T2K Target Station and Decay Volume

Yoshikazu Yamada (KEK, IPNS)

for Neutrino Facility Construction Group at J-PARC

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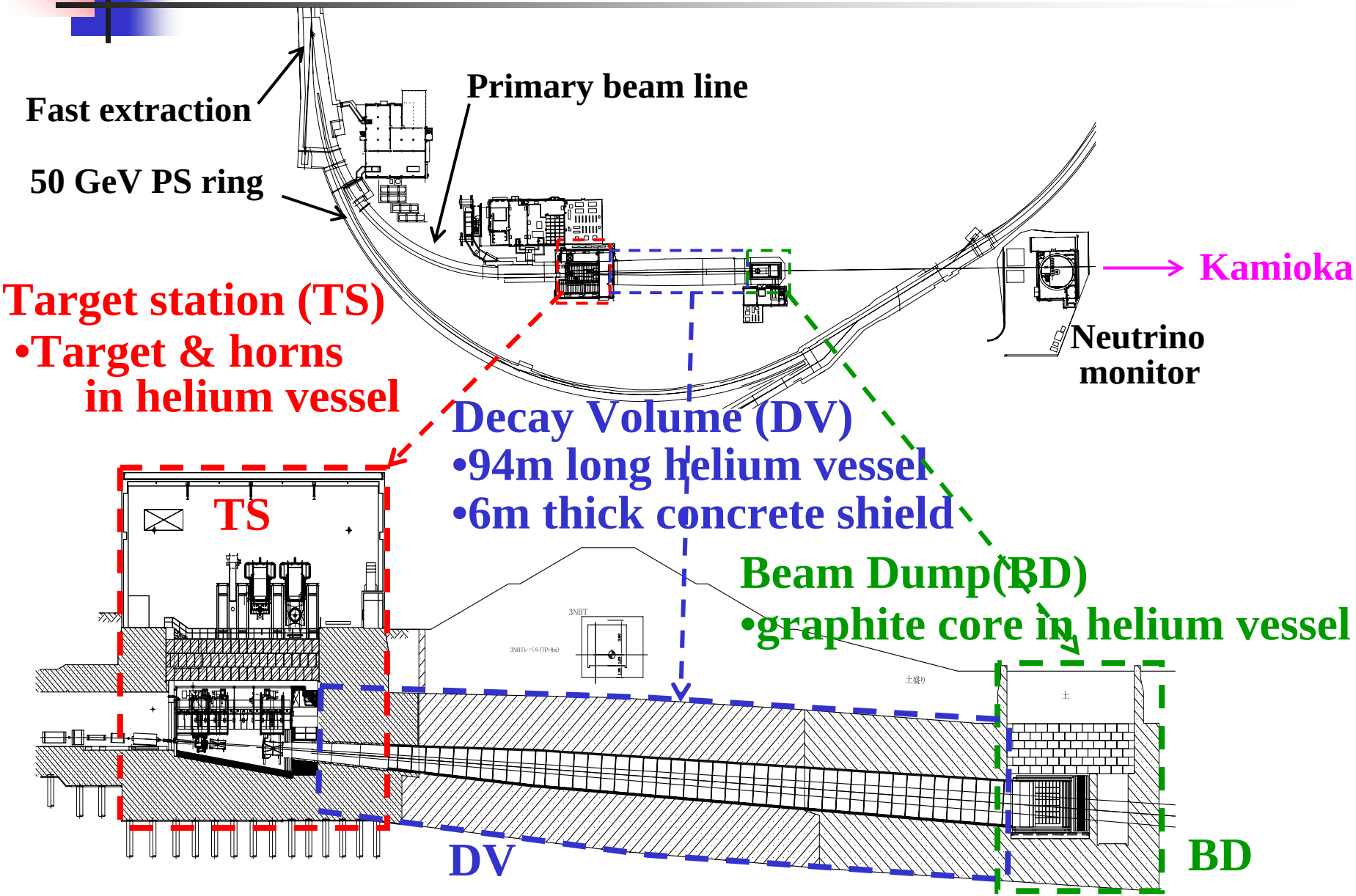
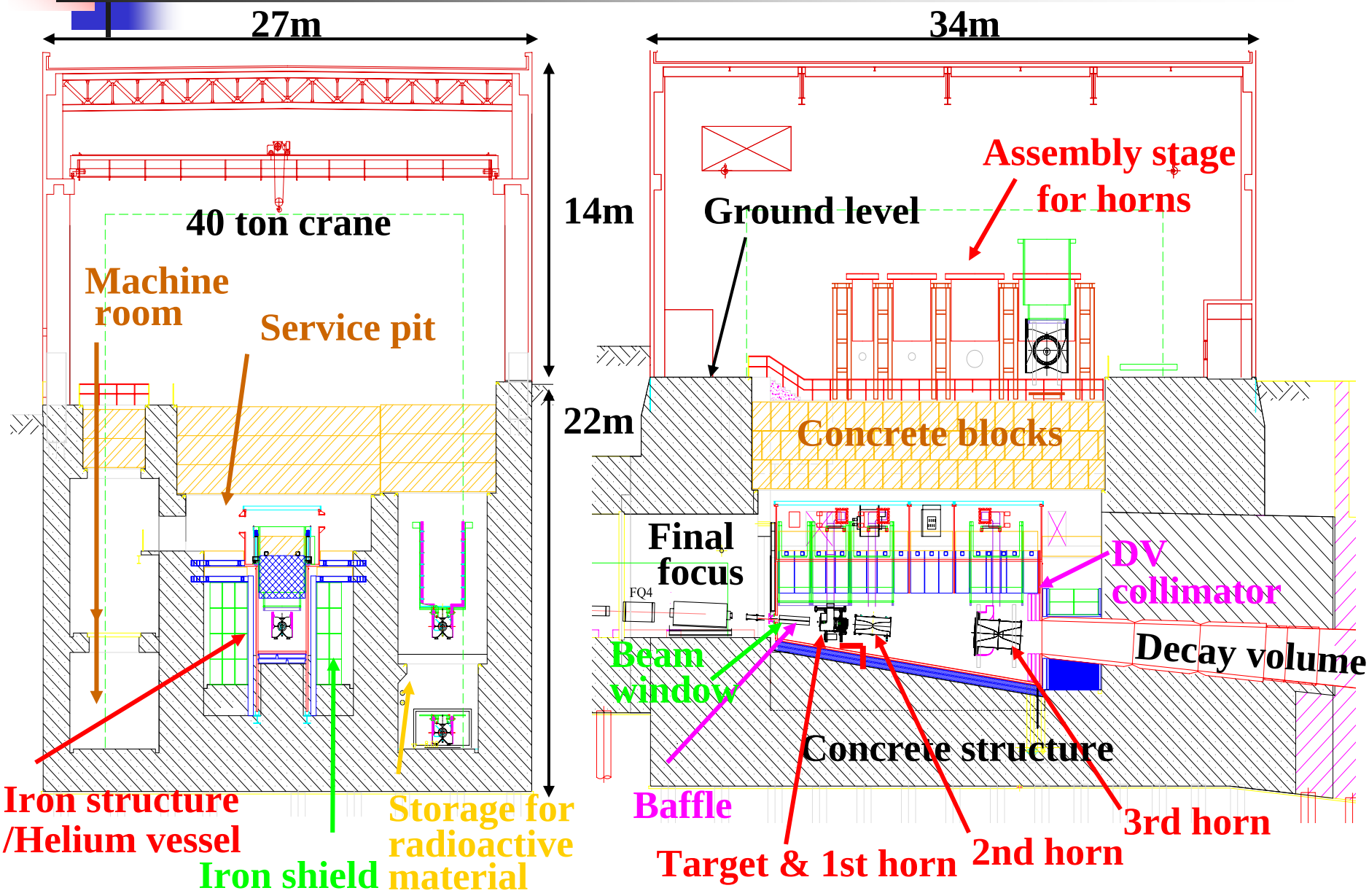
Contents

- Target station
  - Introduction
  - Cooling
  - Structure analysis
  - Schedule
- Decay Volume
  - Status and schedule

