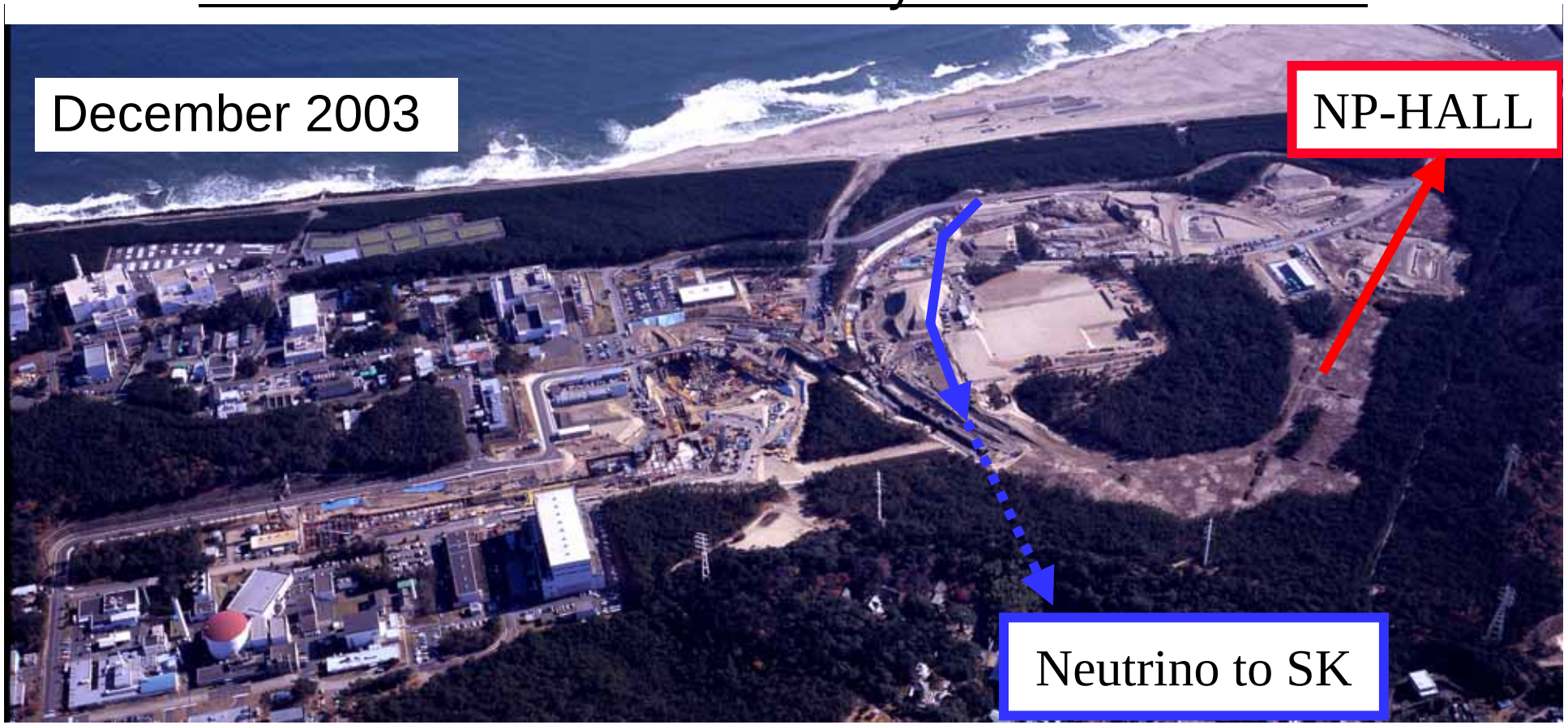
R&D Works for Beam Lines at Hadron Hall

K.H. Tanaka for the HD Facility Construction Team



- Hadron-Hall: Experimental Hall for 50GeV-15 μA Slow Beam
  - The First (Only One?) ***KAON FACTORY*** in the World
- Neutrino Beam Facility (JHF-ν) : Long Baseline Experiment

Beam Profile of JHF-50GeV PS (Phase 1^{-})

- Beam Energy: 50GeV
  (30GeV for **Slow Beam**)
  (40GeV for Fast Beam)
- Beam Repetition: 3.4s
- External Beam Width: 0.7s (1.0s) **Slow Beam**
- Beam Intensity: 3.3×10^{14}ppp, 15μA
  (2×10^{14}ppp, 9μA)
  E_{Linac} = 400MeV (180MeV)
- Beam Power: 750kW (270kW)

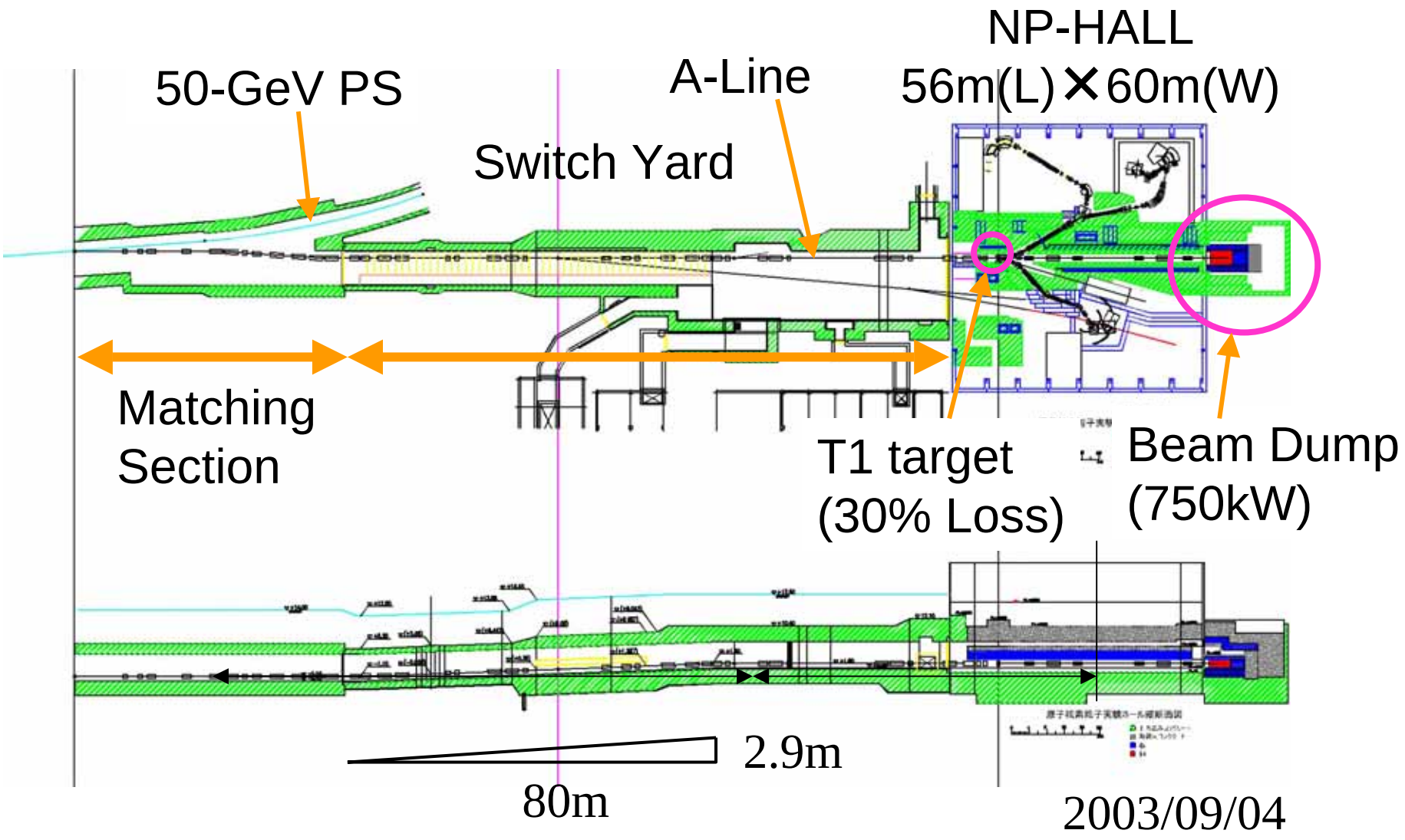
Progress in the Last Two Years after NP02 for Hadron-Hall Design

- ***NP-Hall Design & Beamlines***

  for the Phase 1 Construction

  – Only One Target／Limited Space
- ***Radiation/Heat Resistant Beam Line System*** for SY/ν-line & NP-Hall
- ***T1 Target*** & its Related Parts
- ***Beam Dump***

Slow Extraction Beam Line Facility (Phase I)



Experimental Area Design

Prof. Jun IMAZATO,

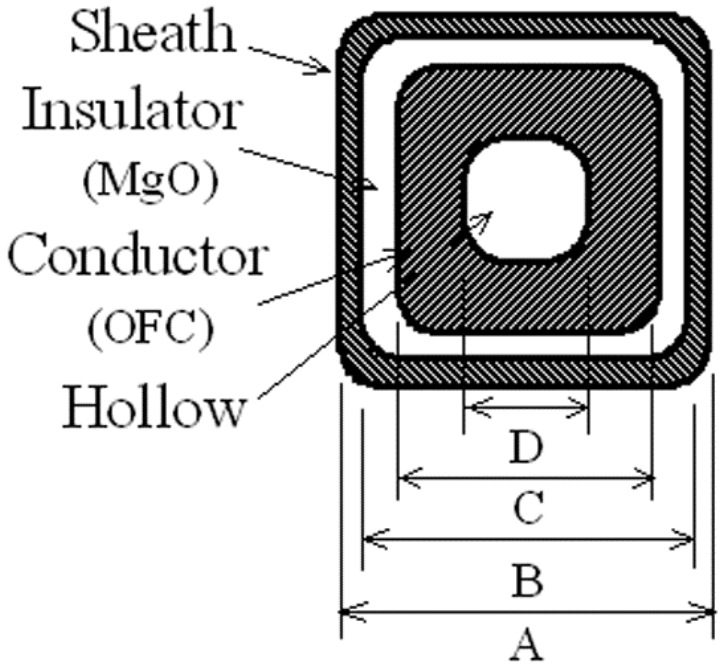
My Previous speaker!

Primary & Secondary Beam Lines

Prof. Hiroyuki NOUMI,

The Next Speaker!

