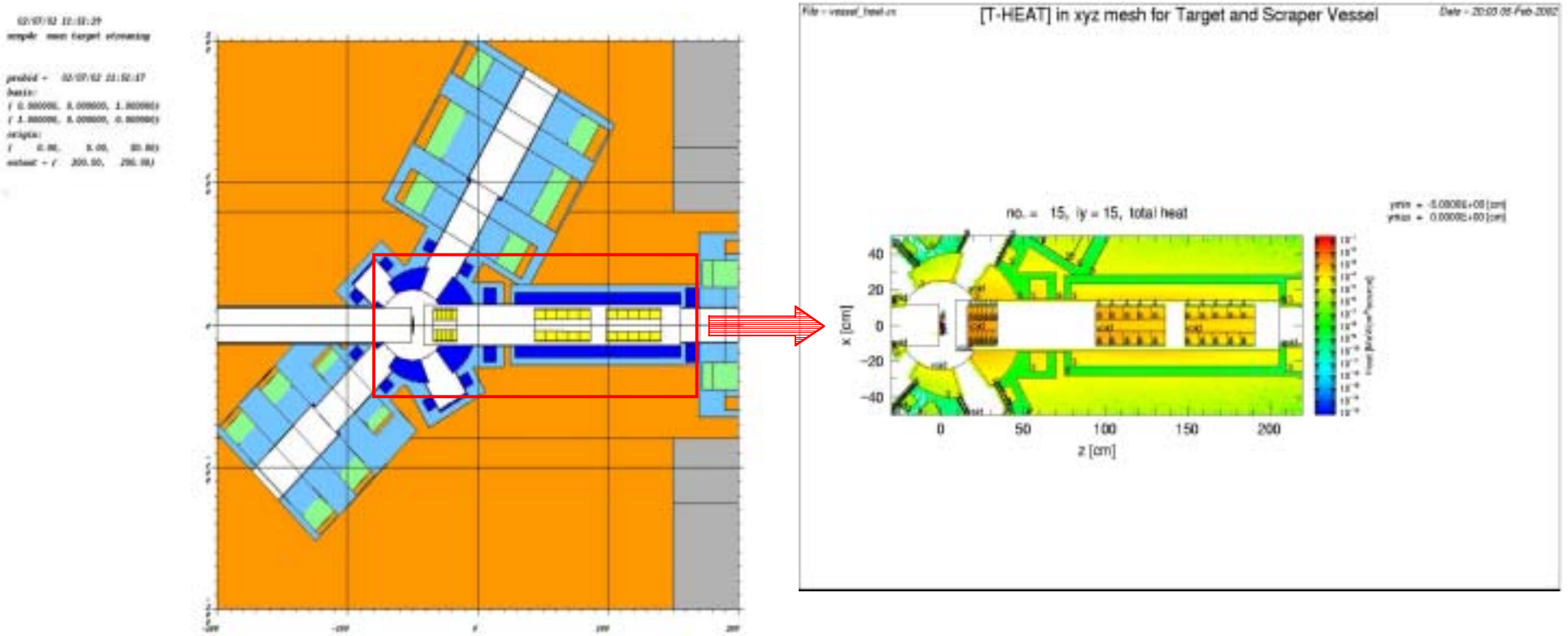
Weight 80 ton
Plug 20ton
Total 120ton



Used Target into Basement Storage

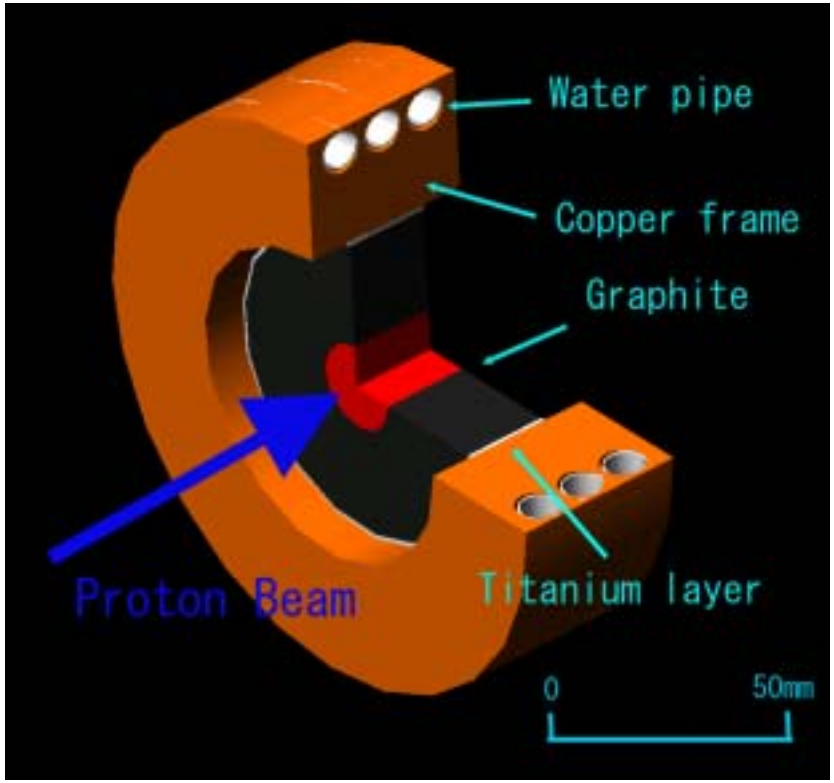
Heat, DPA, Radioactivity

- **Heat generation, DPA, Radioactivity production induced by proton beam and secondary particles are estimated by NMTC/JAM, MCNP and DCHAIN-SP.**

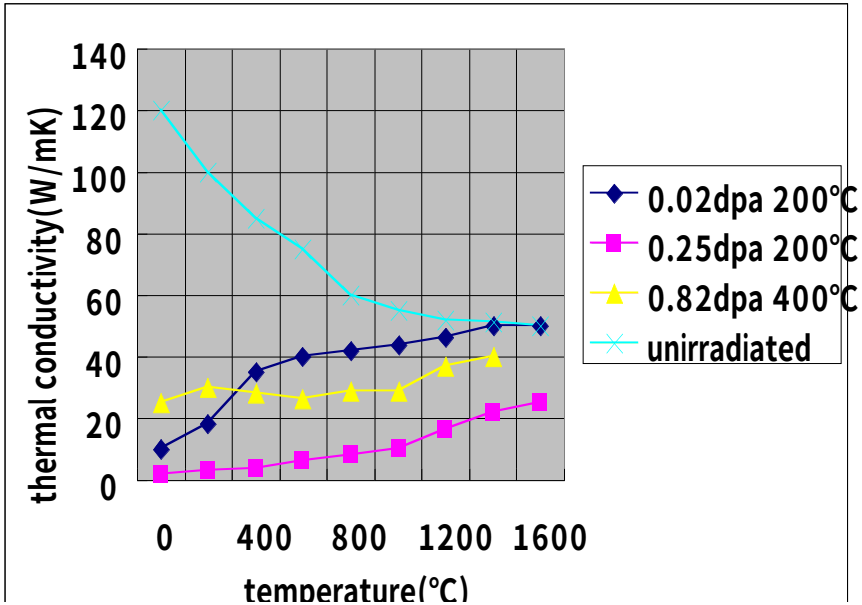


Muon Target

- 3.3kW Heat deposit
- Isotropic Graphite ; t=20mm
- Copper frame ; t=40mm
- Titanium layer
  ; stress absorber
- Thermal conductivity of graphite