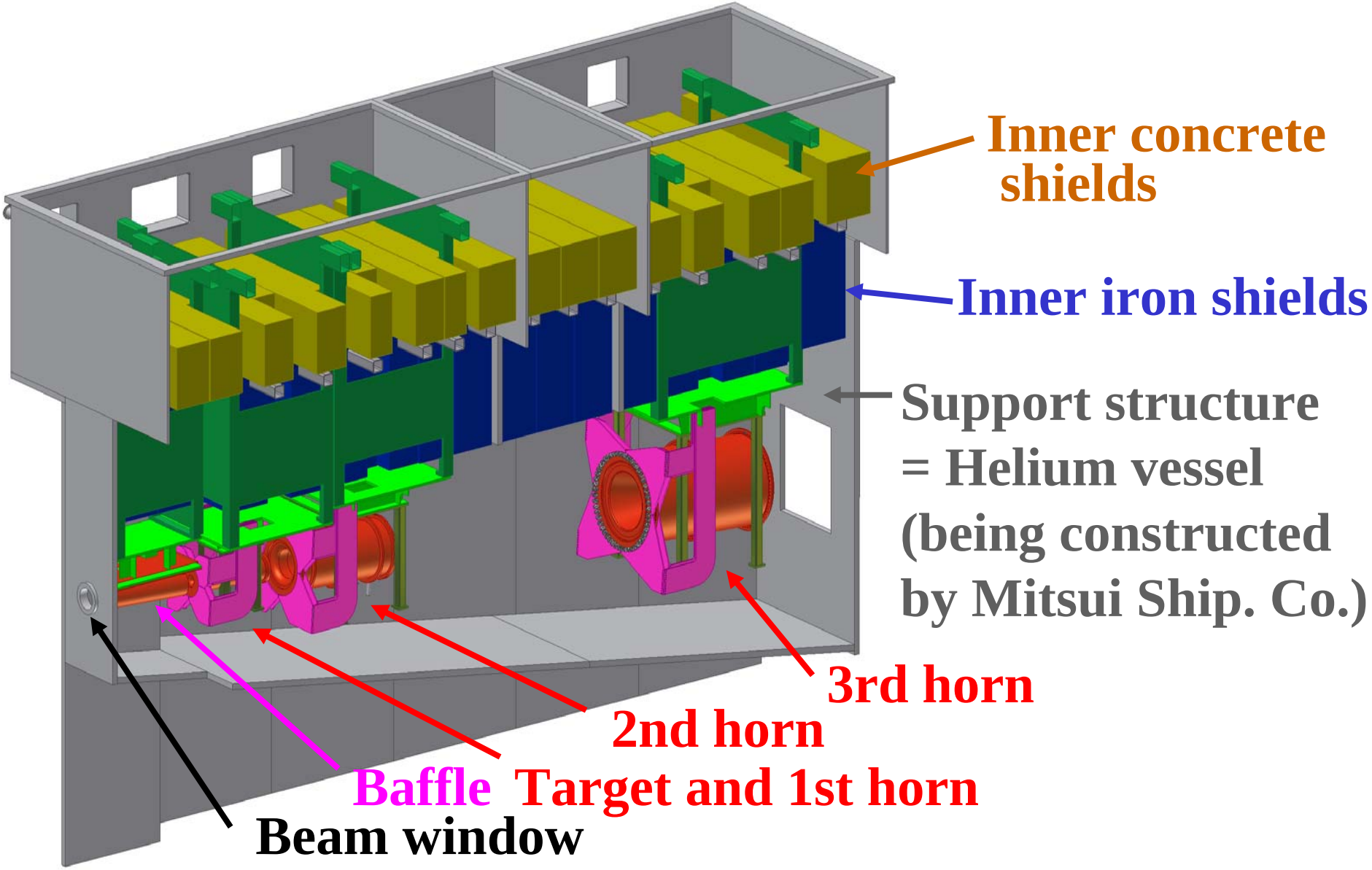
Secondary Beam Line



Target station



Target area

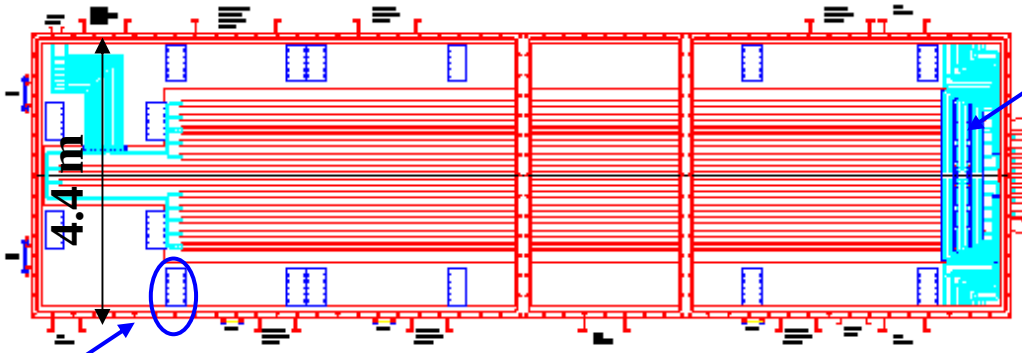

Inner concrete shields
Inner iron shields
Support structure = Helium vessel (being constructed by Mitsui Ship. Co.)
3rd horn
2nd horn
Target and 1st horn
Baffle
Beam window

Energy deposit and cooling

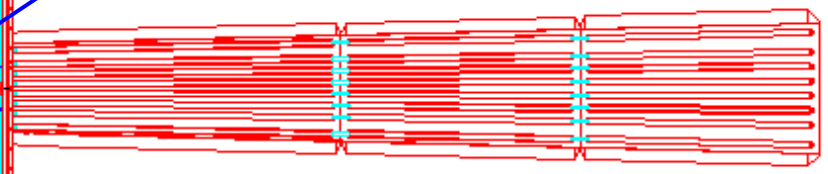
	750kW	4MW	Cooling method
Helium vessel	173 kW	922 kW	Water
Inner iron shield	29 kW	155 kW	Water
Bottom iron shield	12 kW	65 kW	Air
Side iron shield	25 kW	131 kW	Air (Add water-cooled plates at 4MW run)
DV collimator (inside)	85 kW	454 kW	Water
DV collimator (outside)	10 kW	53 kW	Air
Decay Volume (upstream)	128 kW	680 kW	Water
Total	462 kW	2460 kW	

- Components in the helium vessel are cooled by water and kept less than 60 ºC.
- Outer components are cooled by air.

Helium Vessel cooled by water



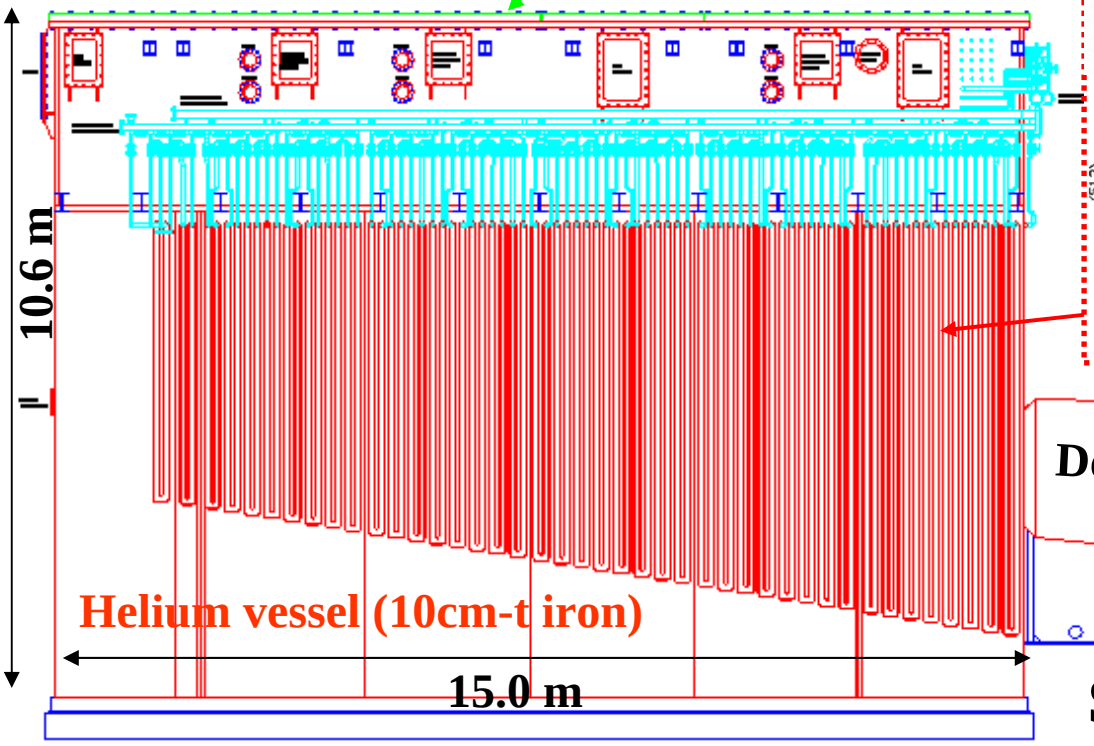
Inner DV collimator



Top and inner view

Base plates for horns

Aluminum top lid



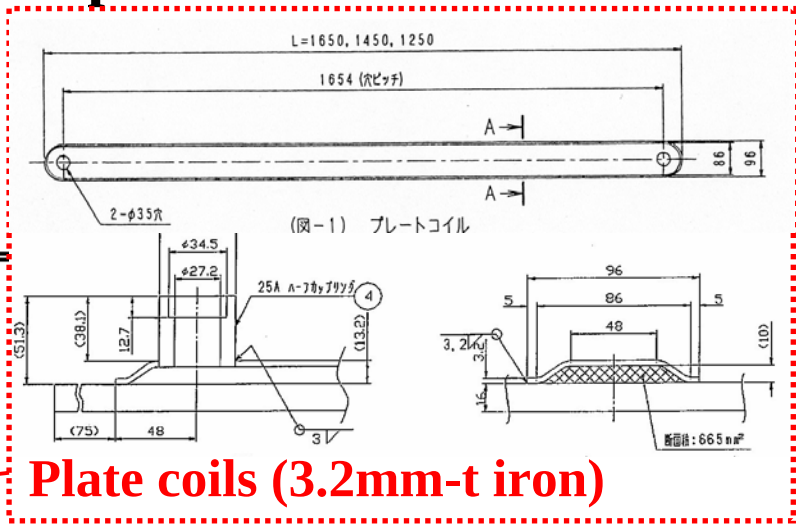
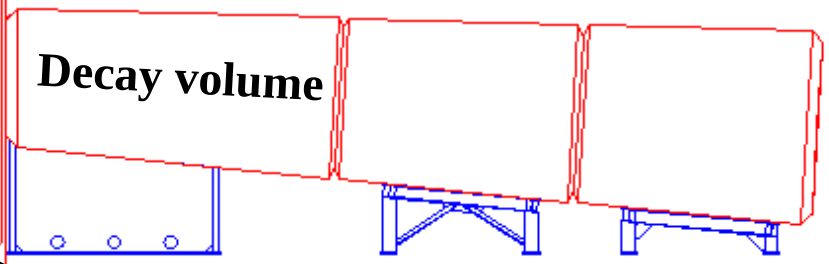