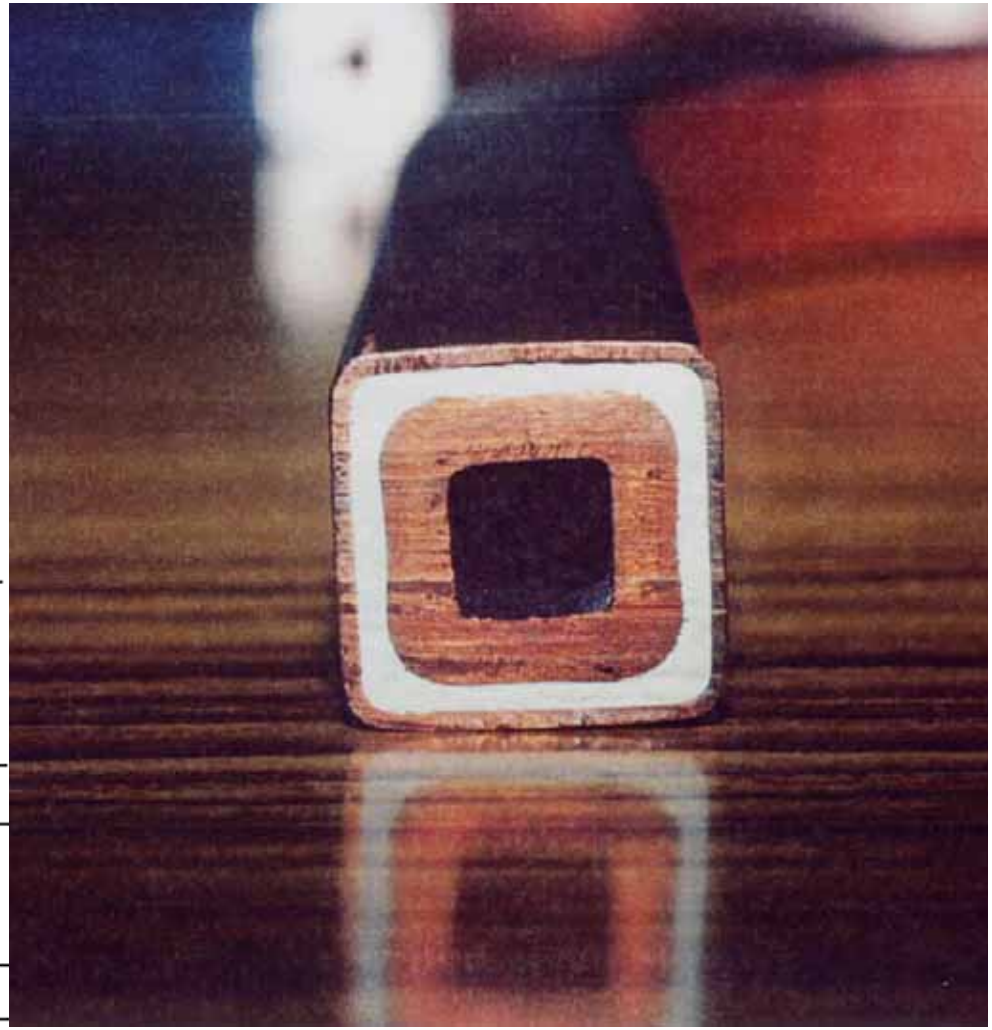
Radiation Resistant Beamline System



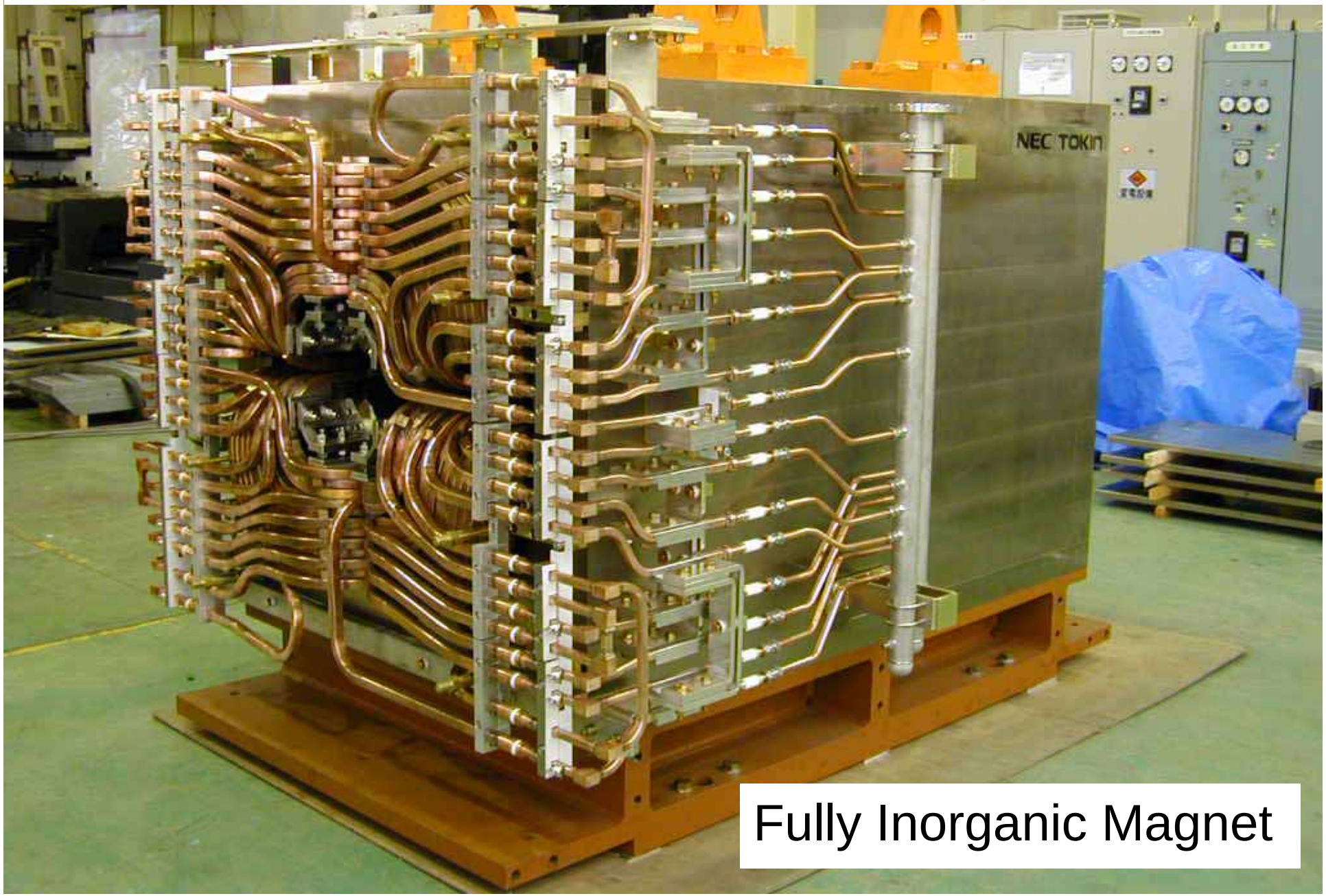
Nominal Current (A)	2000	2500	3000	1000*	2000*
Dimmensions (mm)					
A: Outward Size	20.0	23.8	28.0	18.0	14.0
B: Insulator Size	18.0	21.6	25.0	16.6	12.6
C: Conductor Size	14.6	18.0	20.0	13.2	9.2
D: Hollow Size	7.4	10.0	10.0	--	--
Cross Section (mm^2)					
Conductor	150.9	211.7	293.1	168.4	78.8
Insulator	117.7	153.2	227.4	106.6	79.4
Seath	73.4	95.3	150.6	47.8	36.6

* indicates Solid Conductor MICs. No hollow is in Cu conductor.

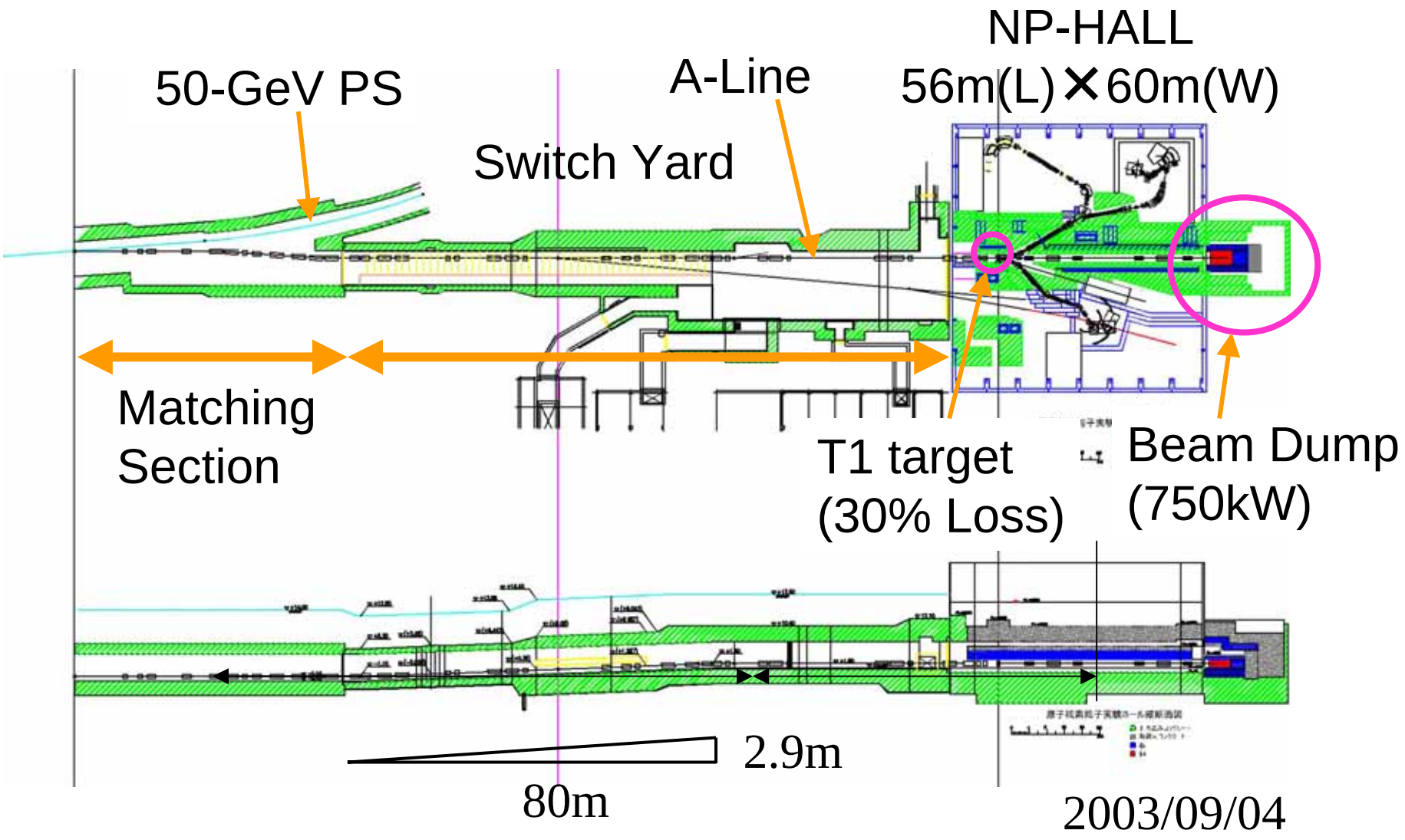
Mineral Insulation Cable



Construction of actual magnet Q440MIC



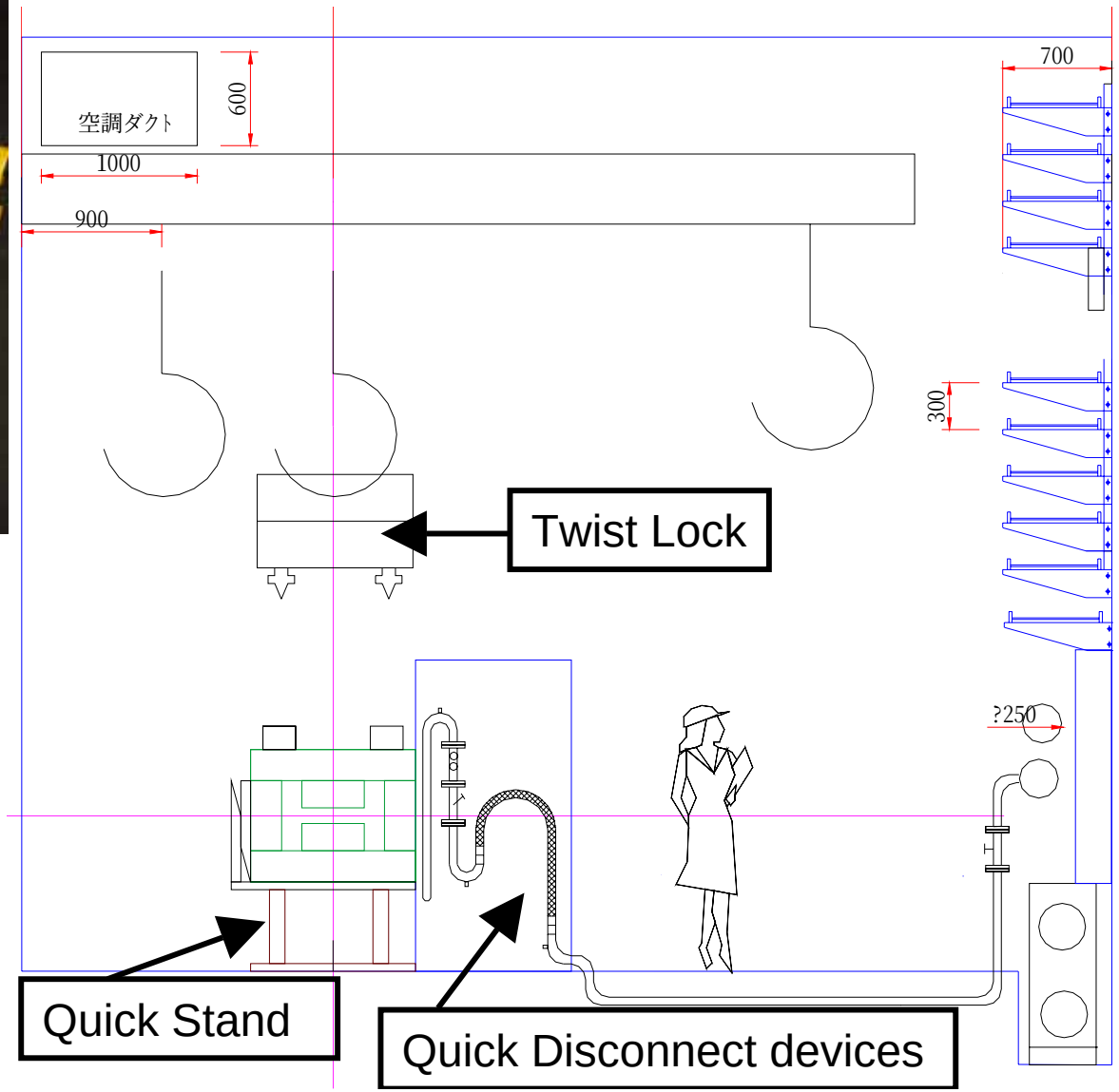
Slow Extraction Beam Line Facility (Phase I)