Neutron irradiation effect



Static Property

- **Temperature**

  max. 1462 degC

- **Tensile stress 13MPa**

  strength 37MPa

  Share stress 0.3MPa

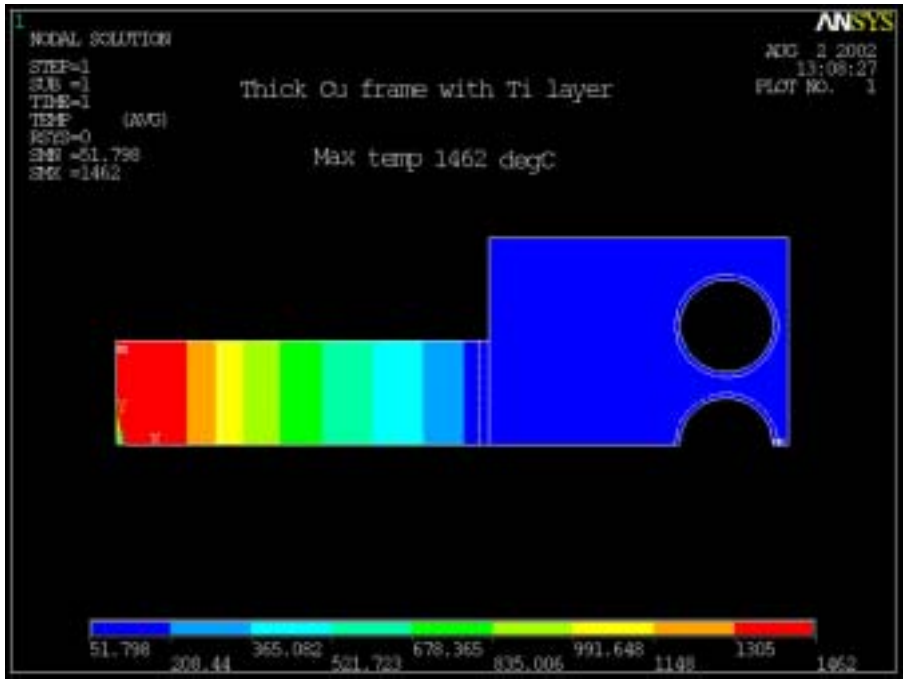
  strength 18MPa

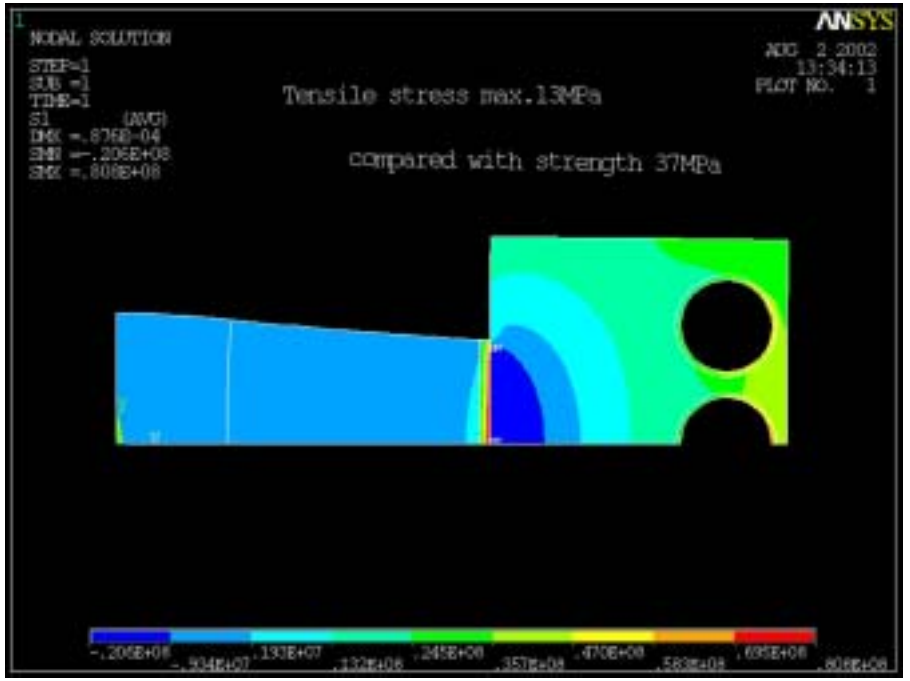
  Compressive stress 40MPa

  strength 90MPa

- **Concentration of stress**

  on Ti layer





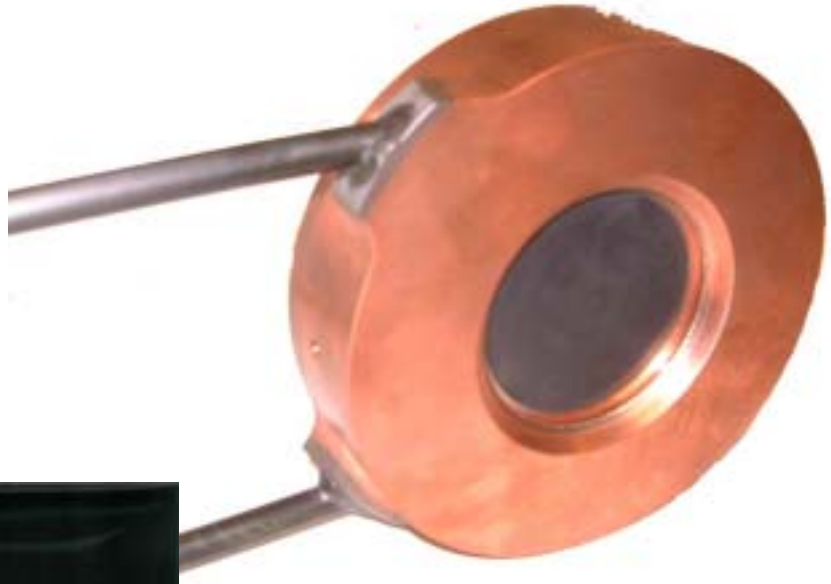
Prototype Graphite Target

SUS Tube Blazed to Mo frame

Cast SUS Tube in Copper

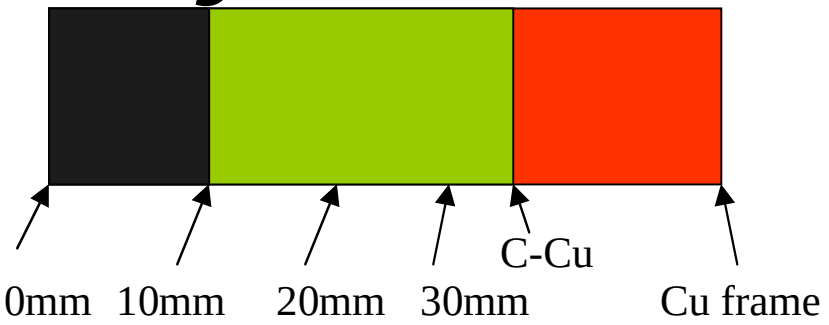
SUS Tube coated with Copper

- Copper –Stainless pipe **HIP**(Hot Isostatic Press)
- Copper –Ti & Ti –Graphite **Silver Blazing in vac.**
- Check the bonding **X-ray & supersonic**