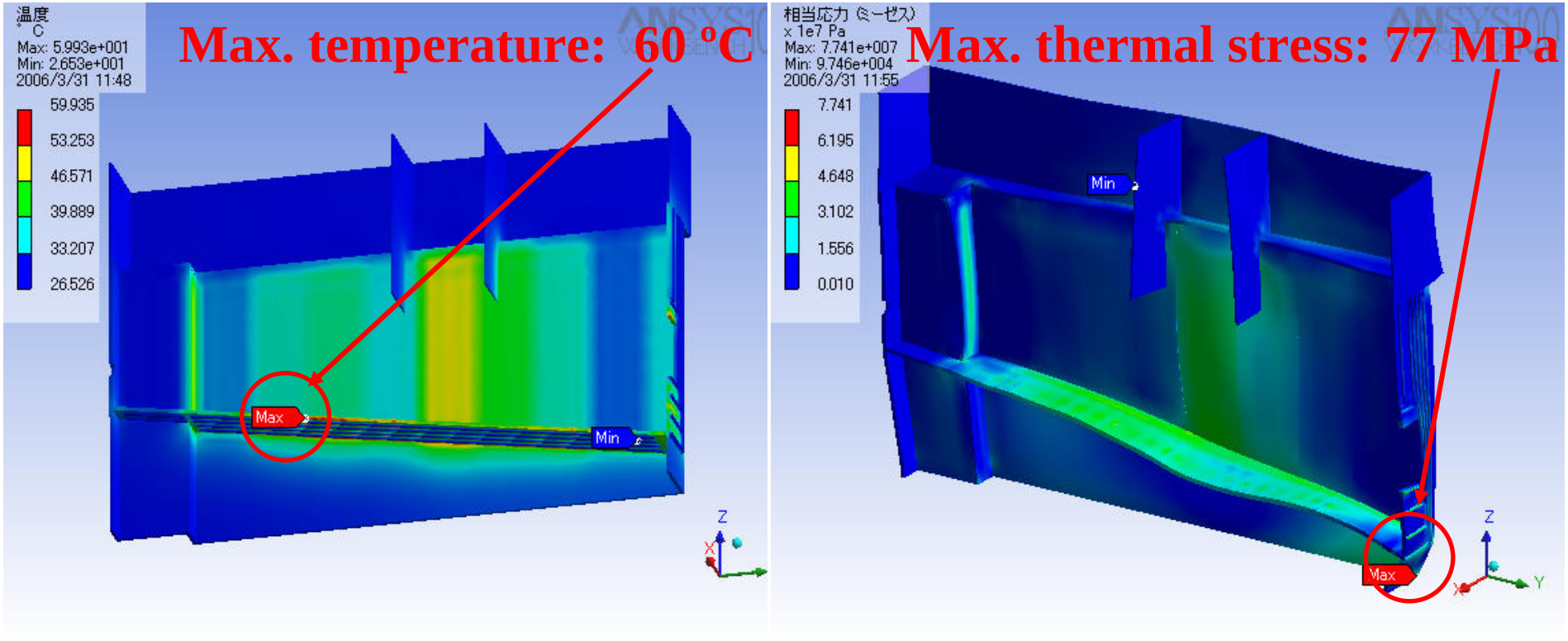
Plate coils (3.2mm-t iron)



Side and outer view

Thermal analysis of helium vessel

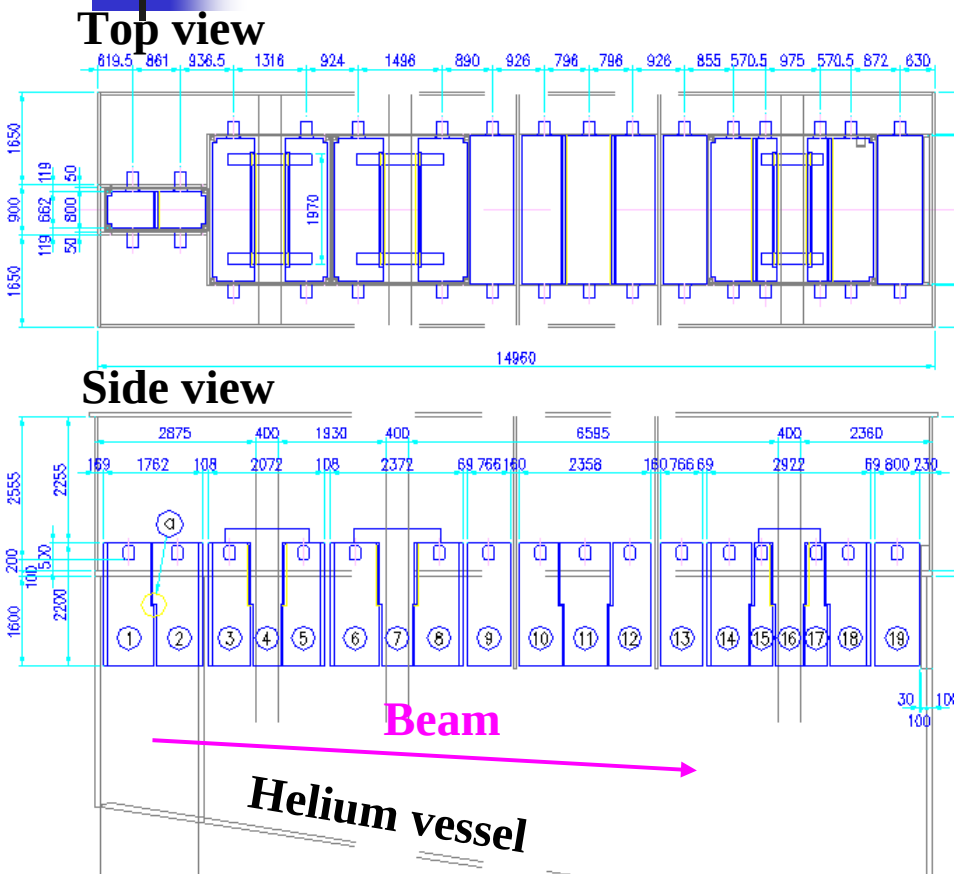
922kW at 4MW-run

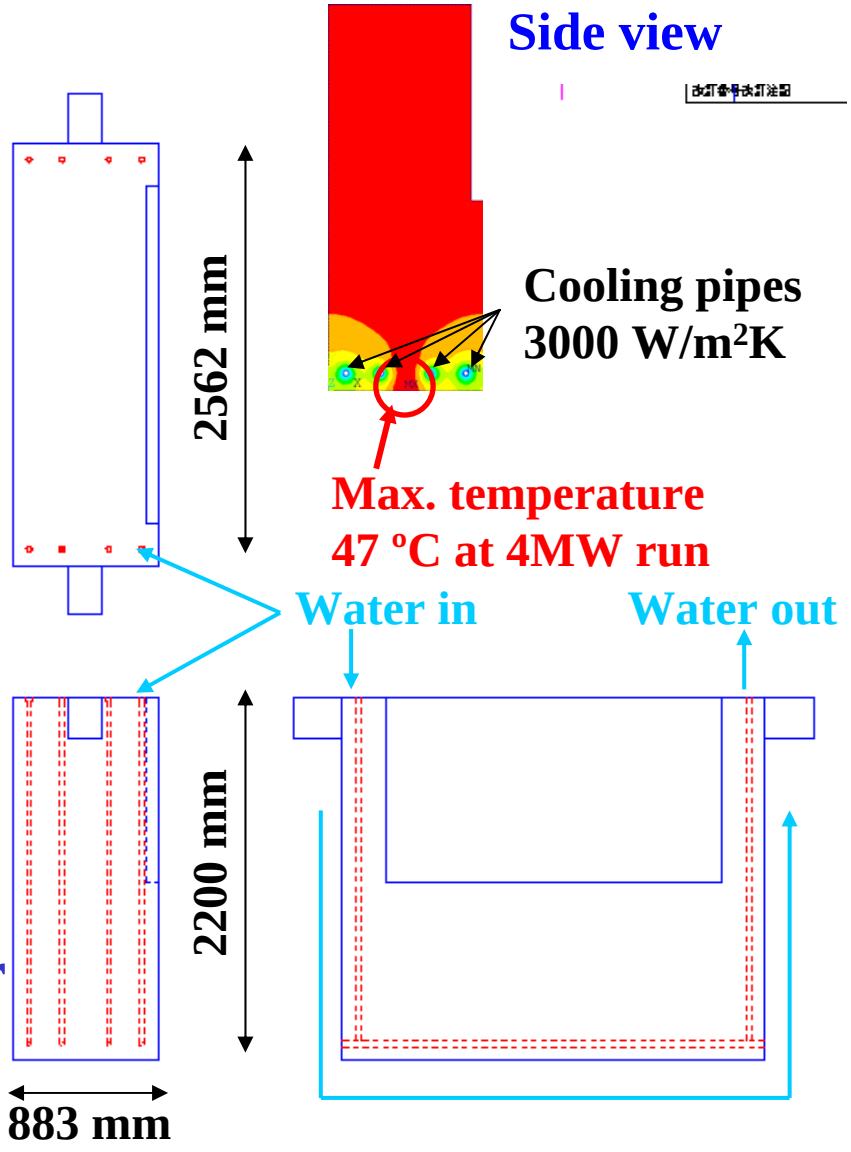


Design criteria for the vessel:

- **lower than 60 °C in temperature**
  (vertical thermal expansion < 1mm)
- **less than 160 MPa in stress**

Inner iron shields

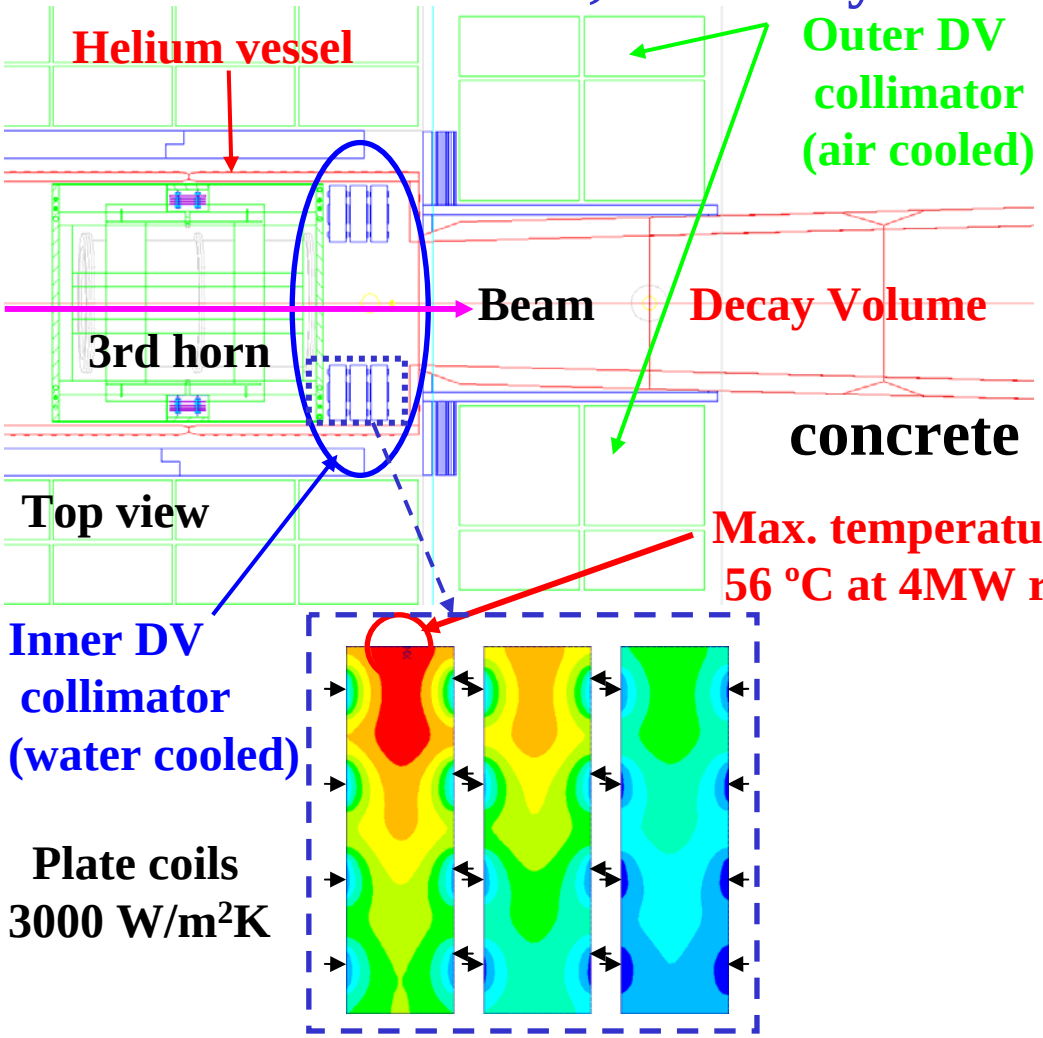


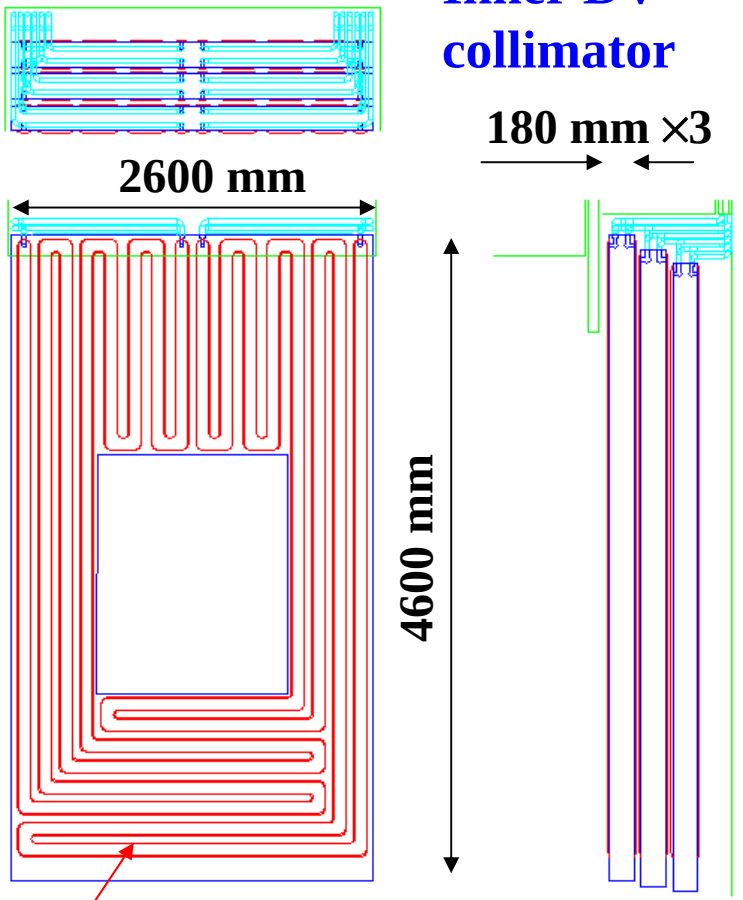


- 19 blocks, total weight ~460 tones
- 155kW(4MWrun), cooled by water
- moved by remote crane
- under design