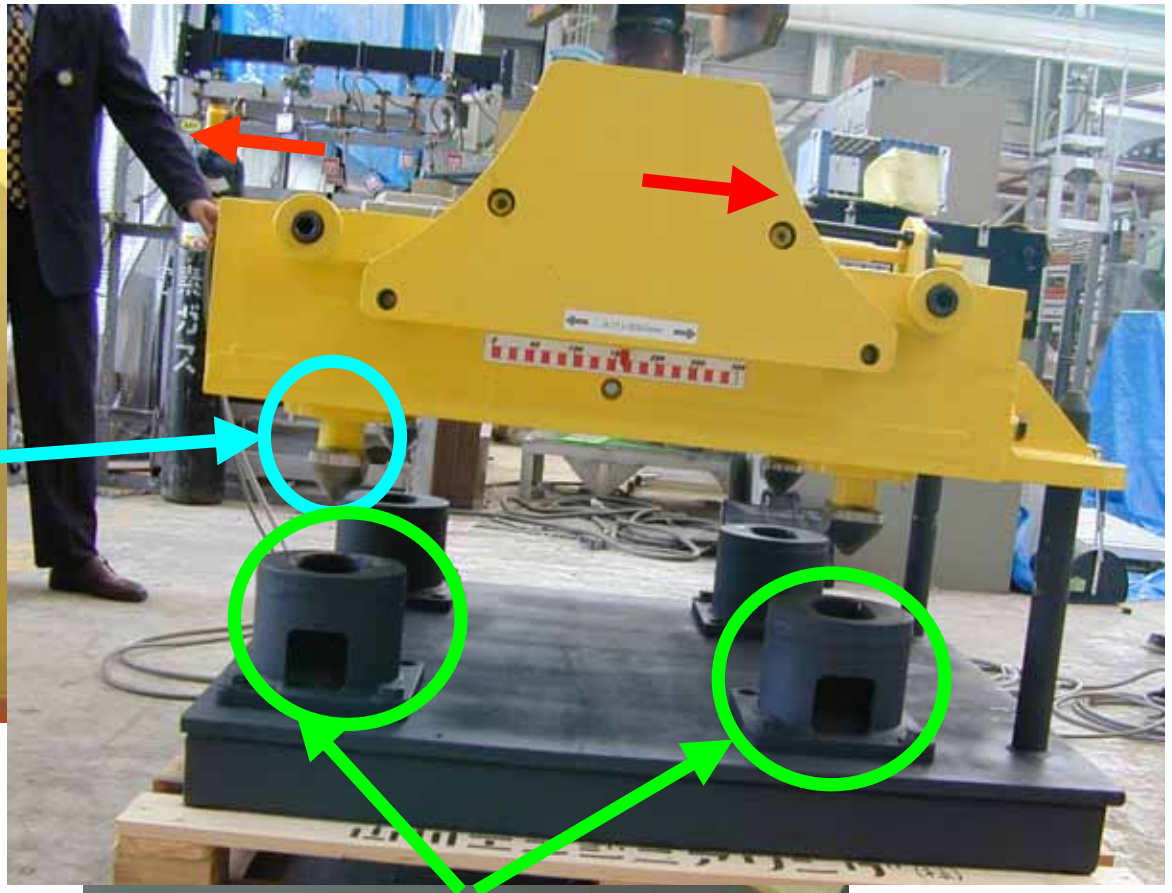
Development of remote alignment system for SY and ν-beam

Twist Lock

Quick Stand



Twist lock



“Twist Lock” system for automated magnet lifting

Corner fitting

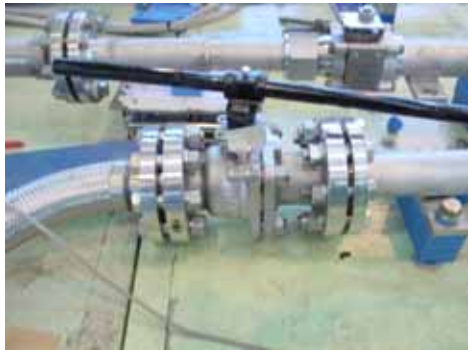
“Drain trap” type

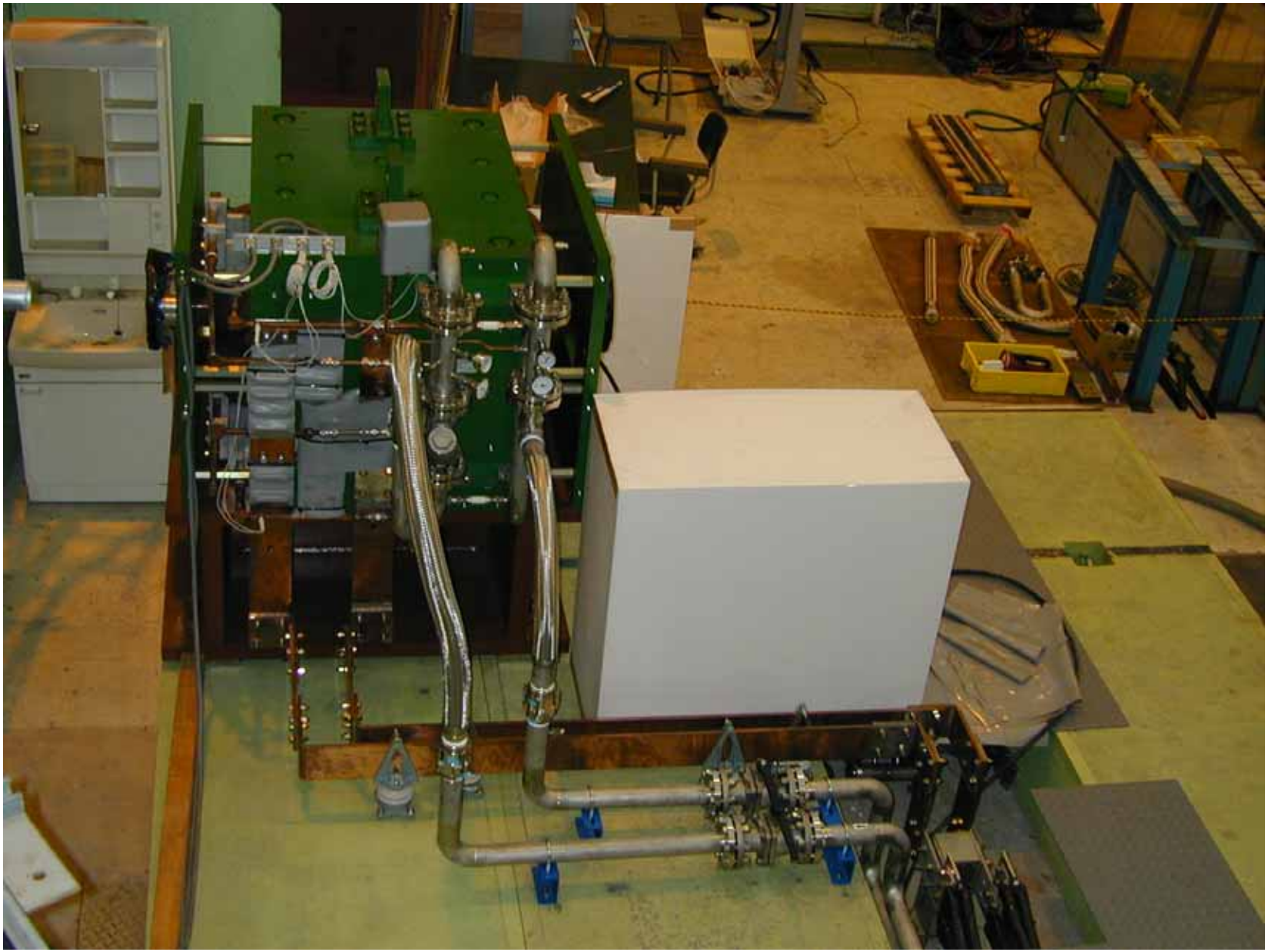
“Elephant nose” type

Mock up test will be done soon.

Water lock
Ball valves used for steam
or viscous fluid piping
on the market
Gasket material : metal,
graphite, asbestos