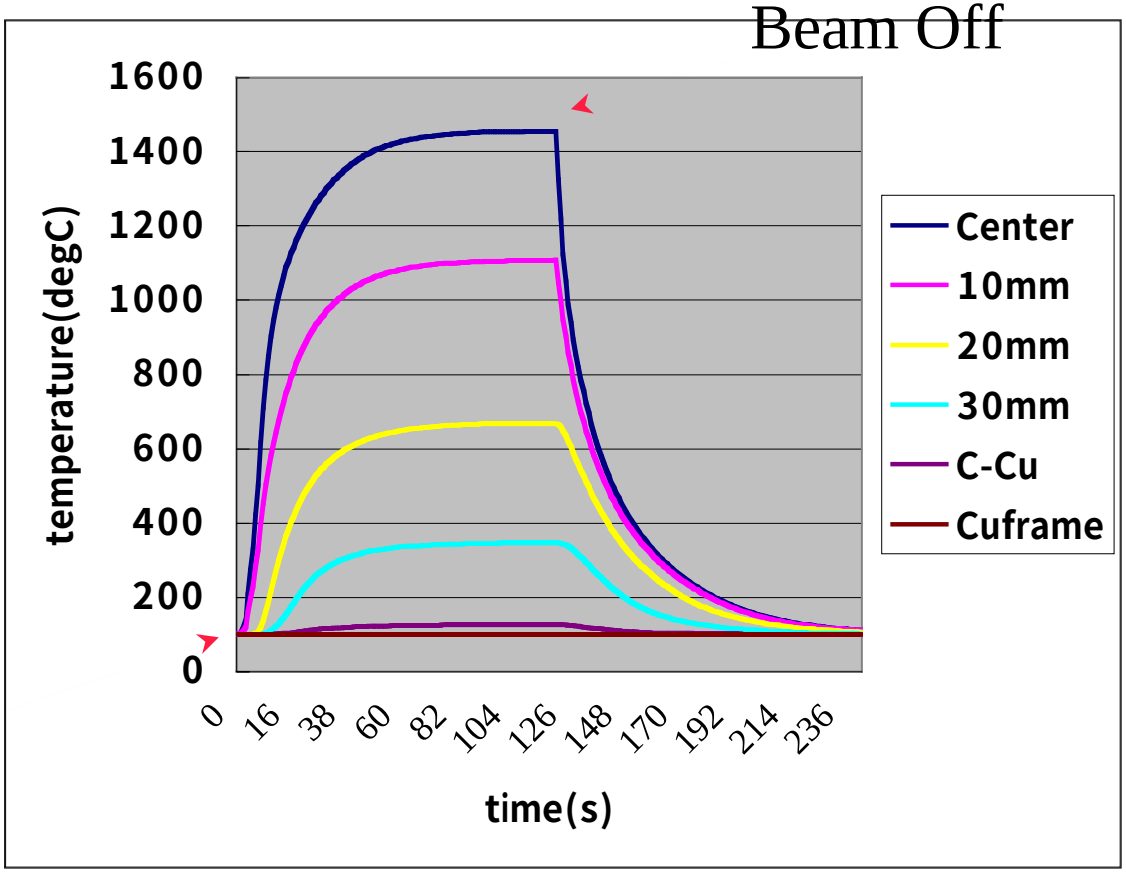


Dynamical Property

- **Shock wave 0.6MPa from thermoelasticity**
- **Thermal transient response**
  1. **No extraordinary gradient of temperature**
  2. **ΔT=6degC/1pulse difference of stress 0.1MPa**



Beam Off



Beam ON

Analysis of Accident

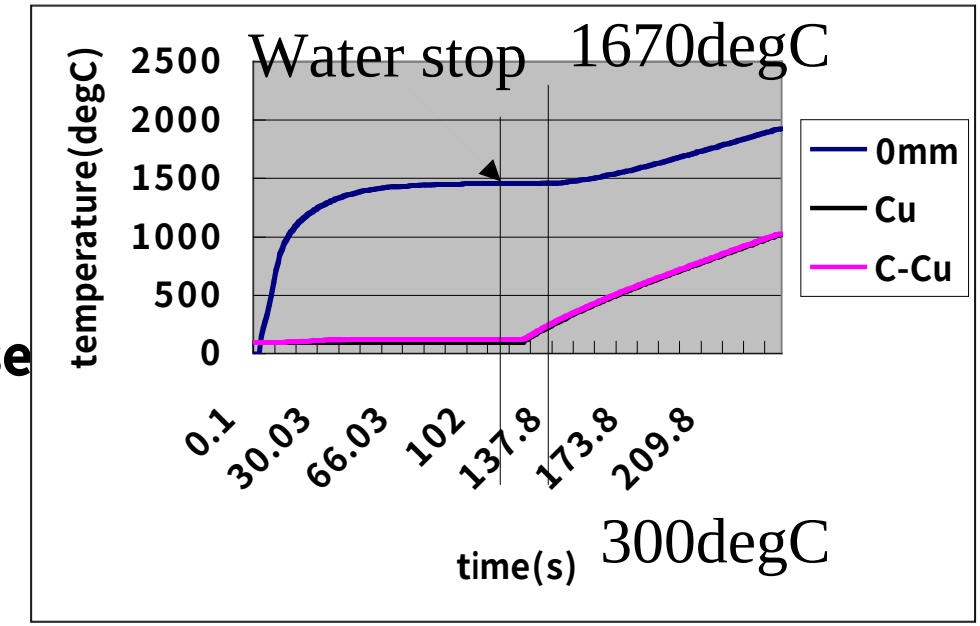
- **What happens in case of water stop without beam stopping ?**
- **What degree C is the best for interlock ?**
- **20 seconds later**

  Copper 300 degree C
  (with water, 100degC)
  Graphite 1470 degree C
- **70 seconds later**

  Blazing will melt. (680degC)
  Graphite 1660 degreeC
  Vacuum becomes bad.
- **120 seconds later (Worst case**

  Copper melts down.

Interlock parameter
- Water speed
- Copper temperature
- Graphite temperature
- Vacuum



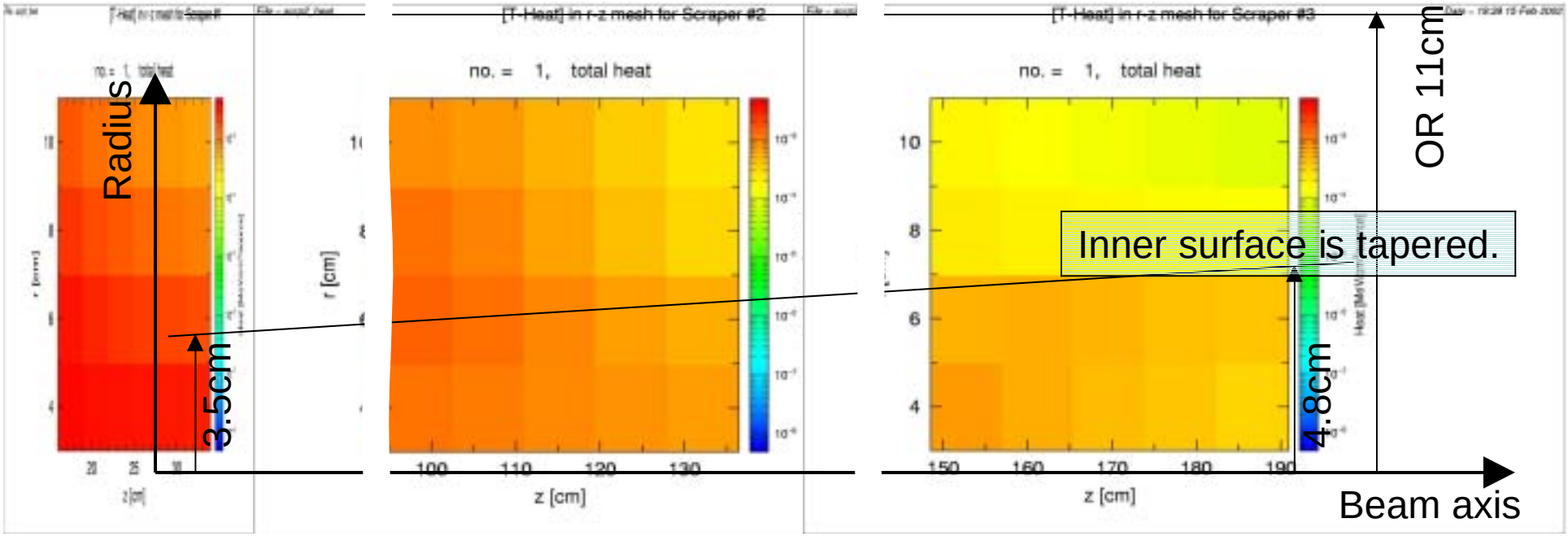
Scrapers

- Beam Loss less than 10 % --> **10, & 20 mm Graphite**
- No Window
- Installation of Scrapers
- No Significant Effect to the Neutron Source
- **Heat generation in Scraper #1 - #3.**