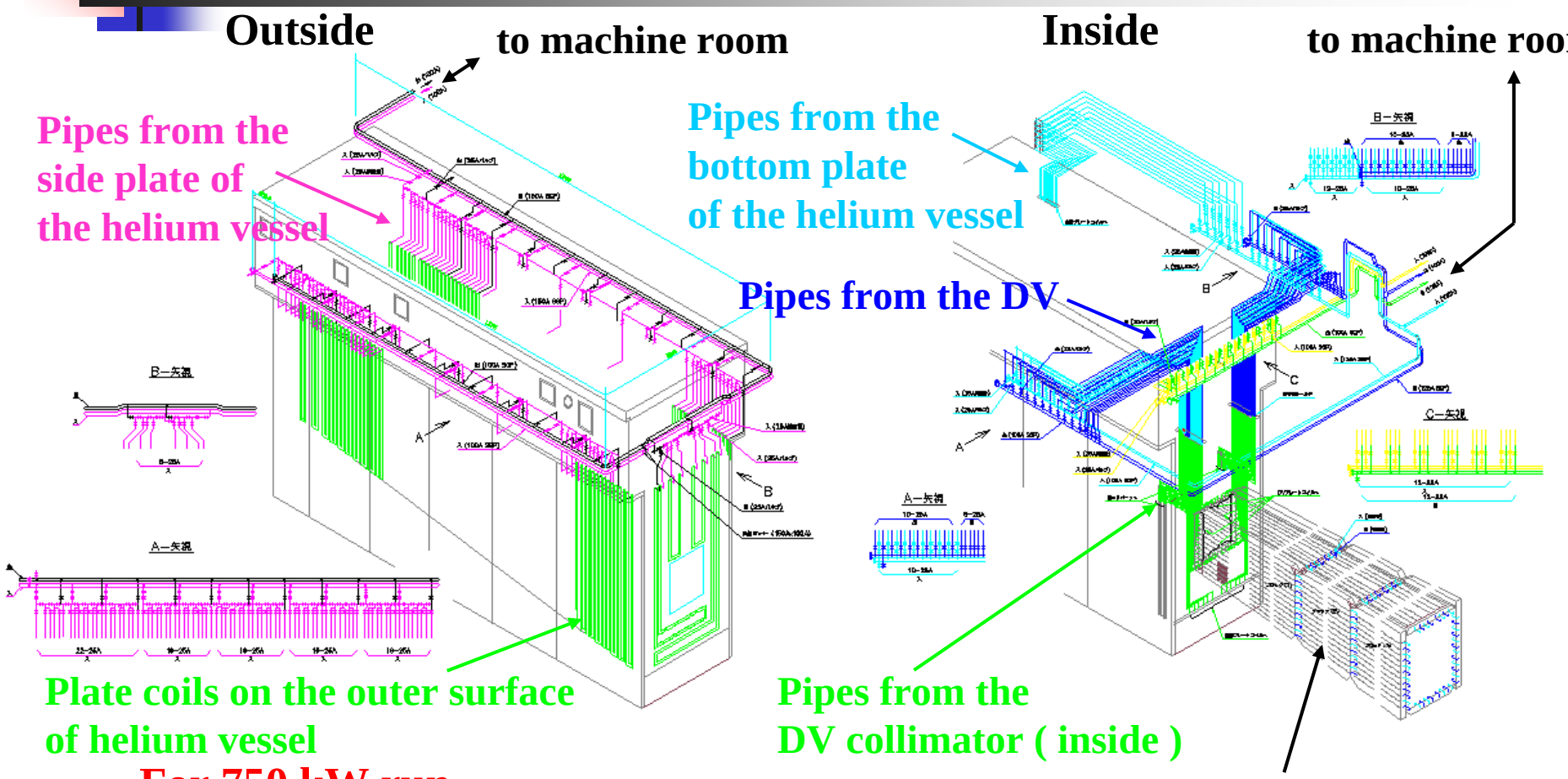
DV collimator

- prevent excessive energy deposit into DV concrete
- 454kW at 4MW-run, cooled by water





Water cooling



For 750 kW run,

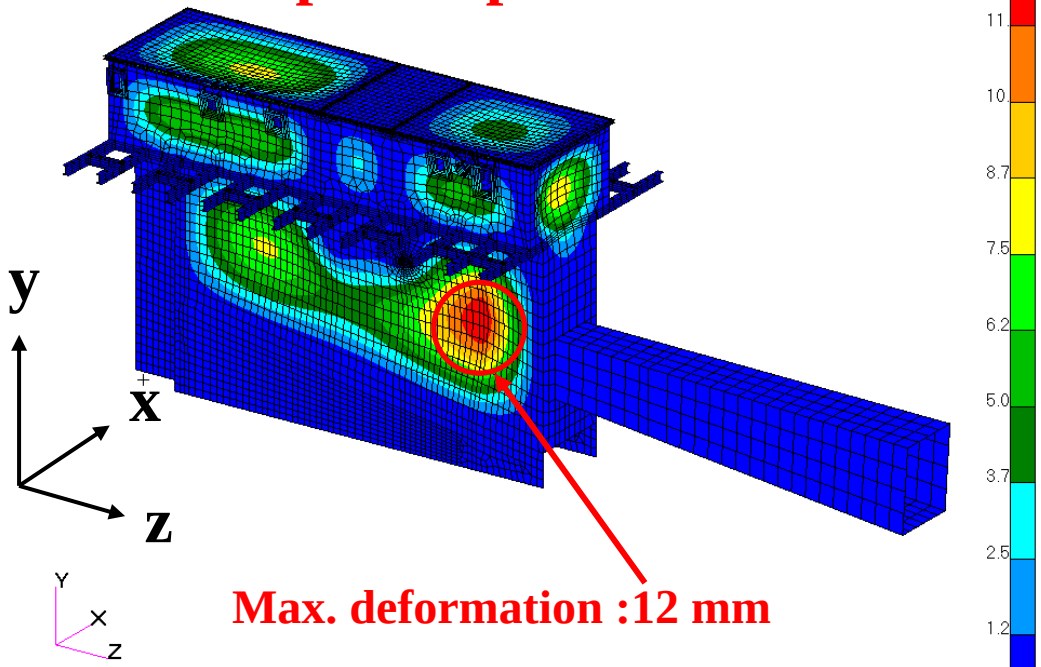
- **Helium vessel: 173kW, 336*l*/min**
- **Inner iron shields: 29kW, 96*l*/min**
- **DV collimator: 85kW, 288*l*/min**
- **DV (upstream half): 128kW, 576*l*/min**

radioactivity→
Oyama's talk

Structural analysis (deform.)

Vessel will be evacuated before being filled with helium gas

⇒Load by self weight and atmospheric pressure

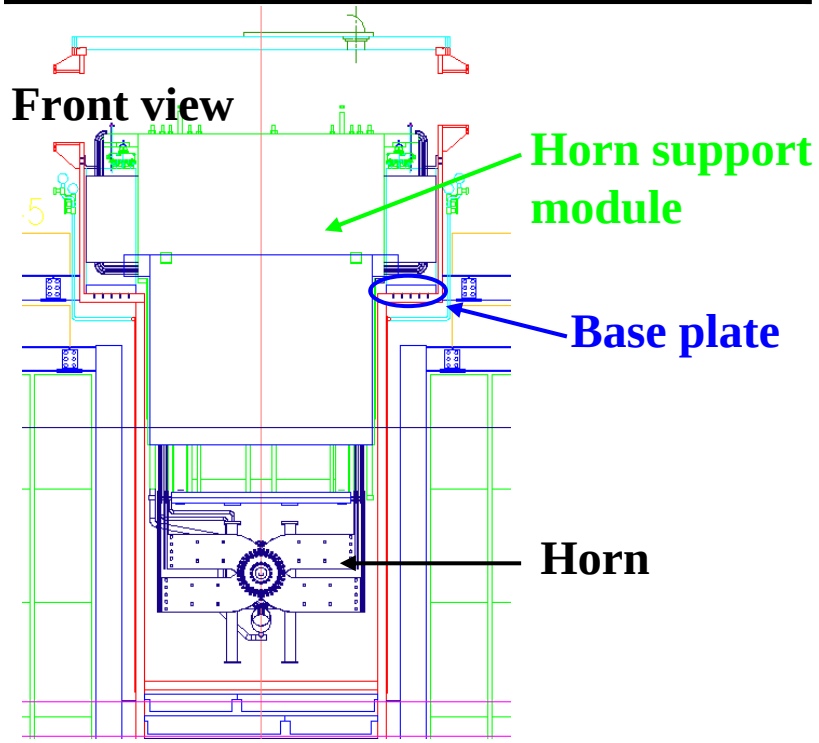


Max. deformation :12 mm

30mm-clearance between the instruments
(vessel and horn support module,
vessel and upper iron shield, …)

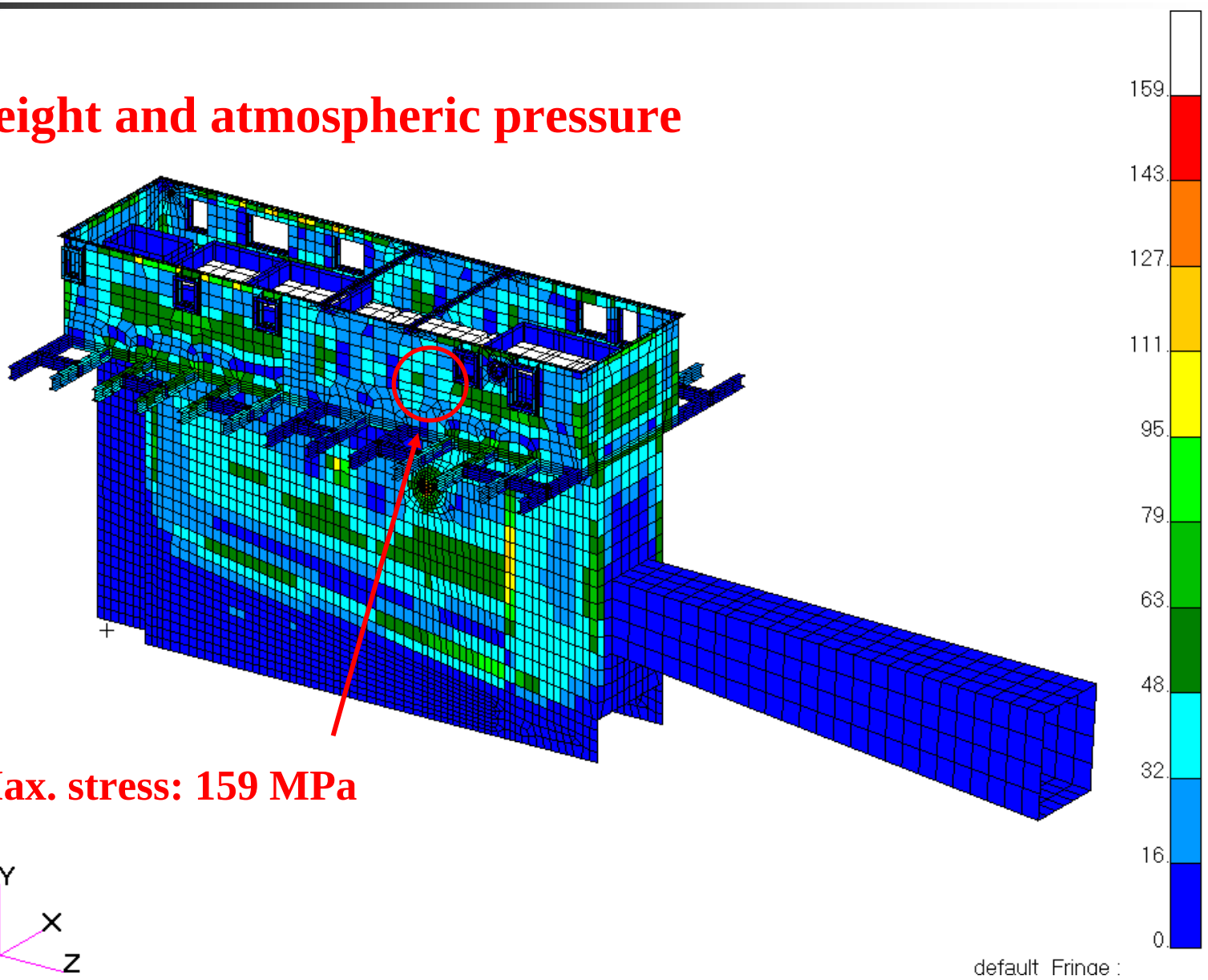
Deformation at base plate of horn support module