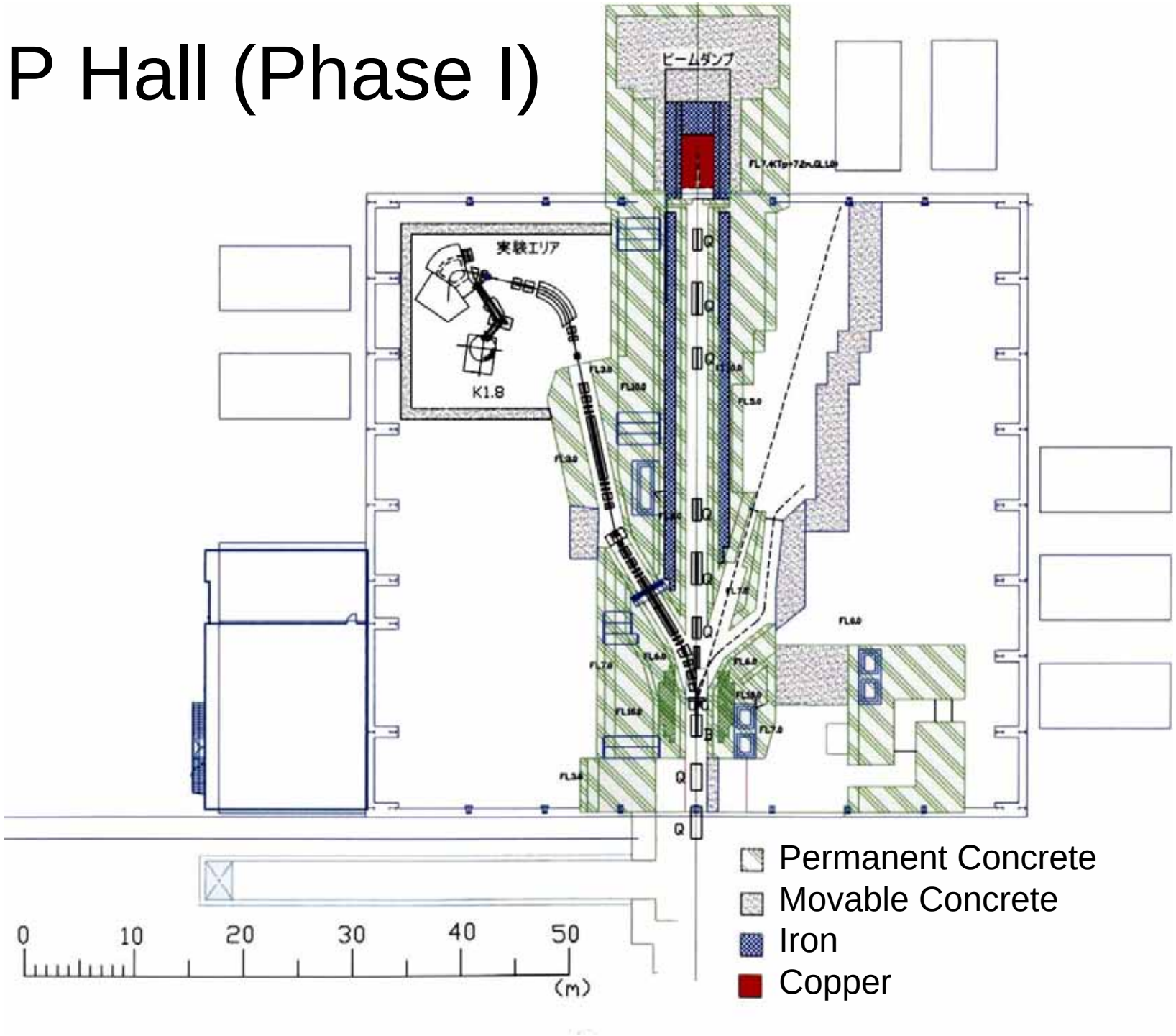
KITZ Ball valve



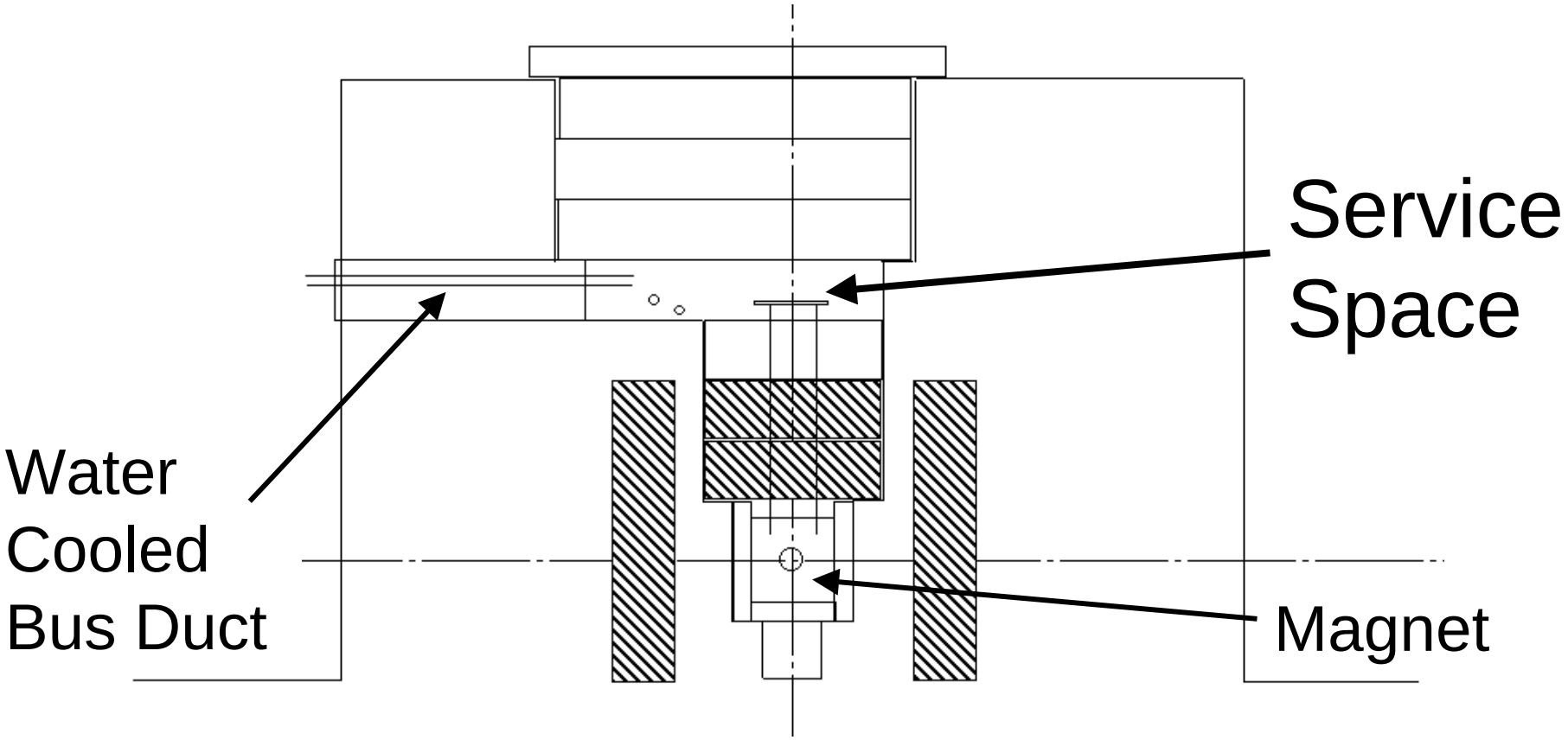


SY and ν line Mockup

NP Hall (Phase I)

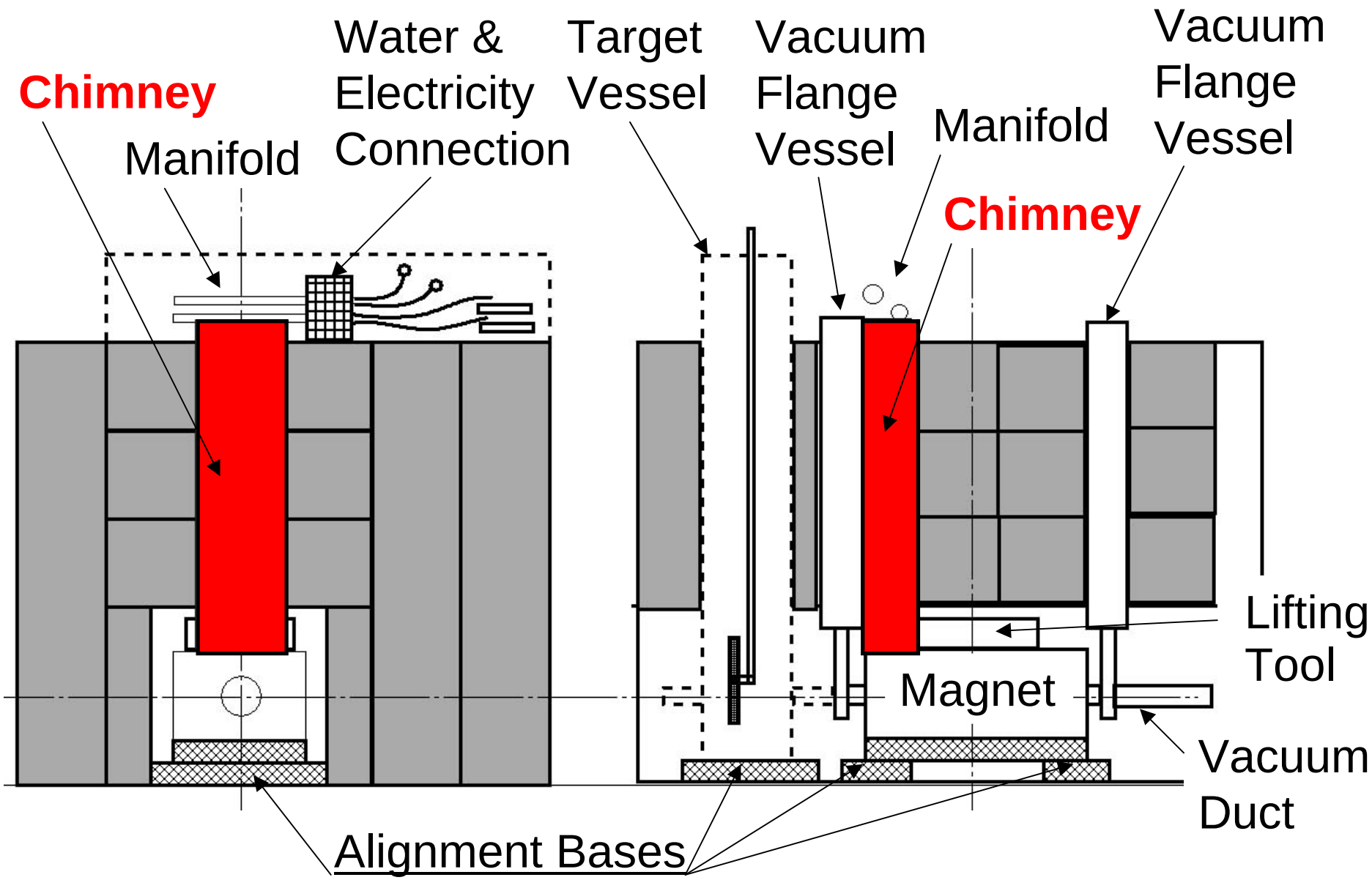


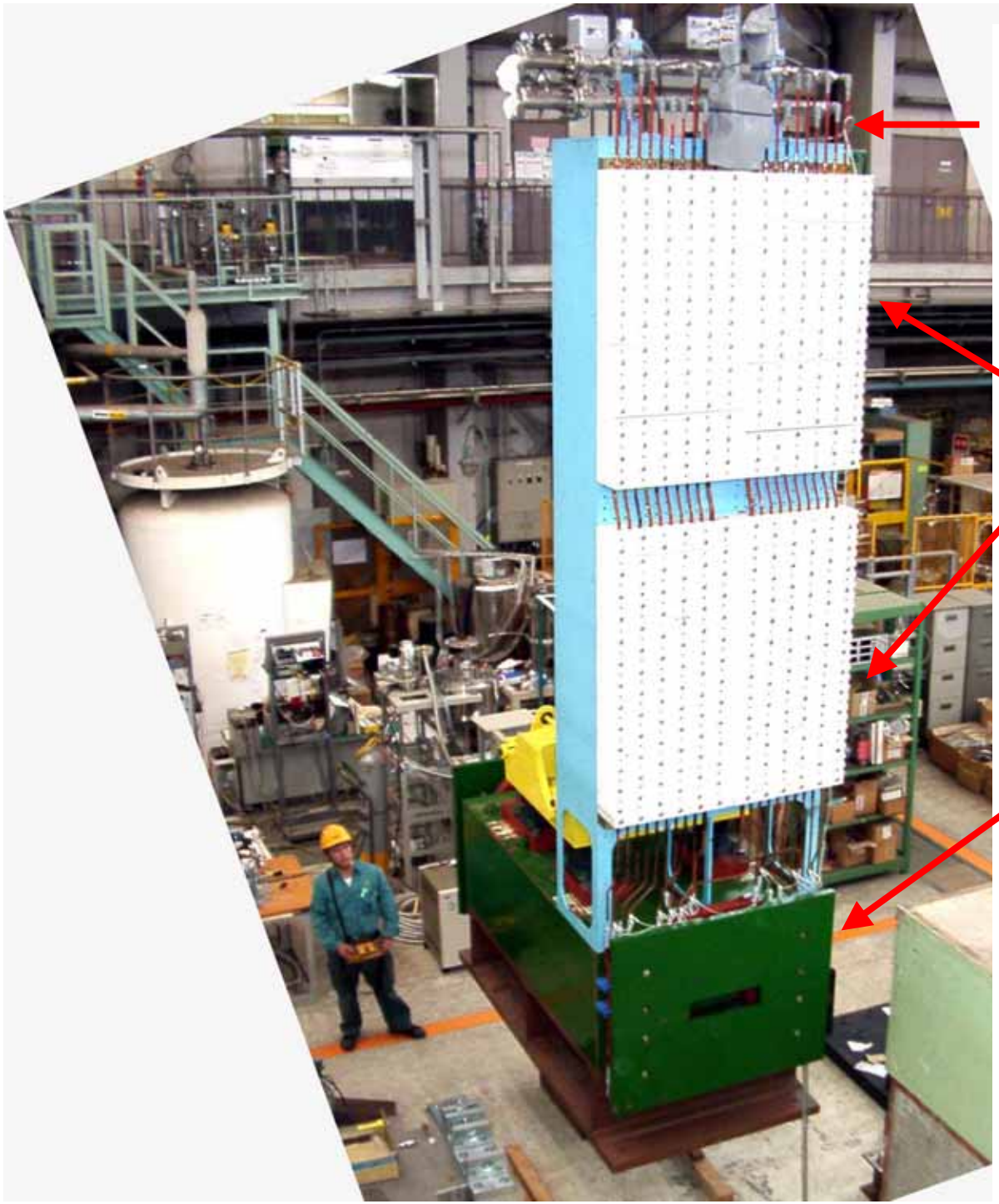
NP Facility: Cross-Section



- Sides 9.0m Concrete with 1m Iron
- Upper 6.5m Concrete with 2m Iron
- Lower 7.0m Concrete