#1 5.7kW

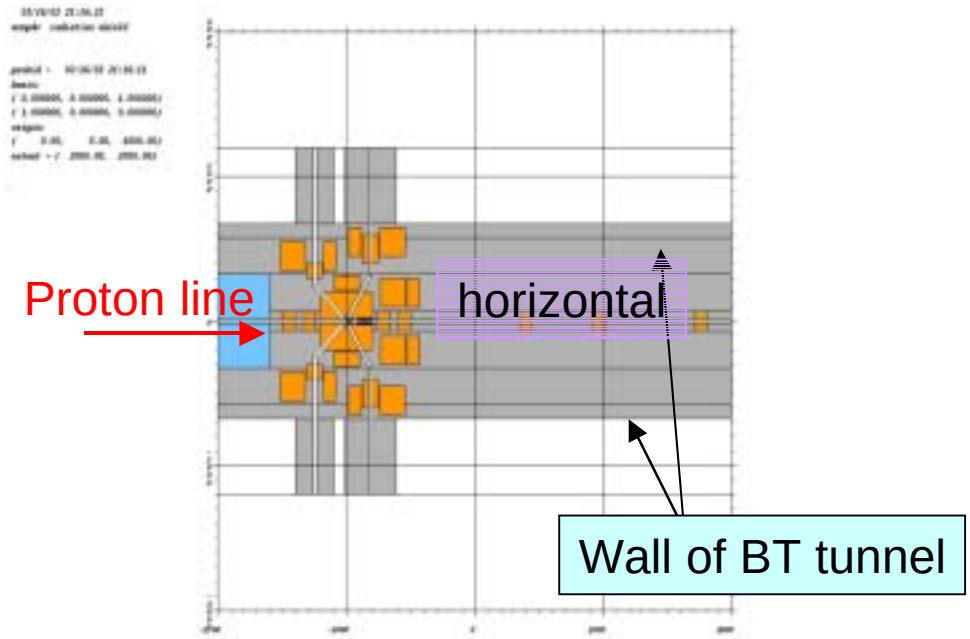
#2 5.0kW

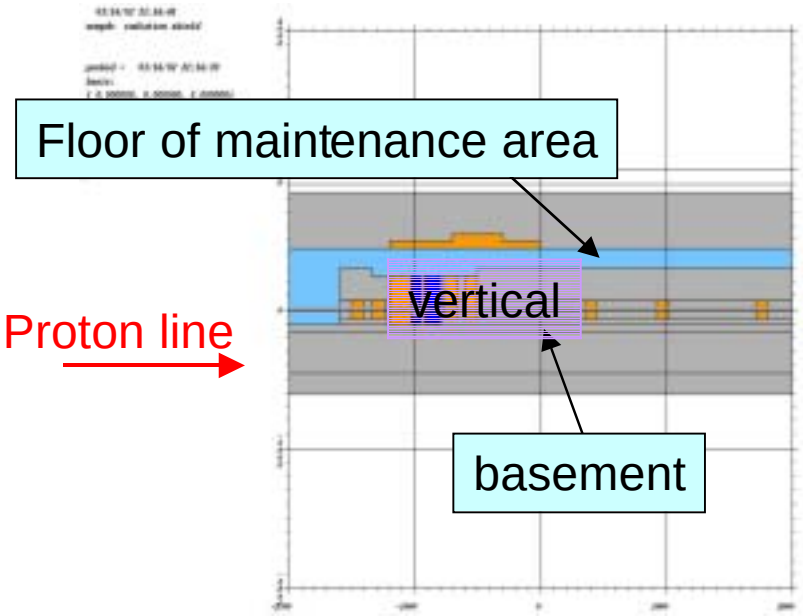
#3 1.8kW

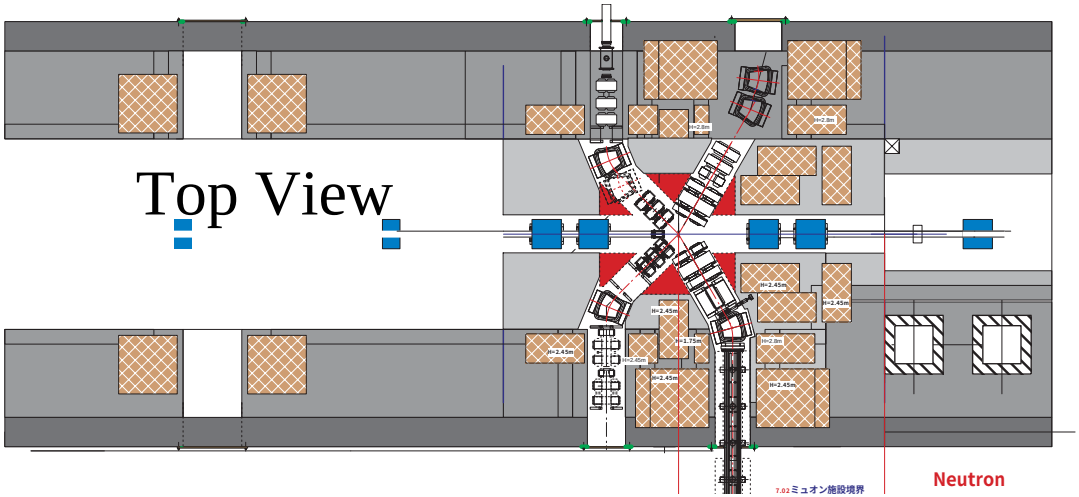


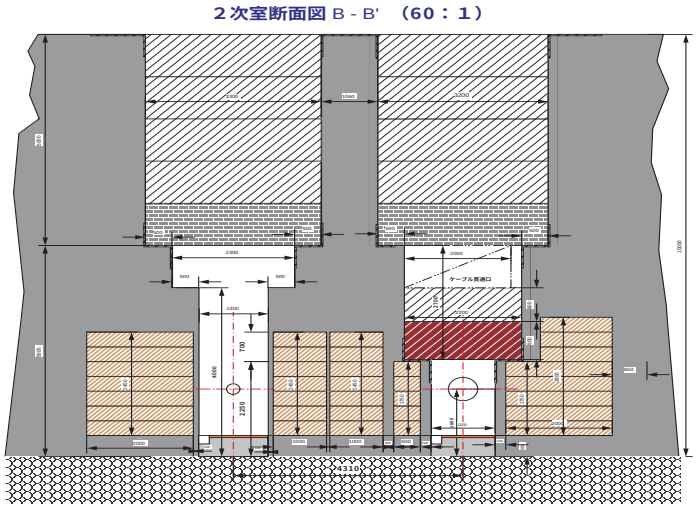
Radiation shield

- From 10-m upstream to 30-m downstream, we estimate the surface doze on the wall of 3NBT tunnel and so forth, by using MCNPX.