direction	1st	2nd	3rd
dx	0.6 mm	0.6 mm	0.2 mm
dy	0.1 mm	0.1 mm	0.2 mm
dz	0.0 mm	0.0 mm	0.1 mm



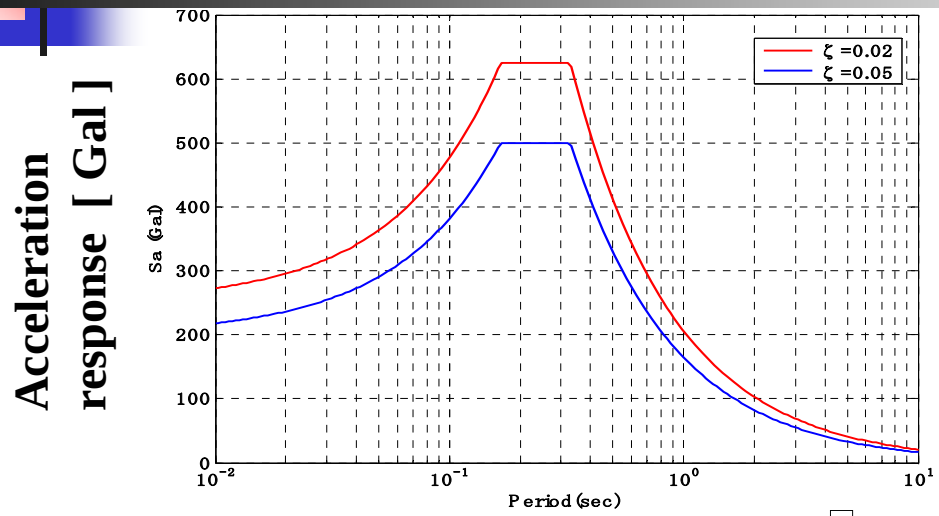
Structural analysis (stress)