Chimney for NP-Hall Magnets





Chimneyed Magnet

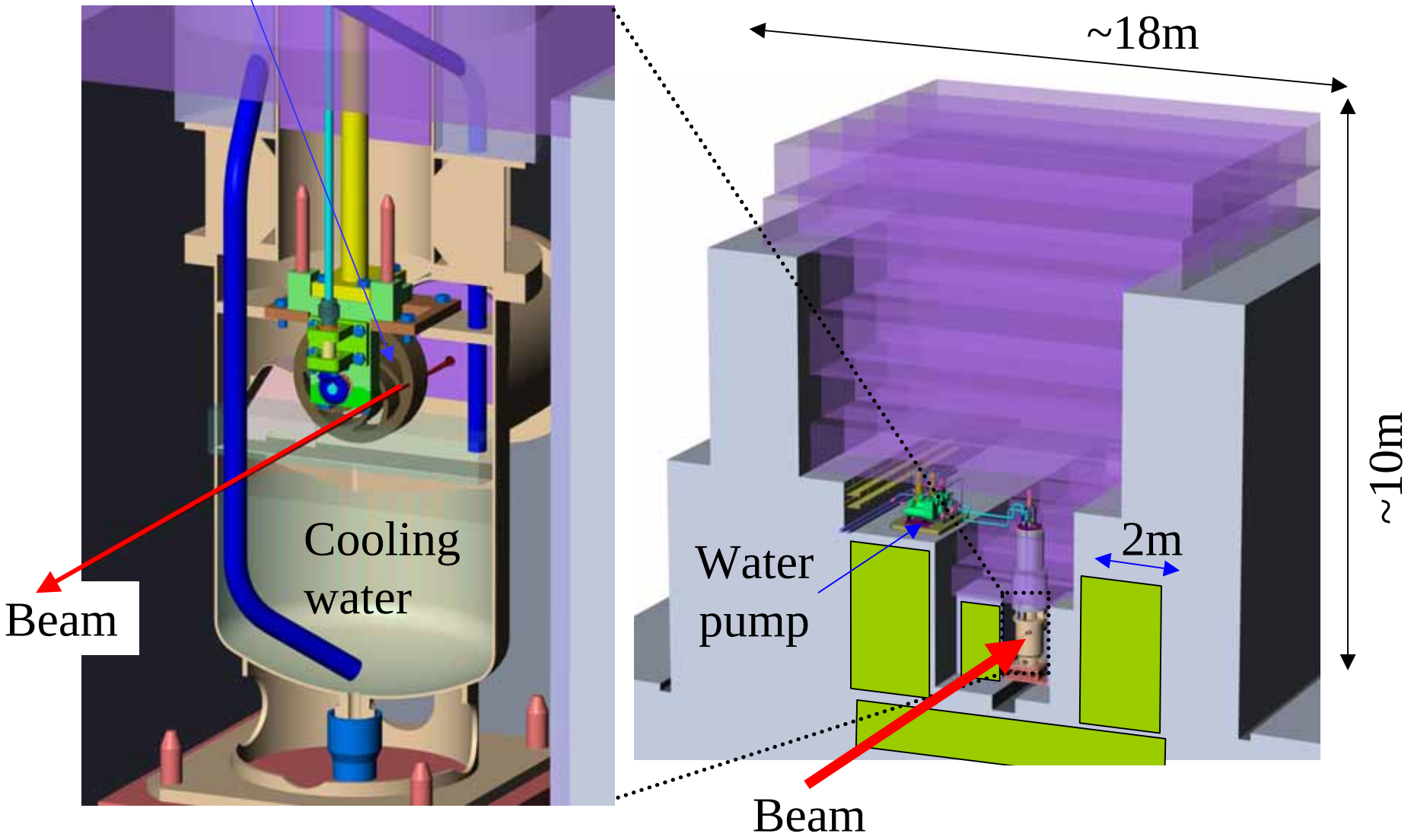
Chimney for NP-Hall Magnets

Magnet **Chimney** Prototype No. 0

Can be Lifted by Twist Lock

T1 Target R&D (by Yamanoi)

Ttarget disk
5.4cm Thick
50cm Diam.

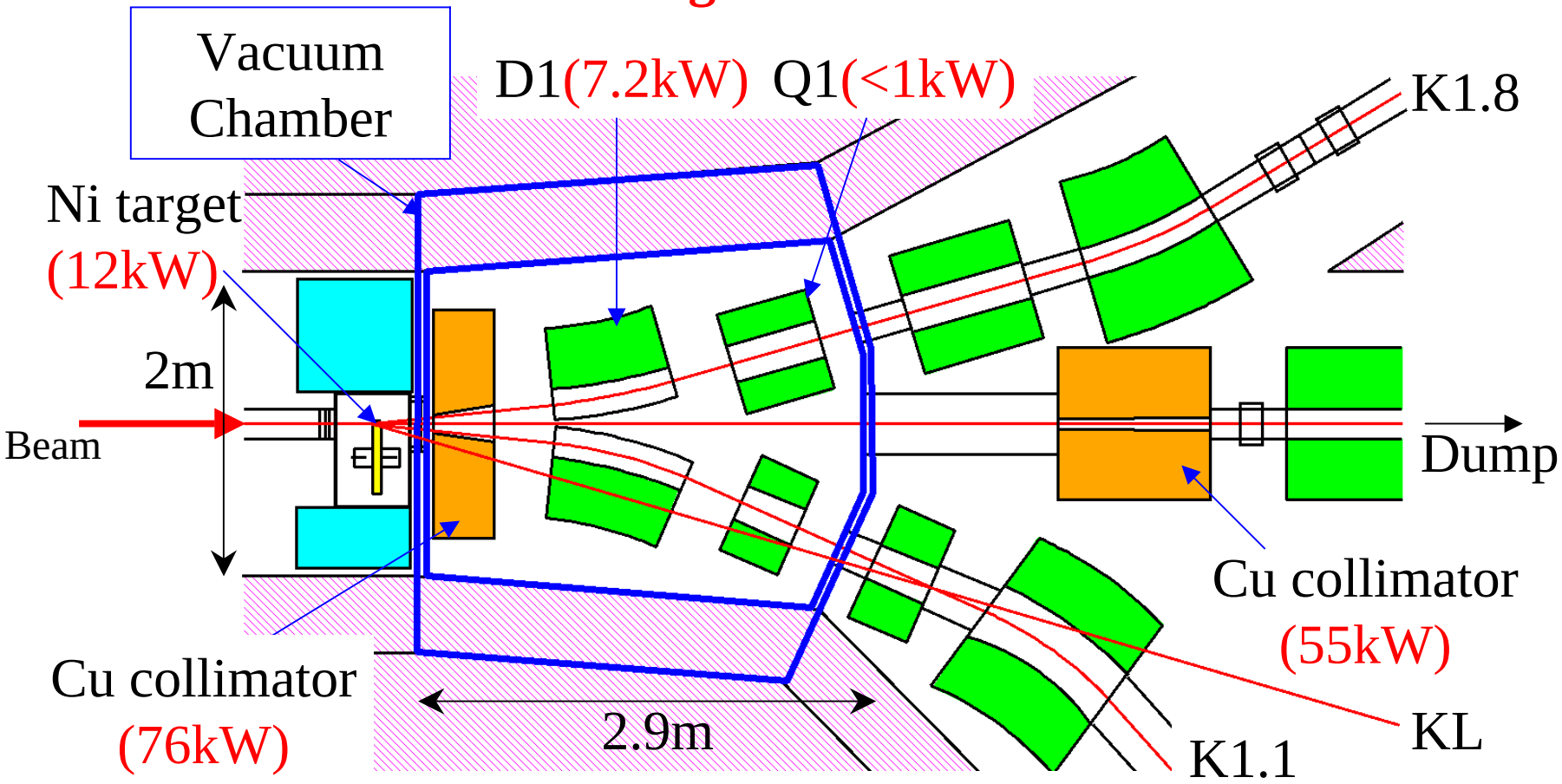


T1 Target & T1 Downstream

How to solve 200kW Hear Problem?