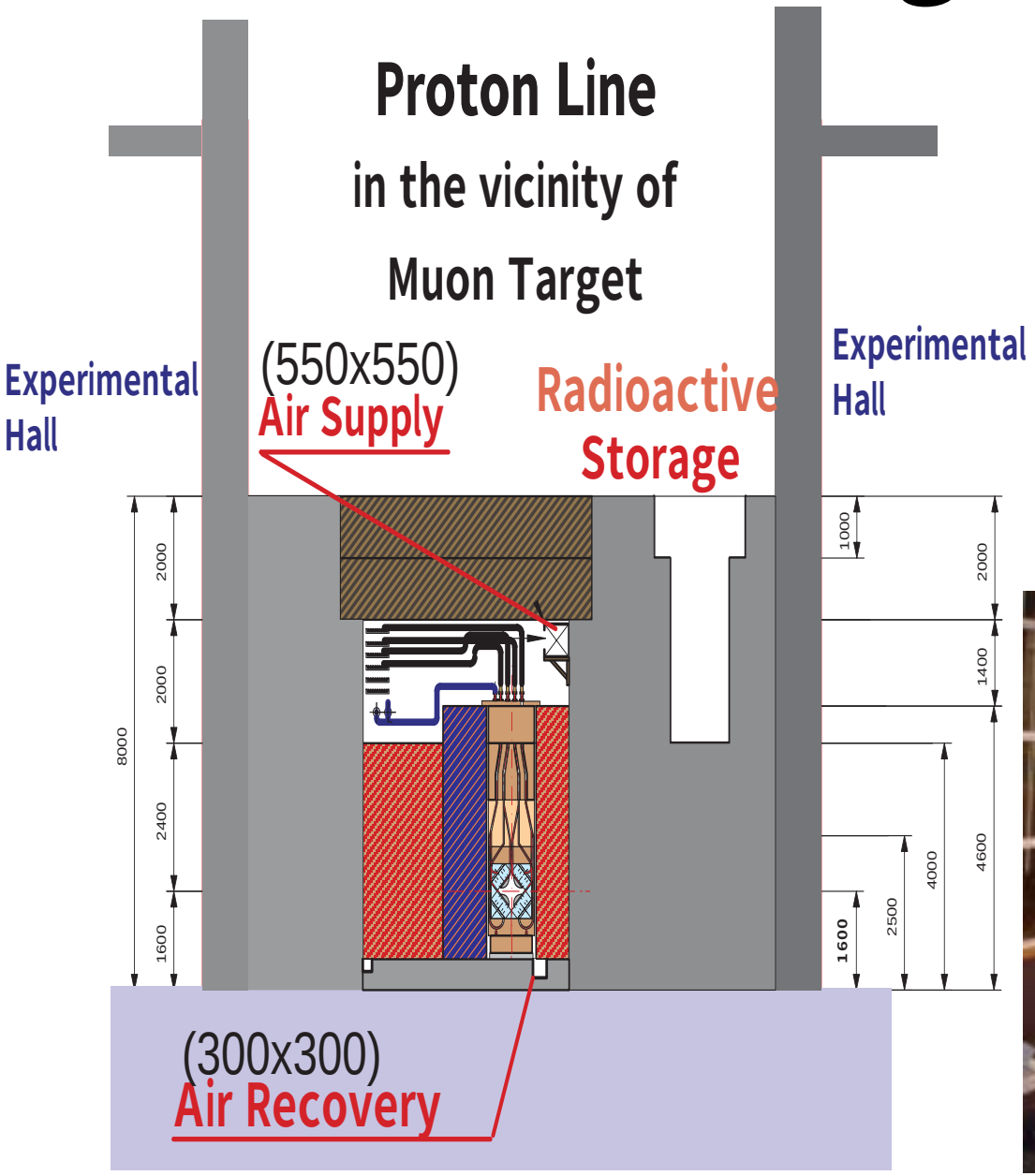








Air Handling System I

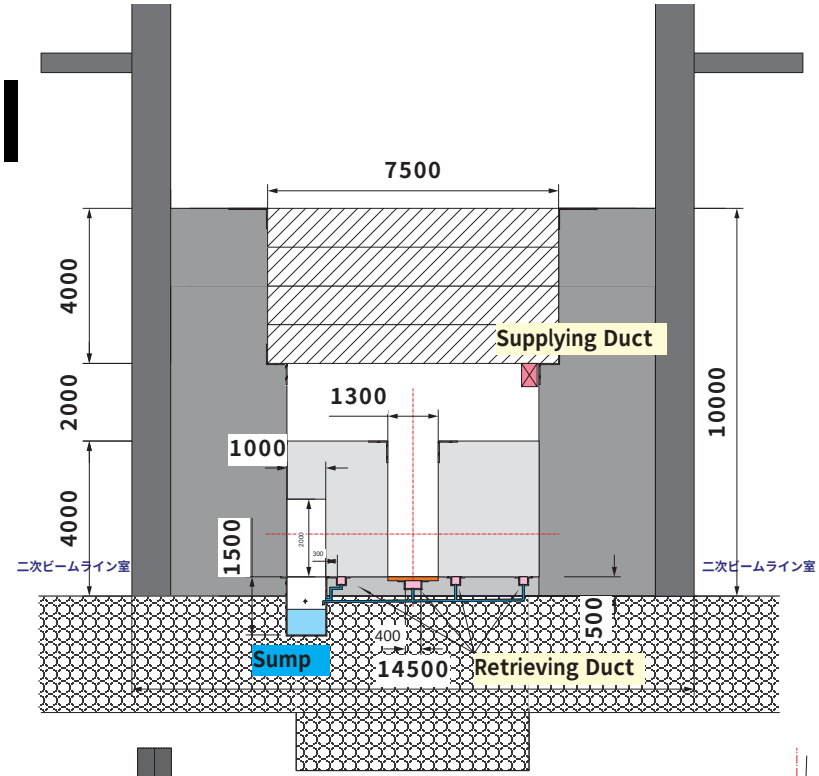


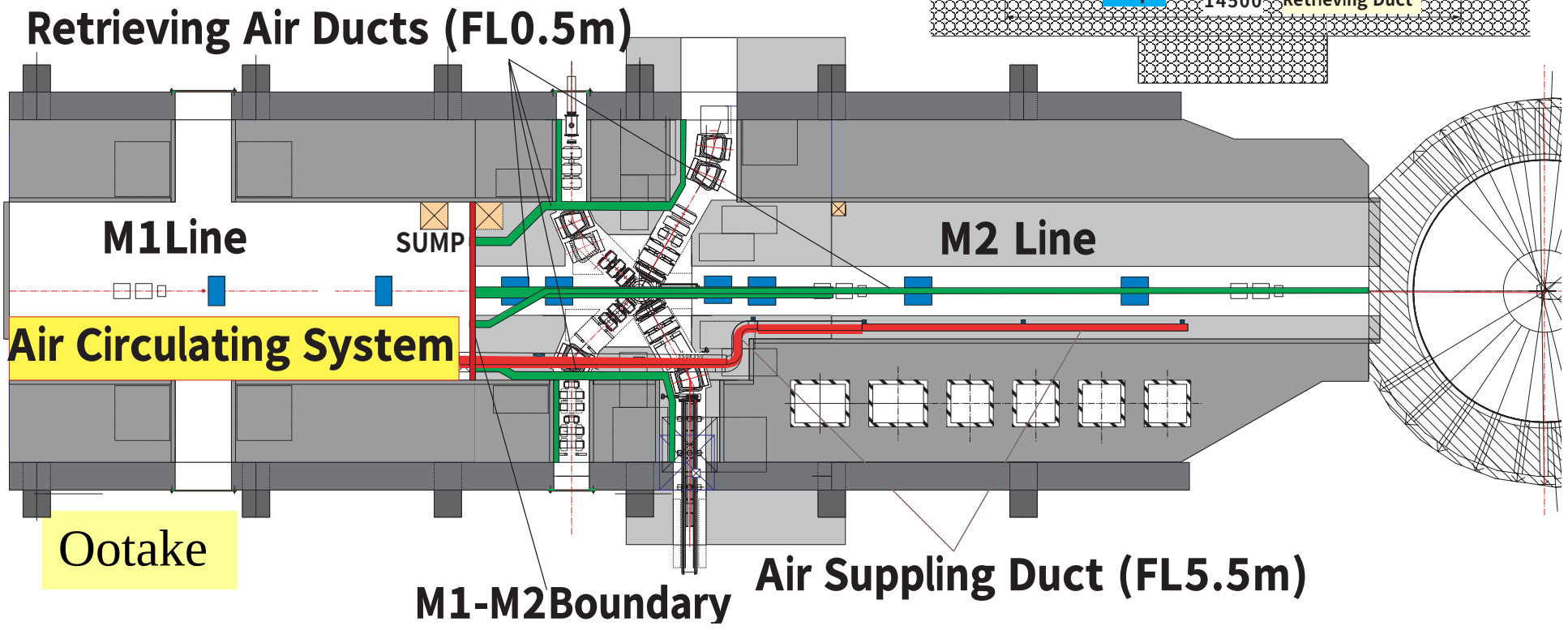
Refering to the
PSI(> 1MW) System

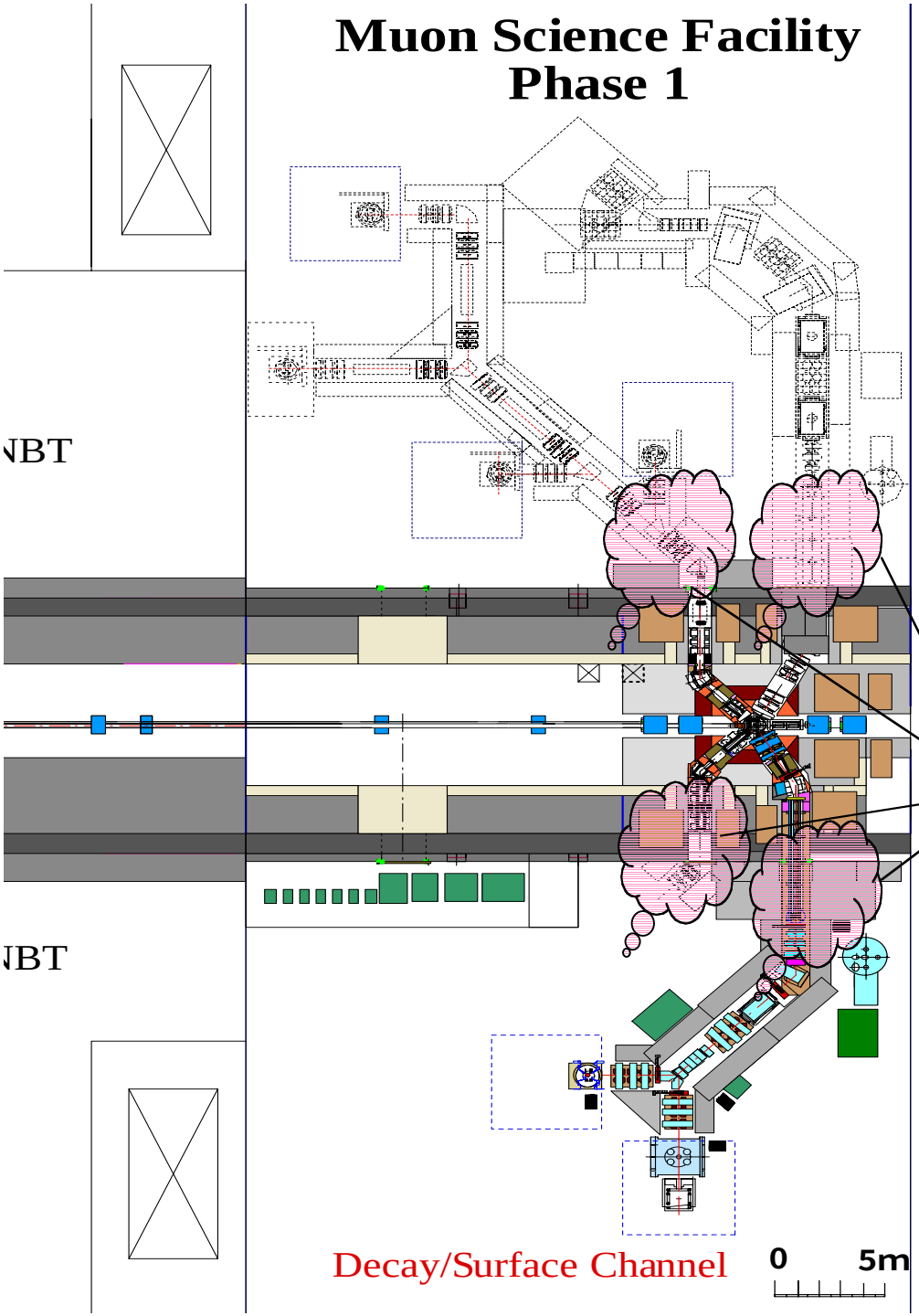
- Supplying cold air
  - –from Maintenance Area
- Retrieving
  - –from the 0.2-0.5mFL

Air Handling System II

- System will be installed at M1 line.
- **4 Retriving Air Duct**
- **Supply 15 Centigurade,**
- **Return 55 Centigurade**







No Ventilation will be done, but just circulating air for a while for M1 & M2 Tunnel