Self weight and atmospheric pressure

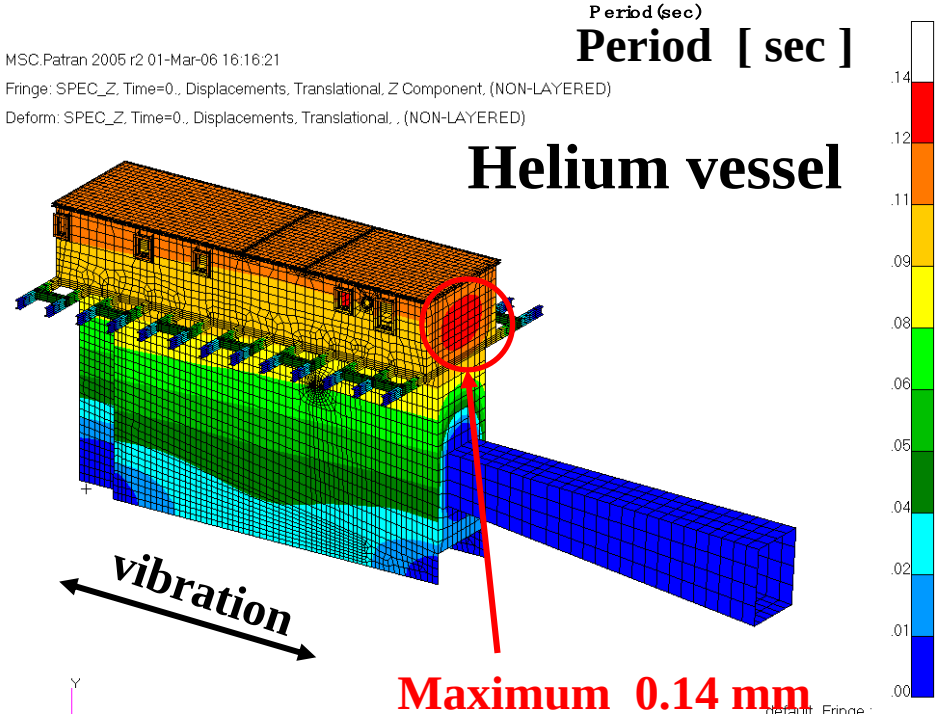


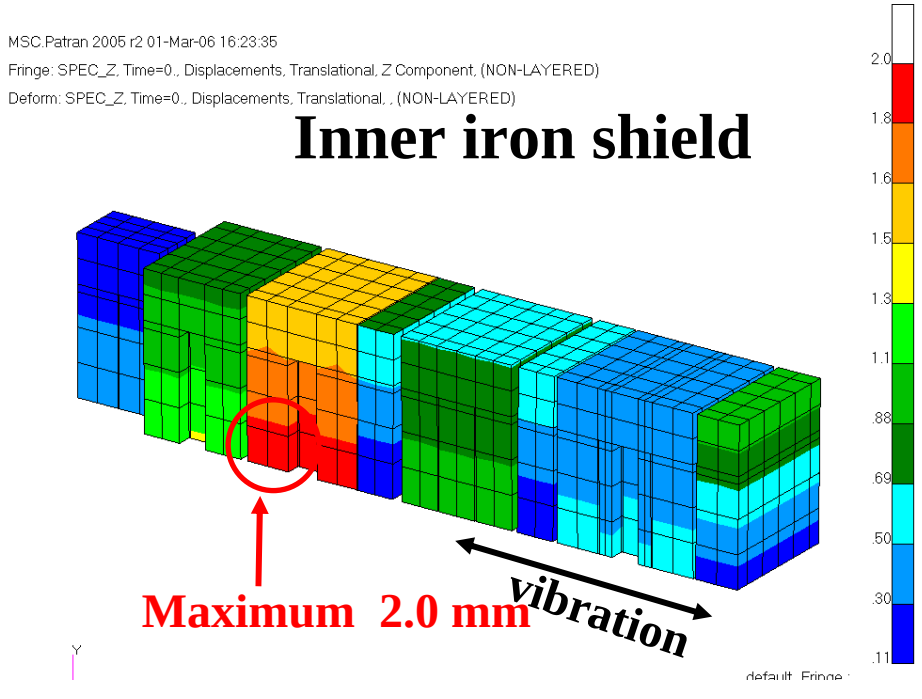
Max. stress: 159 MPa

Seismic analysis



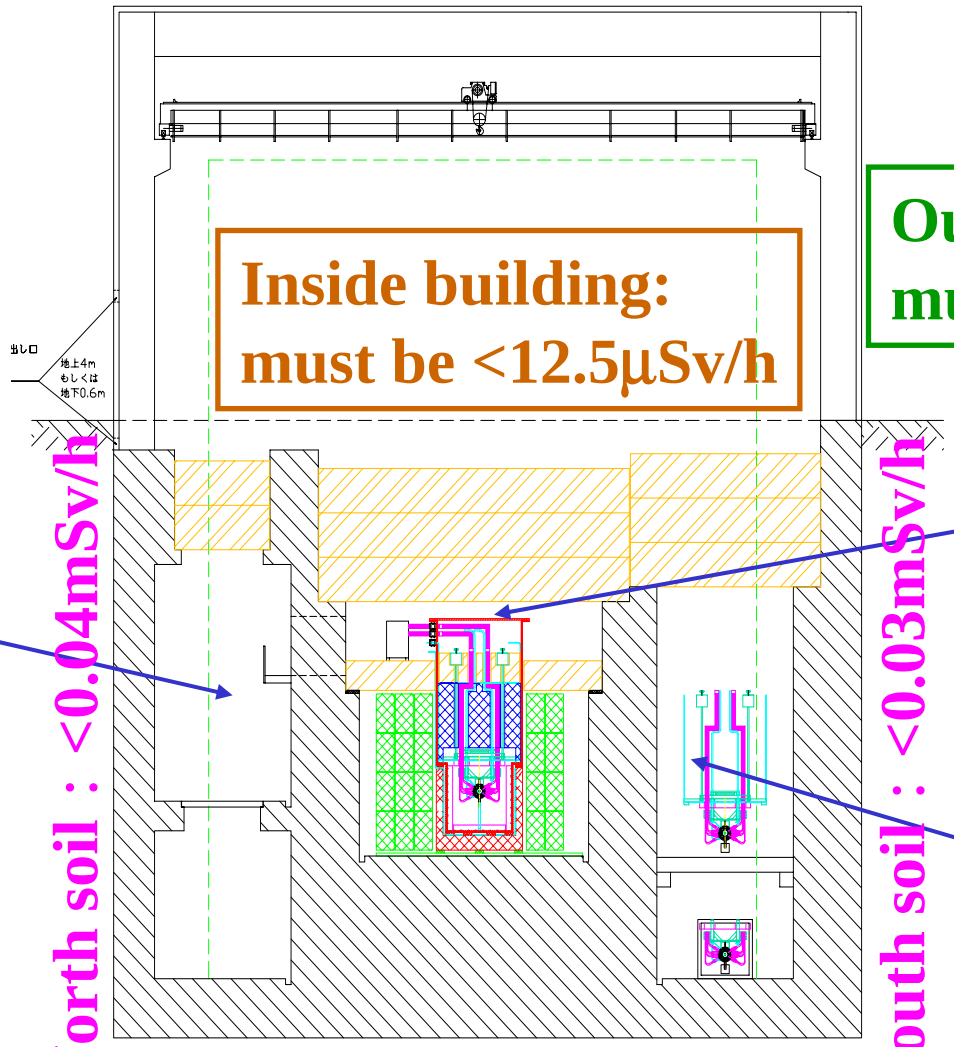
Max. acceleration: 0.6G
Corresponds to a earthquake "6plus" (once in a 100 years) in the Japanese scale





Radiation dose with beam operation

0.75MW operation



Inside building: must be <12.5μSv/h

Outside of building: must be <0.25μSv/h

Service pit: 25mSv/h

Machine room <0.35mSv/h

Storage area A few mSv/h

North soil : <0.04mSv/h

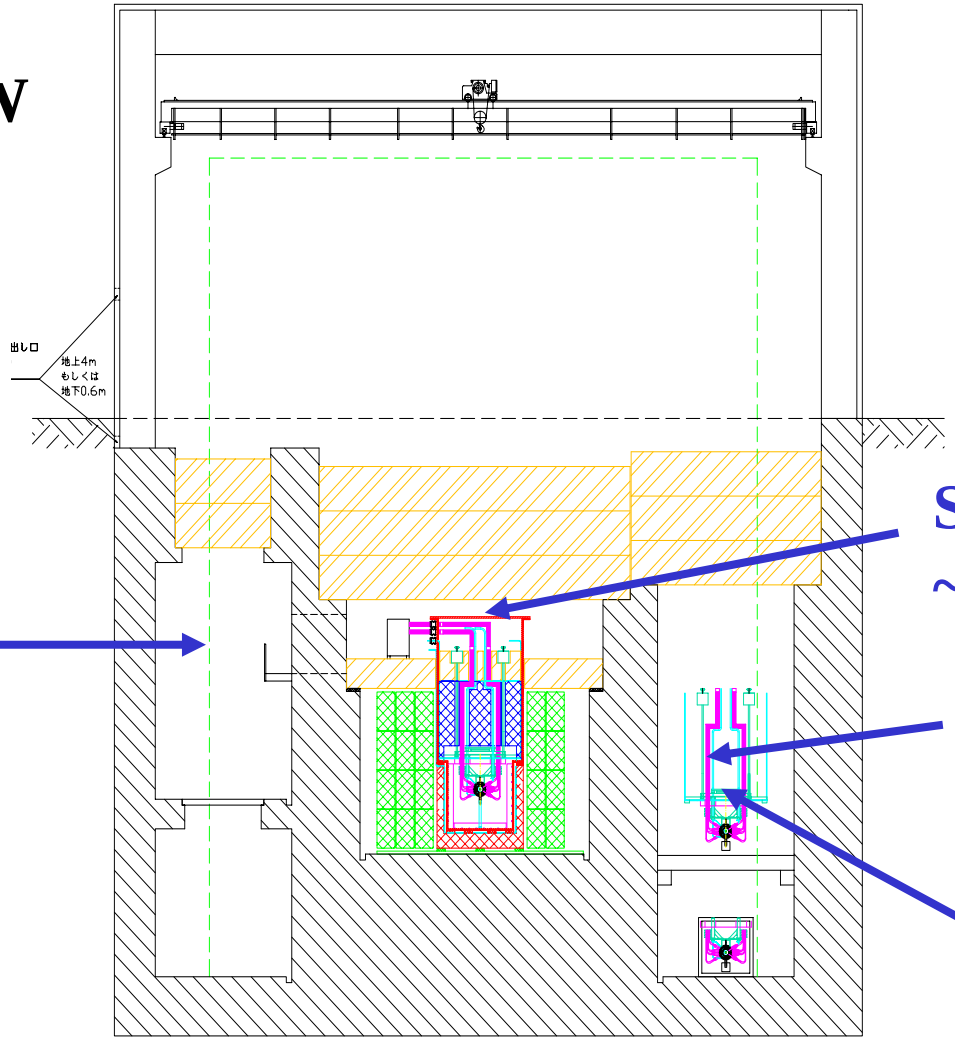
South soil : <0.03mSv/h

Bottom soil<1.6mSv/h

soil: must be <5mSv/h

Residual dose

30 days of 0.75MW operation and one day cooling



Machine room ~0.03μSv/h

Service pit: ~2μSv/h

Storage area ~0.1μSv/h

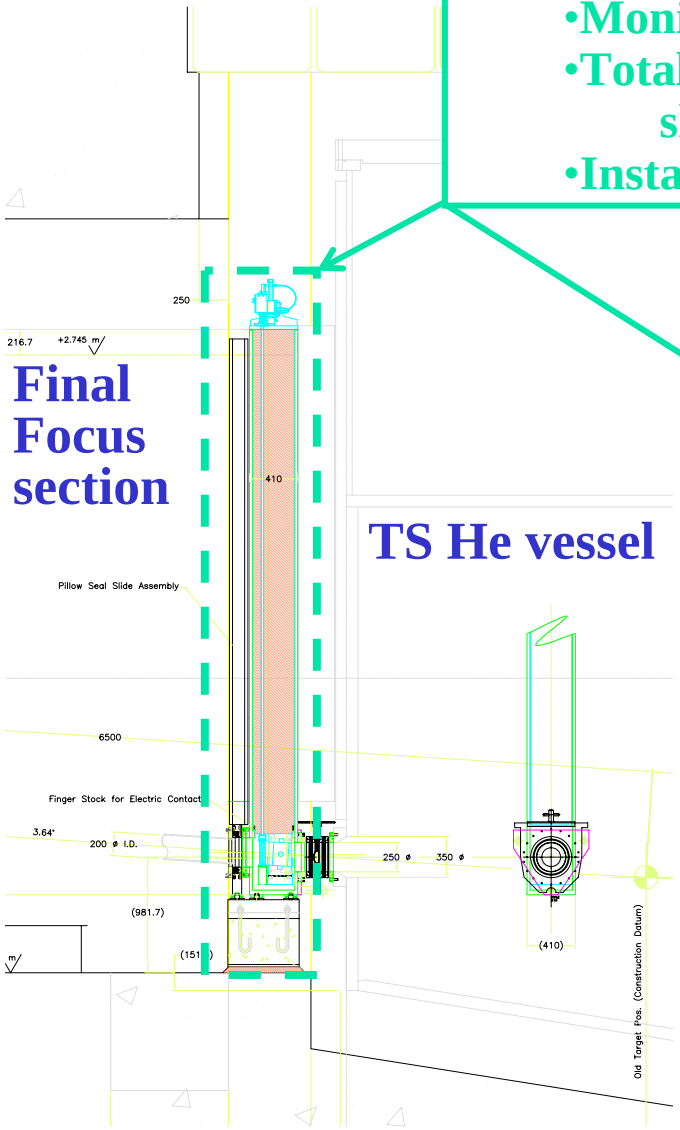
Hot lab. ~0.02μSv/h

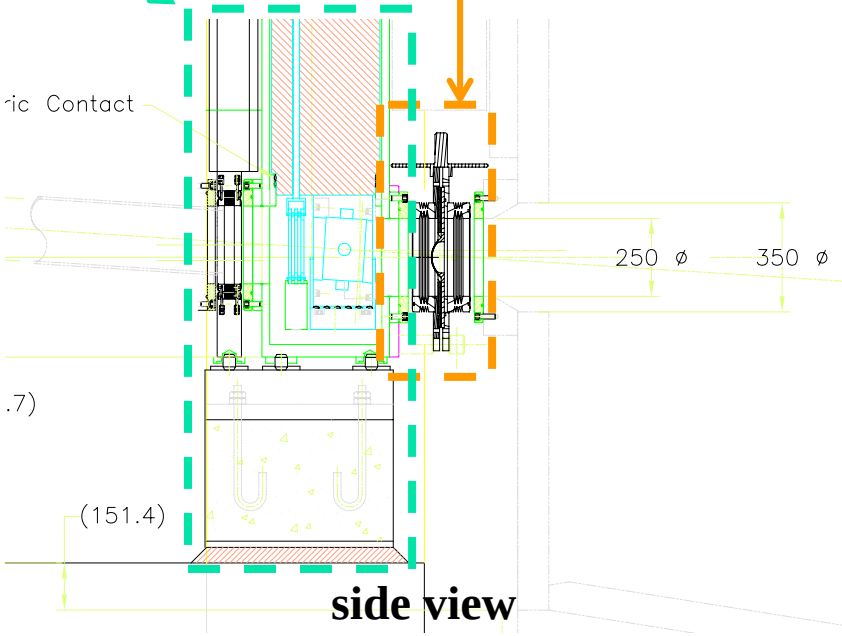
MARS: 1/10 under estimation (?) in μSV/h region