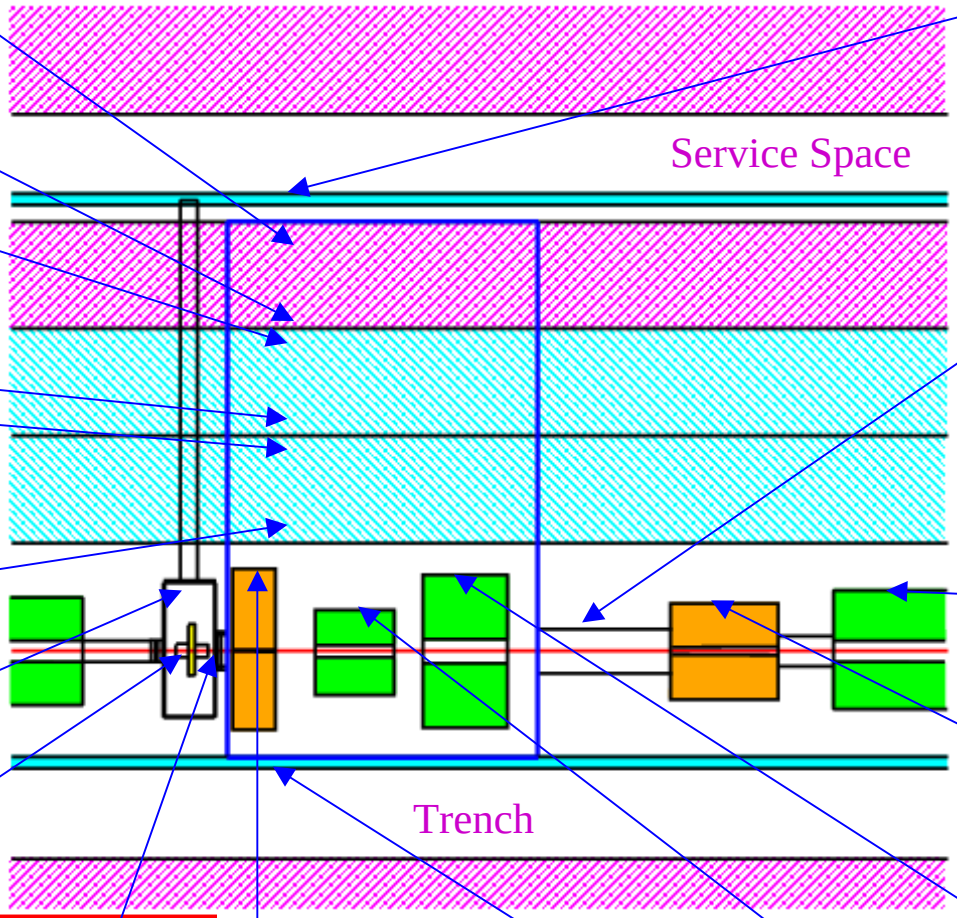
Magnets→ Upstream Collimator

Beam Ducts → Big Vacuum Chamber instear of Ducts



Residual Dose

30Days Operation/1Day Cooling
1Year Operation/Half Year Cooling



Concrete
7.9 μSv/h
0.03 μSv/h

Concrete
5.3 mSv/h
1.6 μSv/h

Iron
60 μSv/h
11 μSv/h

Iron
430 μSv/h
160 μSv/h

Iron
1.1 mSv/h
460 mSv/h

Iron
170 mSv/h
460 mSv/h

T1 Vessel
2.2 Sv/h
850 mSv/h

T1 Target
650 Sv/h
230 Sv/h

Vacuum Seal
30 Sv/h
11 Sv/h

Collimator
380 mSv/h
100 mSv/h

Iron Base
560 mSv/h
210 mSv/h

D1
530 mSv/h
270 mSv/h

Q1
62 mSv/h
33 mSv/h

Collimator
710 mSv/h
420 mSv/h

q1B
110 mSv/h
49 mSv/h

Vacuum Duct
SUS 3.2 Sv/h
1.2 Sv/h

Ti 1.1 Sv/h
97 mSv/h

Water Pipe (SUS)
8.4 μSv/h
2.4 μSv/h

T1 Target & T1 Downstream

Dr. Hitoshi TAKAHASHI,

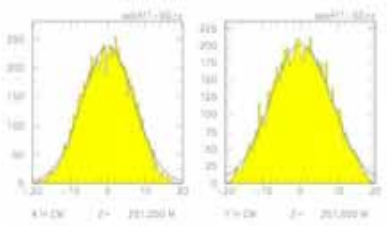
Beam Monitors

Dr. Yoshinori SATO

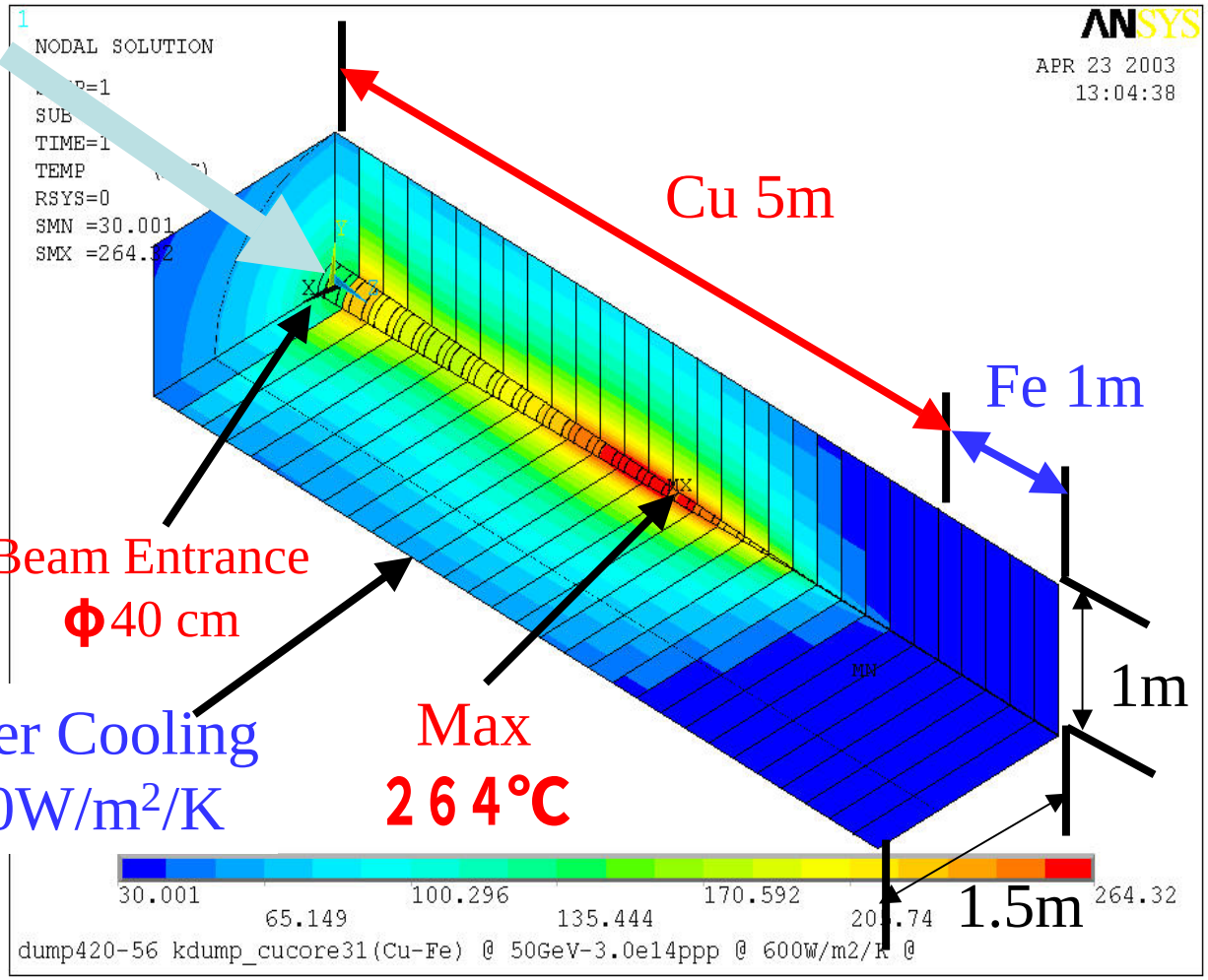
Talk in the Tomorrow Morning!

Beam Dump Design

Proton beam
50GeV-15μA
(750kW)
φ40cm



An Example of the Dump Core ¼ Model Calculation by MARS & ANSYS

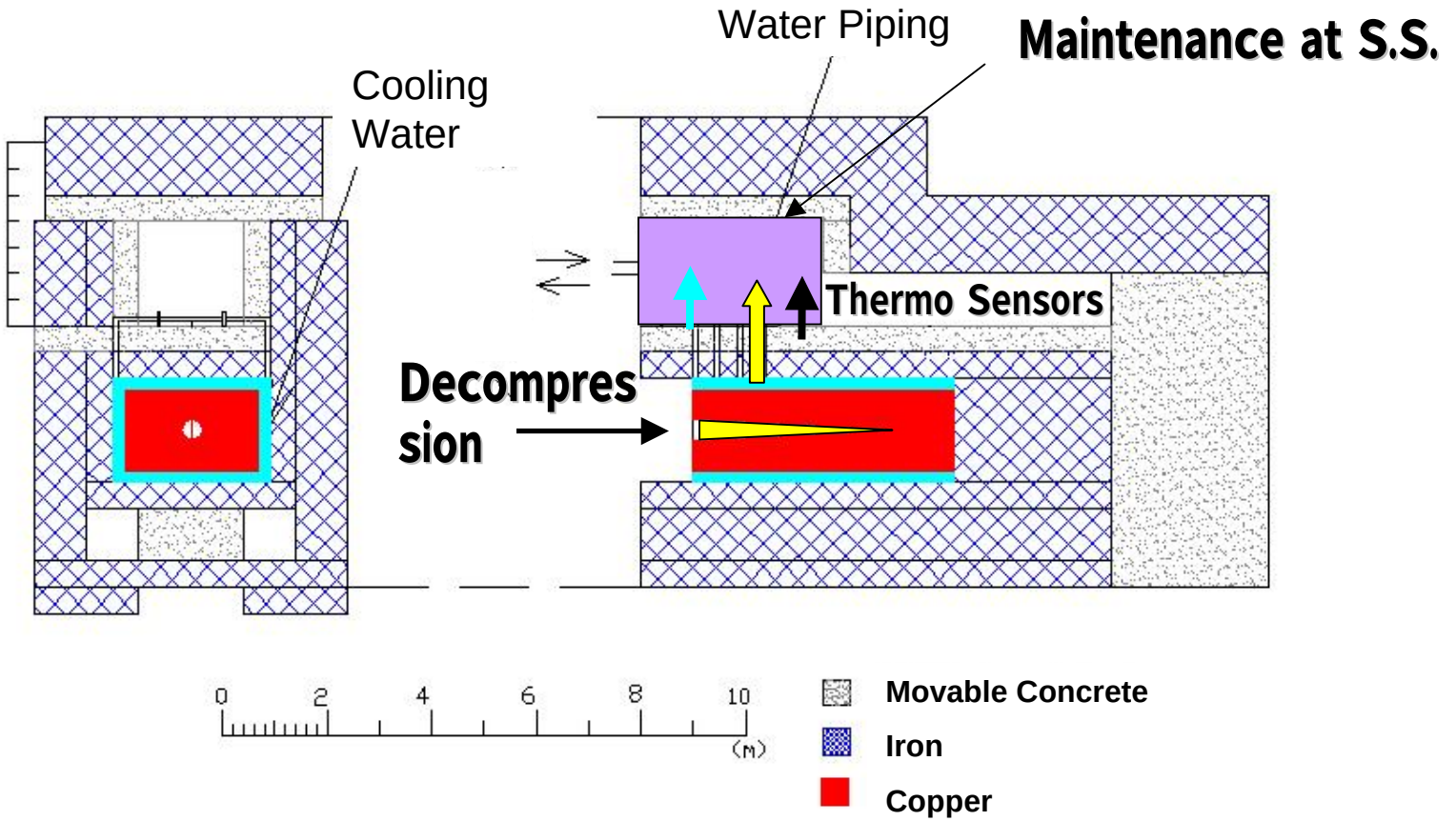


OFC
ρ =8.9[g/cm³]
Thermal
Conductivity
390 [W/m/K]

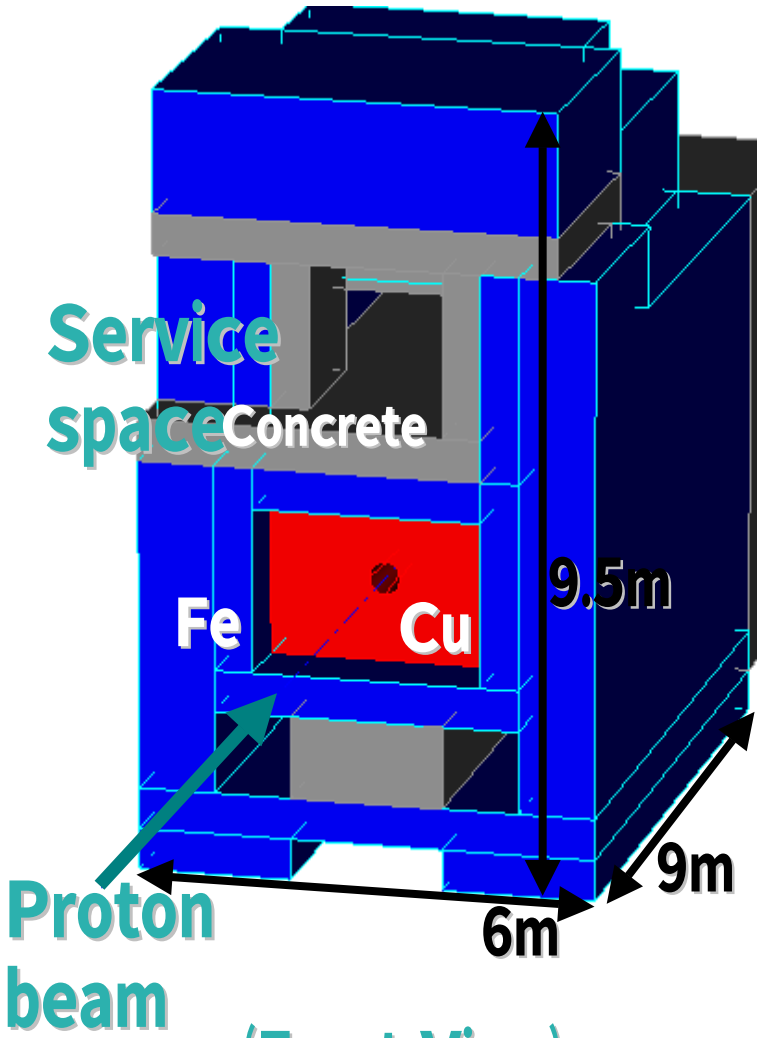
(calculated by Y. SATO & M. MINAKAWA)

Maintenance/Operation Scenario

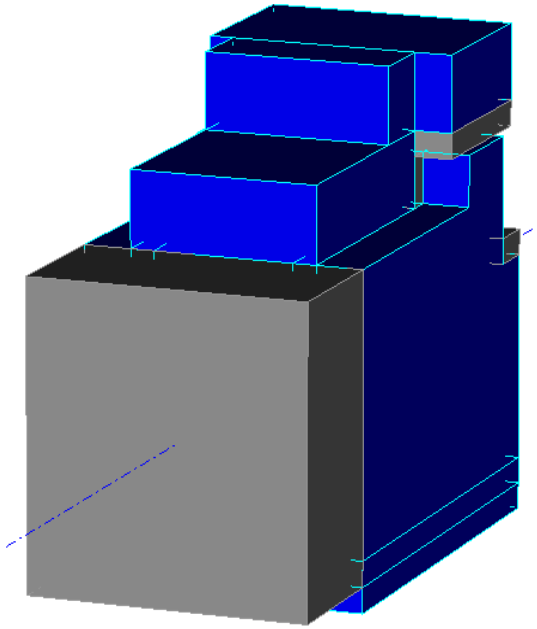
- Core Part should be Maintenance Free
- Cooling Water from Service Space(S.S.).
- Reduce the air Pressure in the Taper.
- Beam Stop at High Temp and/or Imbalance Temp. Distribution.