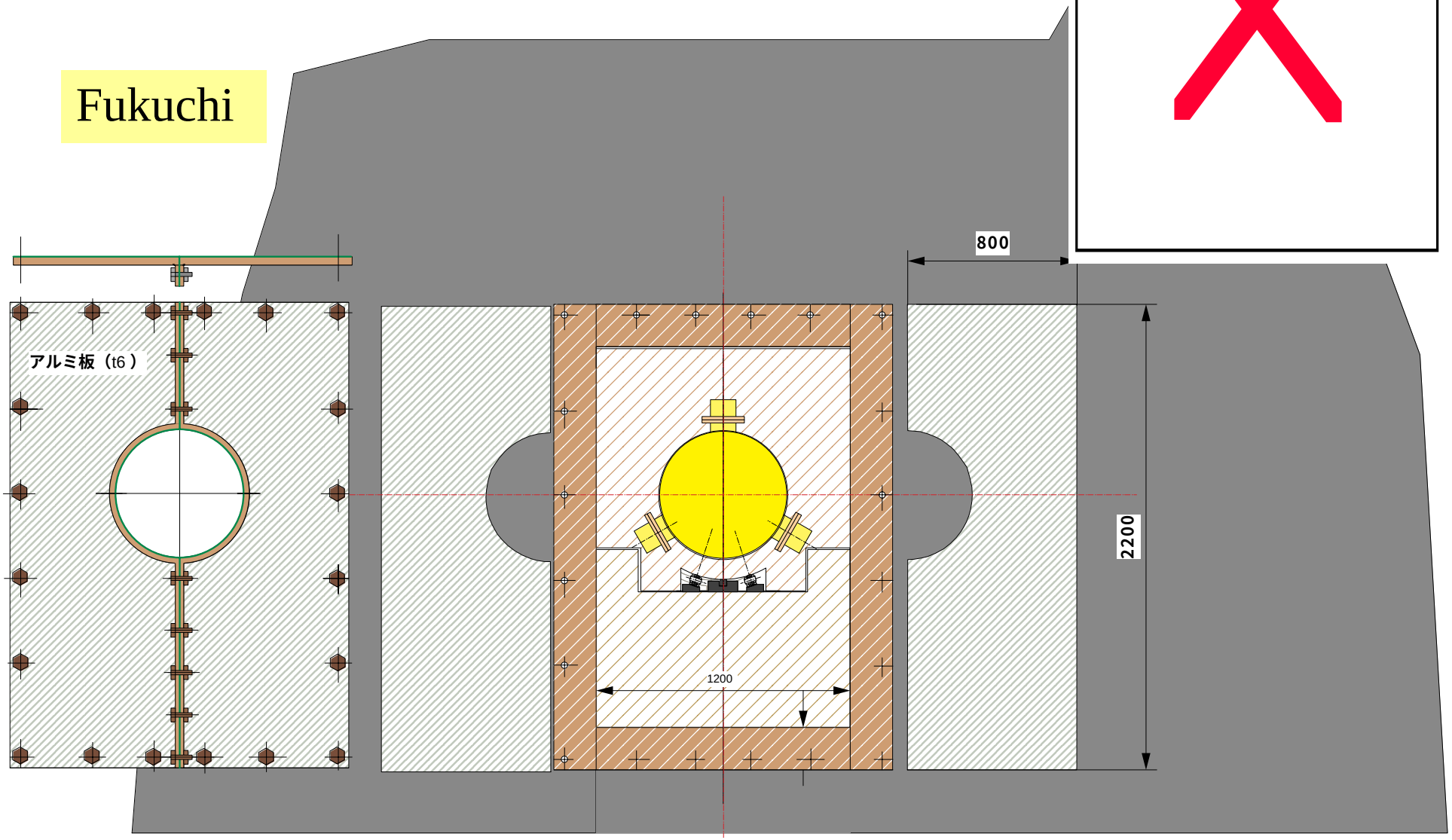
Sealing is important

How to Seal

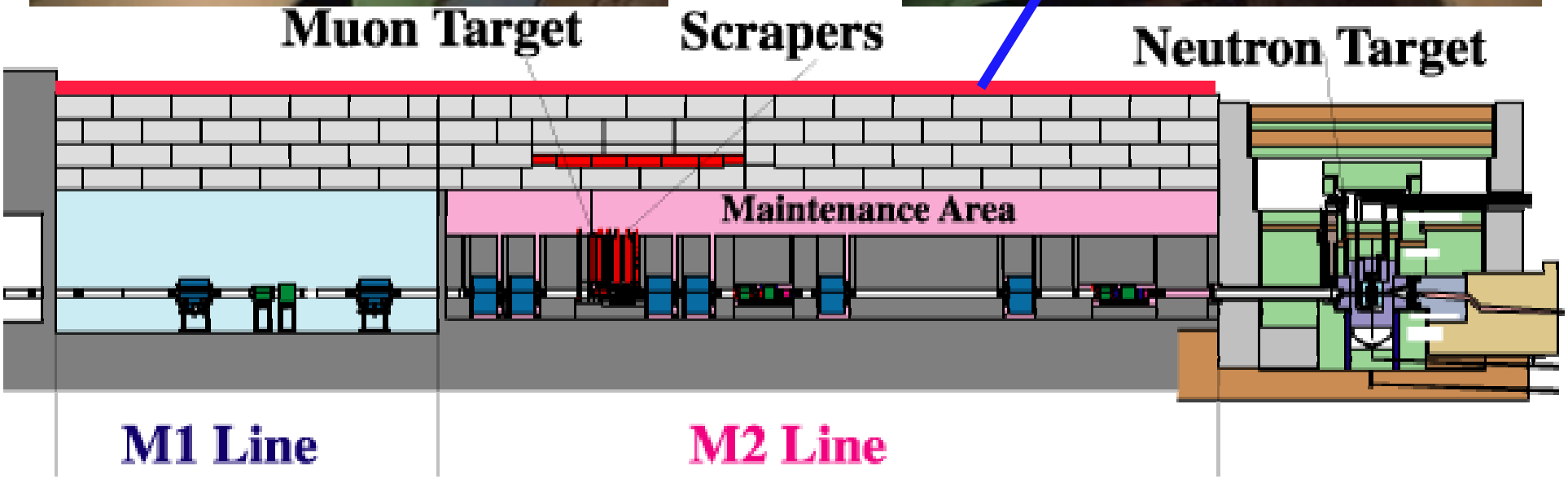
- **Exit of the 2dary Line on the wall**
- **Towards to the tunnel through the concrete blocks**
- **Boundary of M1 and M2**
- **Cable Feed Through**

Exit of the 2dary Line on the wall

Fukuchi



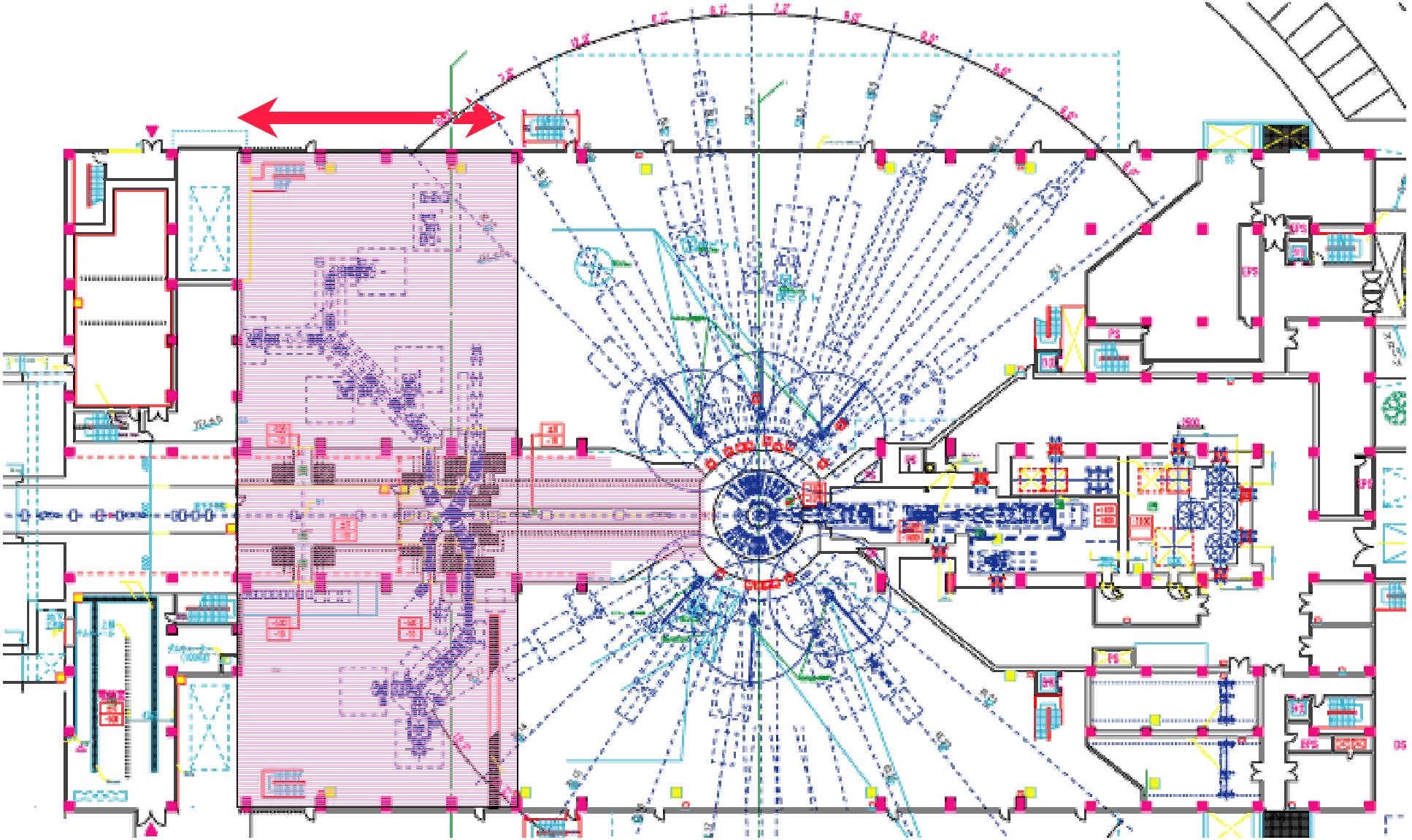
Towards to the tunnel through the concrete blocks