How to build



(Front View)



(Back View)

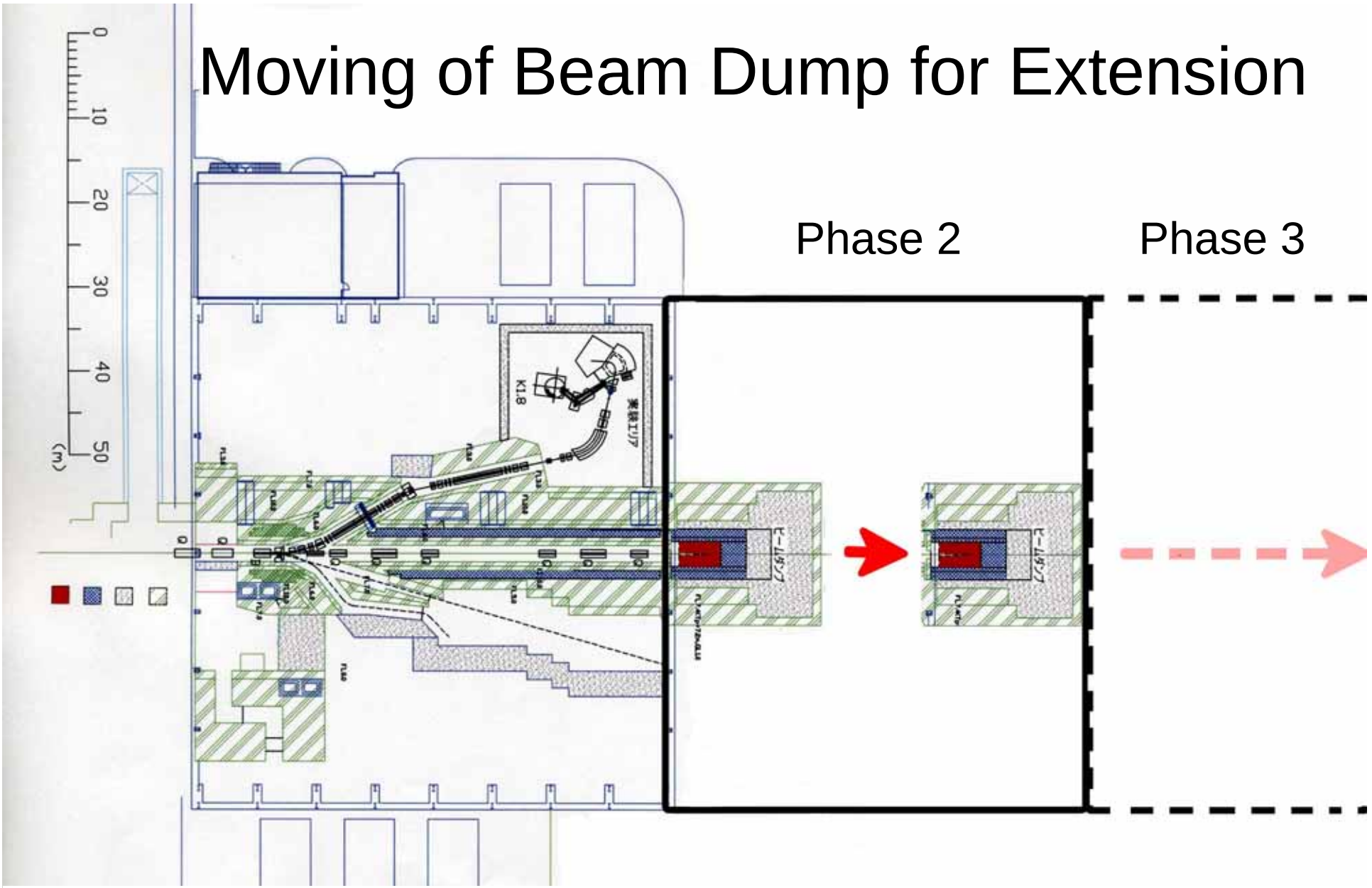
Core: Copper

High Thermal Conductivity.

Maintenance

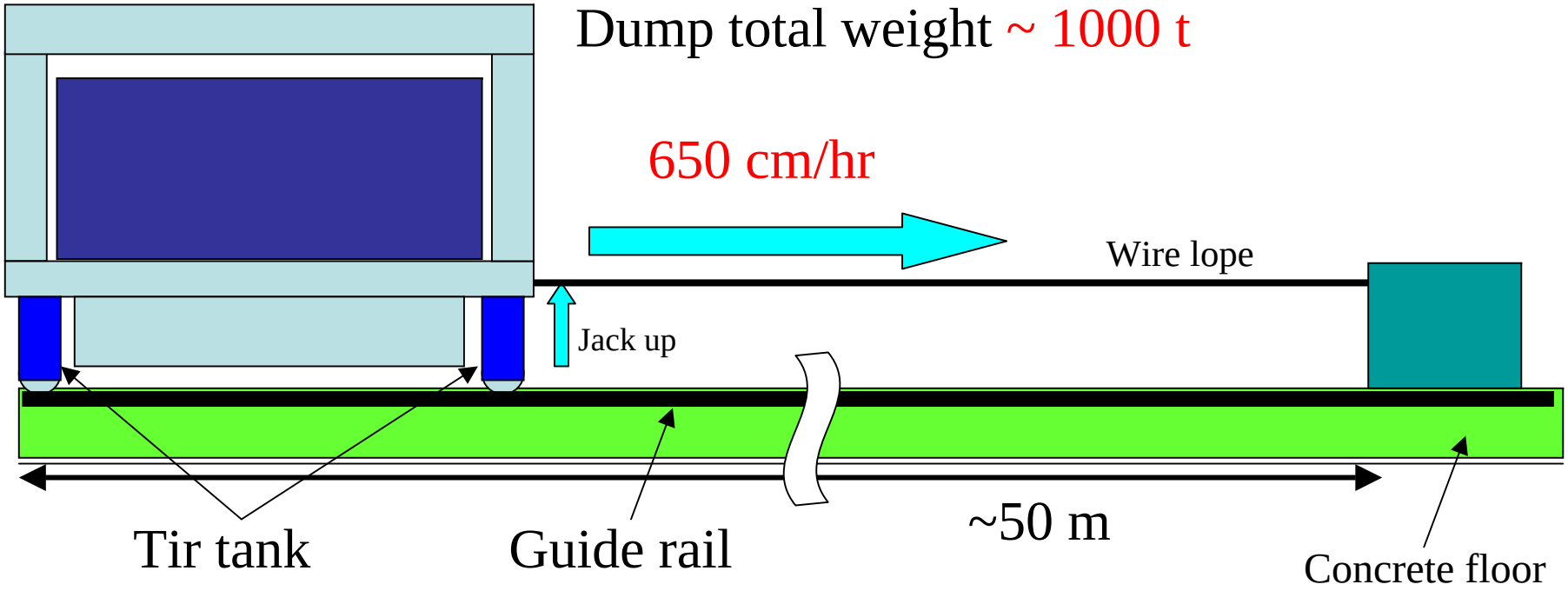
Service Space Structure.

Moving of Beam Dump for Extension



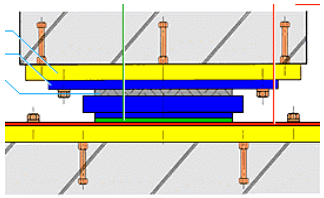
Beam dump must be moved for the future extension!

How to move it safely?



- Need to be balanced carefully
- Guarantee flatness of the floor

How to move

Methods	Advantage	Disadvantage	
Roller	◆Easy ◆Cheap	◆Manpower & Time ◆Unstable	
Linear Guide	◆Stable	◆Expensive	
Air Bearing	◆Low Friction	◆Motion Guide ◆Braking ◆Clean Floor	
Till Tank	◆Space Saving ◆Cheap?	◆Some Guide for Linear Motion	
Sliding Shoe	◆Manpower Saving ◆Easy Installation	◆Organic Material for Shoe	

Moving scheme and Radiation

End of Phase
1 Experiments

Beam Stop

One or Half Year Cooling

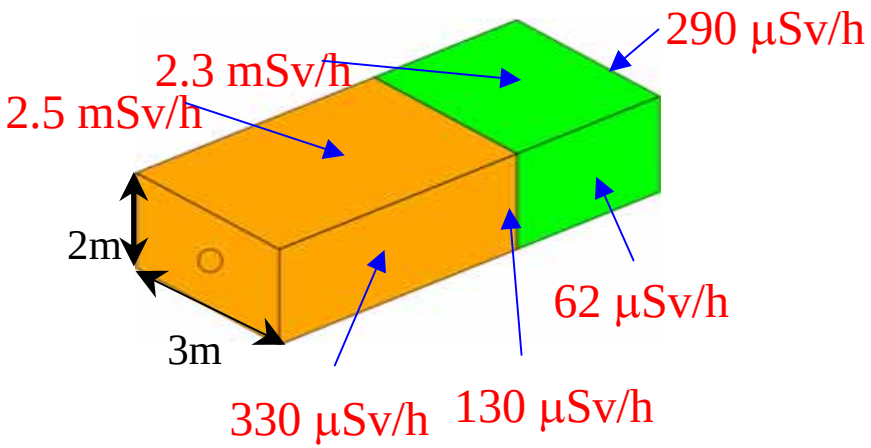
New Expanded Building
Removal of Radiation Shields
Water Pipe etc. Removal

MOVING!

Dump Reconstruction

Experiments Re-Start

- Residual Radiation after 1 Year Operation/Half Year Cooling at the Core Surfaces
- 500mm Iron will be Left at the Core Surfaces: Less Radiation for Work Places

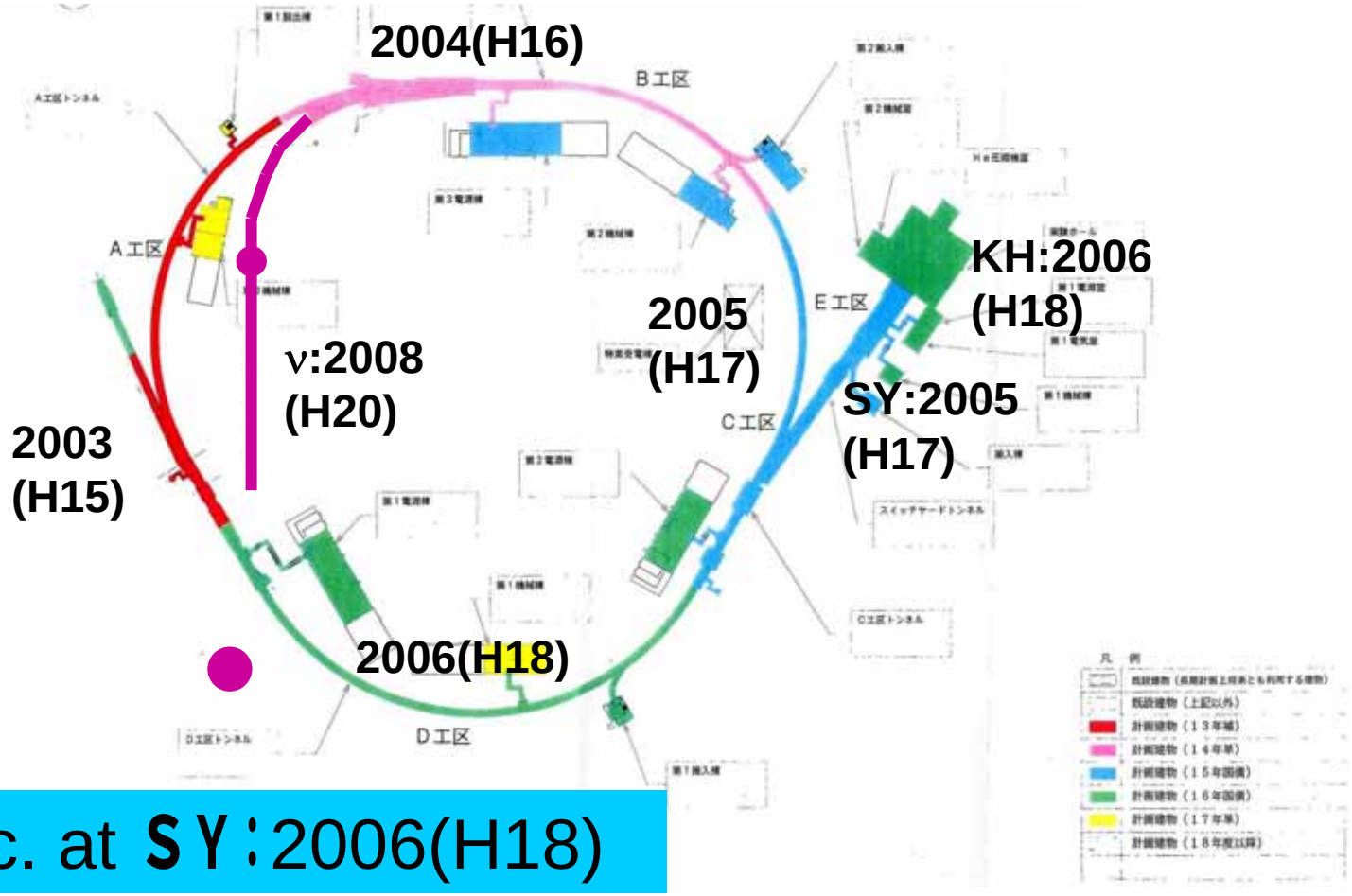


Summary & Status

- Facility Design & Beam Line Layout
  - Almost Completed
- High Intensity Beam Handling System
  - Almost Ready.
- Most Serious Parts,

  i.e. Target & Beam Dump
  - Final Stage of Design/R&D.

Construction Schedule



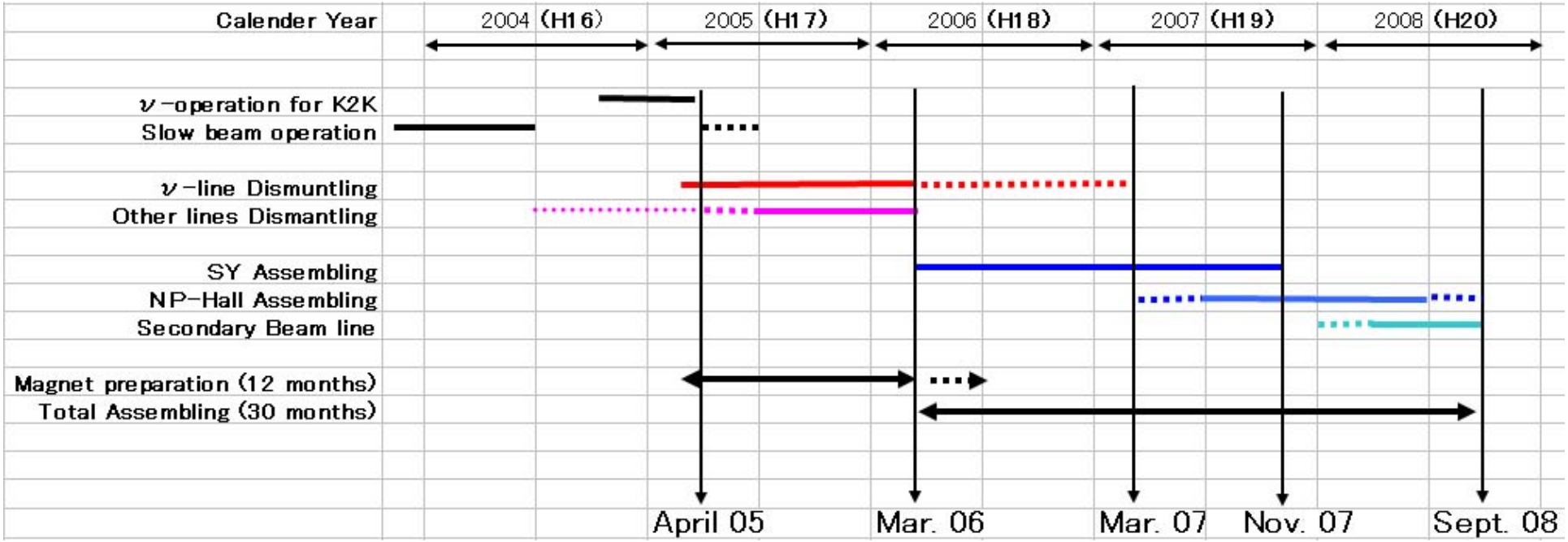
Magnets etc. at ＳＹ：2006(H18)

Magnets etc. at NP-Hall：2007(H19)

The first Beam to NP-Hall：2008(H20)?

ν-Beam：2009(H21)

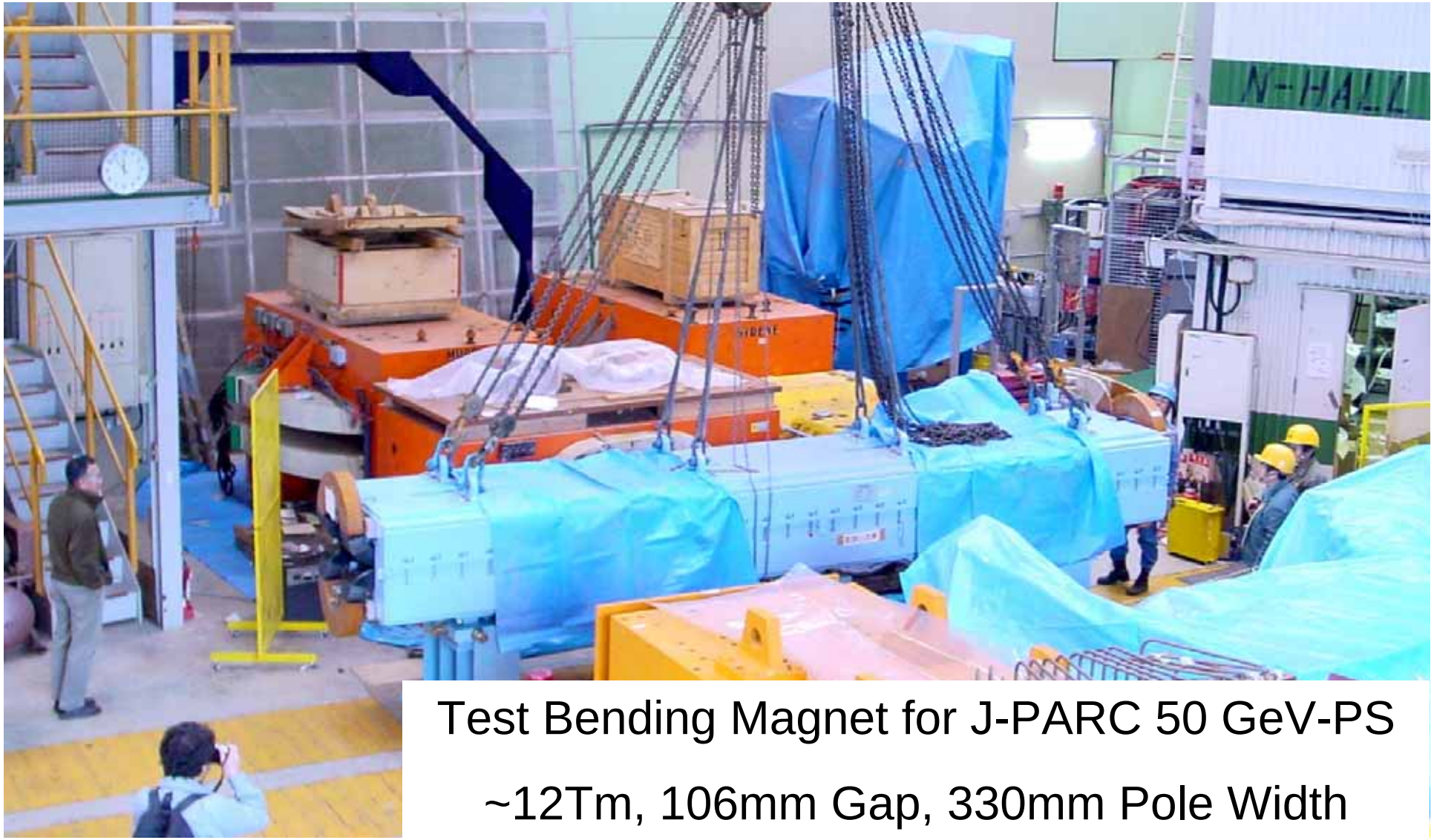
Dates of Remember



- **April 2005**: We can start recycling magnets!
  - **March 2005**: K2K shut down
  - **June 2005**: KEK-PS shut down. The most of construction team should take care of external beam lines of the KEK-PS until then.
- March 2006: We can start SY settings &
  The most magnets should be ready until then!
- March 2007: We can start NP-Hall settings
- Sept. 2008: The construction should be completed (officially) &
  The First Beam!

Magnet Collection Project

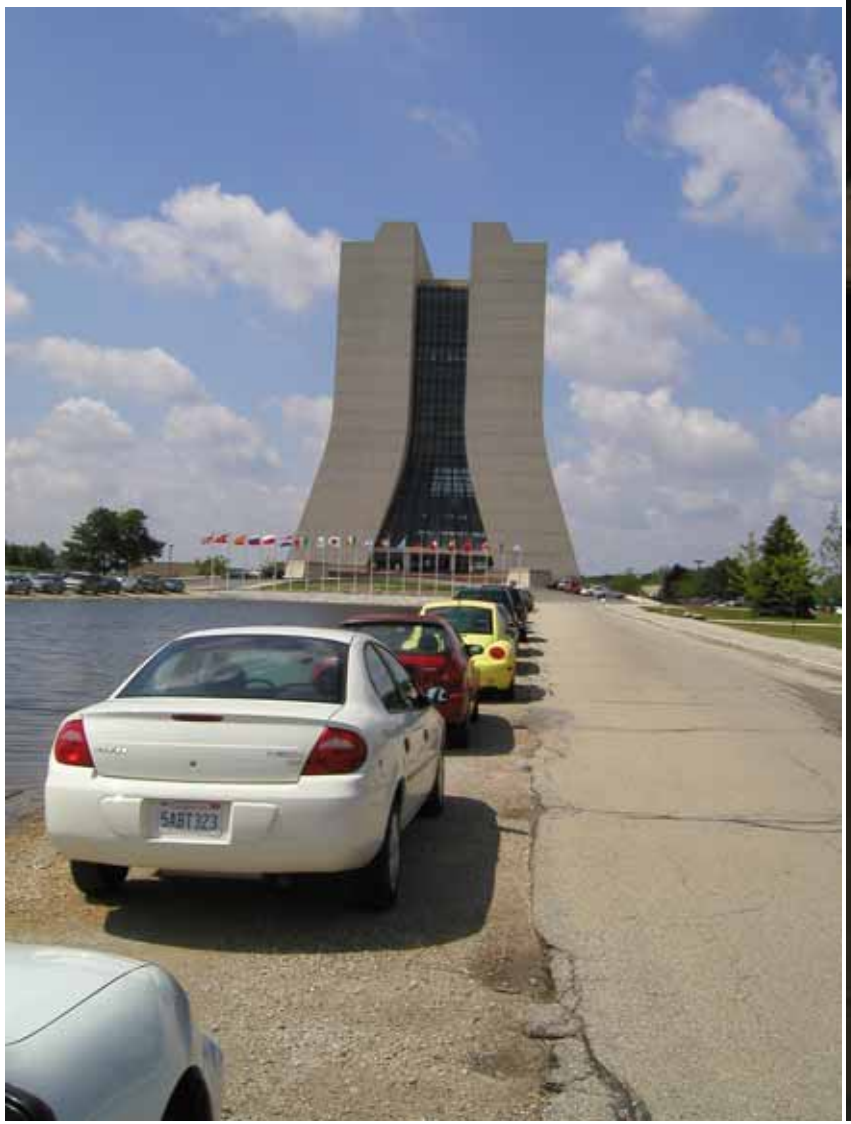
The Latest Contribution!



Test Bending Magnet for J-PARC 50 GeV-PS

~12Tm, 106mm Gap, 330mm Pole Width

18D72 Magnet from FNAL?



Radioactive Iron from DURATEK

- 1$/10t in US
- 170$/1t including transport cost for J-PARC.
- 1/4 of Normal Iron?
- Less than 2nCi/g (10Bq/g)
- Max. 0.3mR at Surface.
- It’s NOT Nuclear Wastes.
- Possible in Japanese Law!

Hadron Beam Sub-Group in 2004