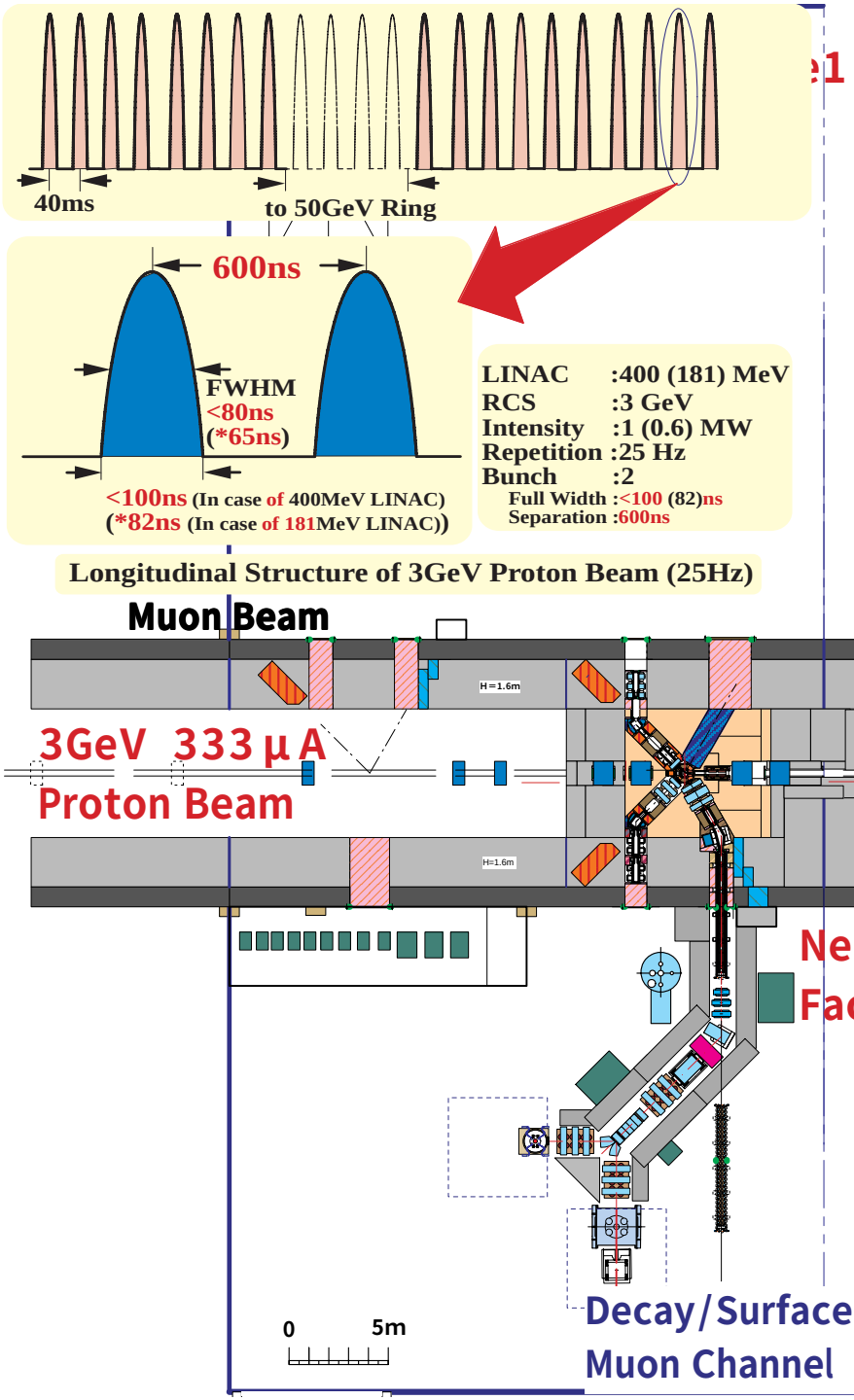


Mission of Muon Science

All the Components up to Neutron Source

out of 12.2 OKU Yen





Phase 1 Budget 12.2 OKU Yen

- •Target &Scraper 1.7 OKU Yen
- •Shield 5.4 OKU Yen
- •Primary Line 6.2 OKU Yen

- •Fundamental Facility 3.2 OKU Yen
- •Secondary Line 1.6 OKU Yen

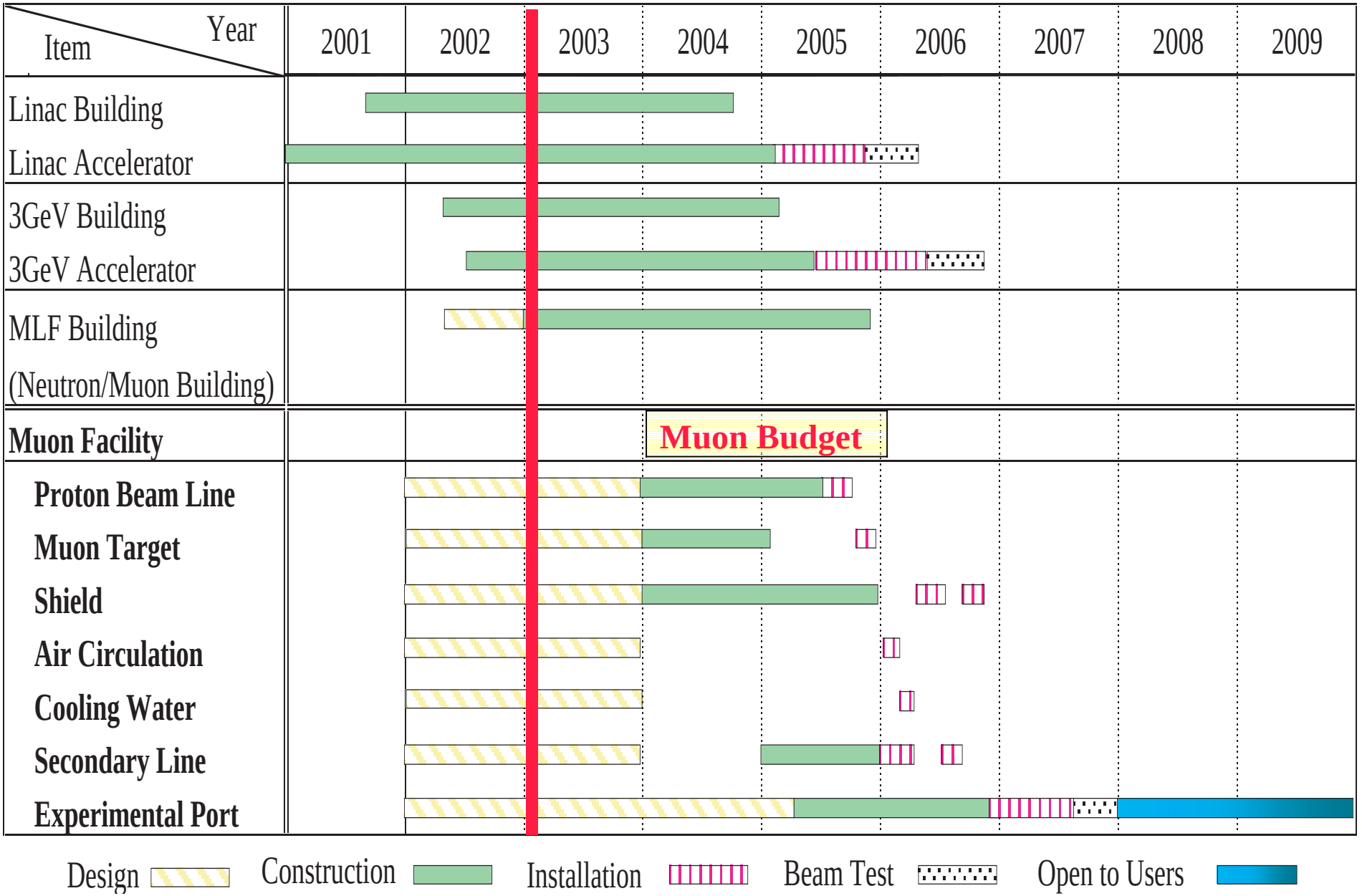
(5.4)

Decay/Surface Muon Channel

Beam Size ϕ25 mm, Divergence 80 mrad

- μ^+
  - Surface Muon(4MeV) 3×10^7/s
  - 60 MeV/c 6×10^6/s
  - 120 MeV/c 2.5×10^7/s
- μ^-
  - 40 MeV/c 1×10^6/s
  - 60 MeV/c 3×10^6/s

A Tentative Schedule of Phase 1



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- **Technical Issues of the one year progress**
  - **Design of MLF Building related with the Muon Facility considering maintenance**
  - **Graphite Muon Target & Scrapers**
    - **Prototype Target was successfully made. --> Real test with proton beam!**
  - **Radiation / Ductstreaming for the shield optimization**
  - **Design of the Air Handling System for NO_X, *Ar-41*** etc Production
- Expecting budget for Phase 2, as soon as possible for the rest of the secondary beam line.