Beam window & Monitor chamber

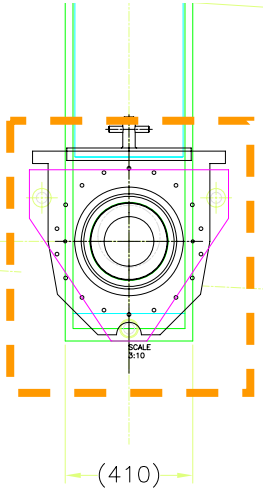
- **Monitors between FF and TS**
  - Monitors (SEM&ESM): U of Tokyo
  - Total design, vacuum chamber, moving mechanism, shield, remote maintenance: TRIUMF
  - Installation: KEK

- **Beam window**
  - Design, production, assembly: RAL
  - Remote maintenance: TRIUMF
  - Installation: KEK





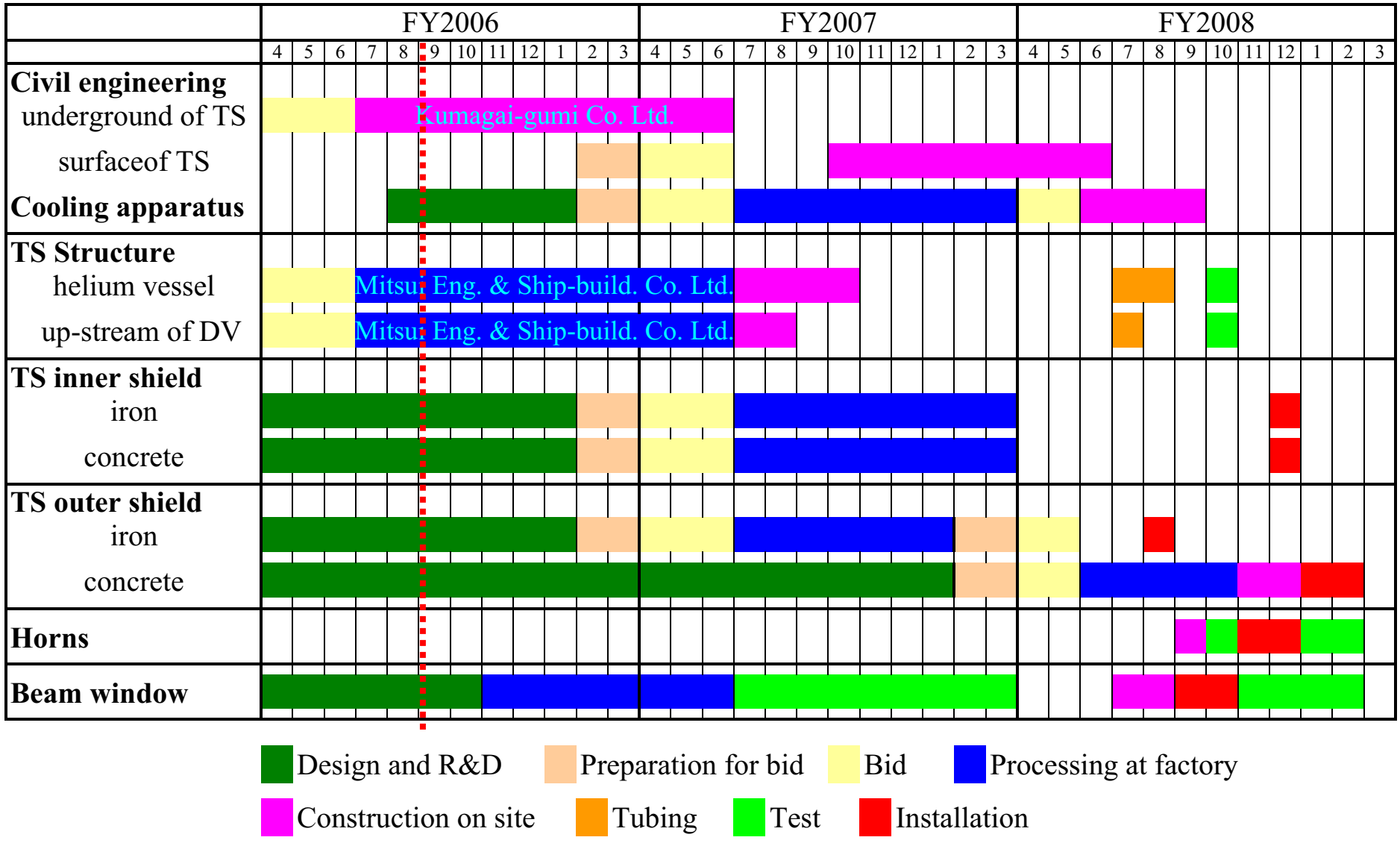
side view



front view

Schedule for TS

Status of TS: Construction of building & helium vessel just started.

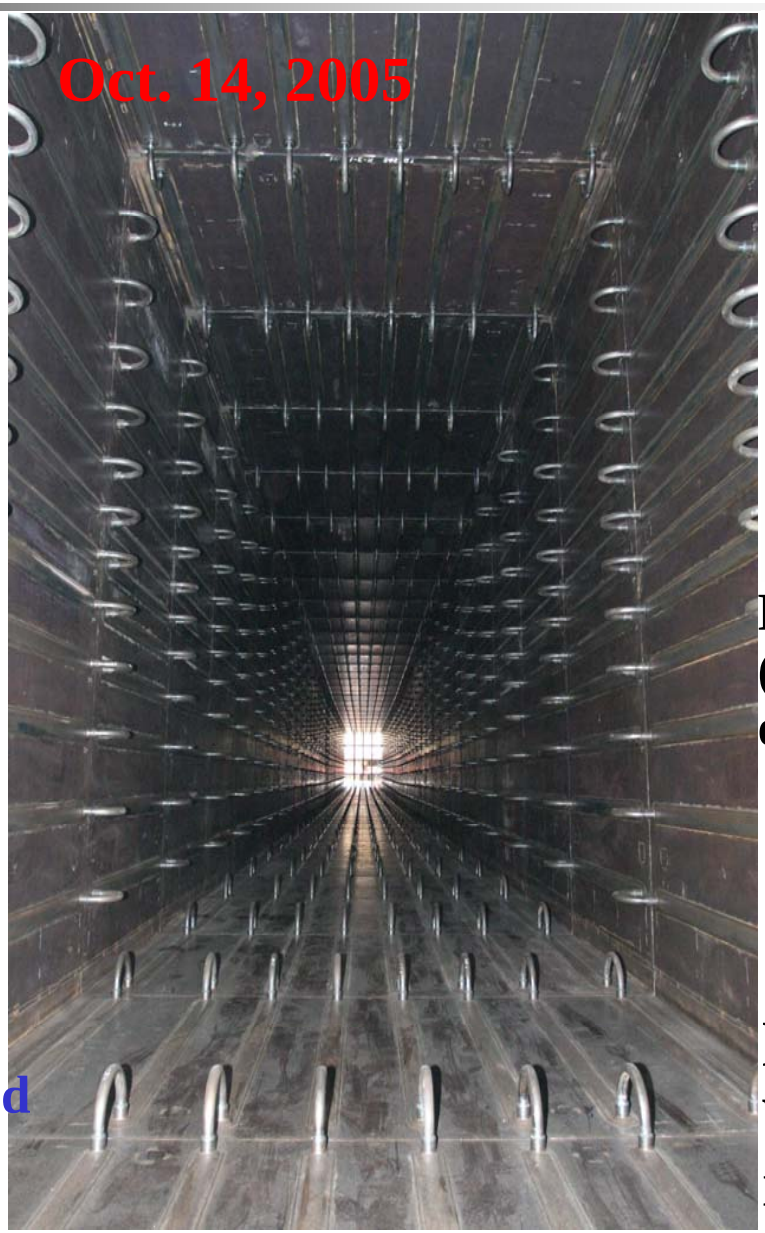


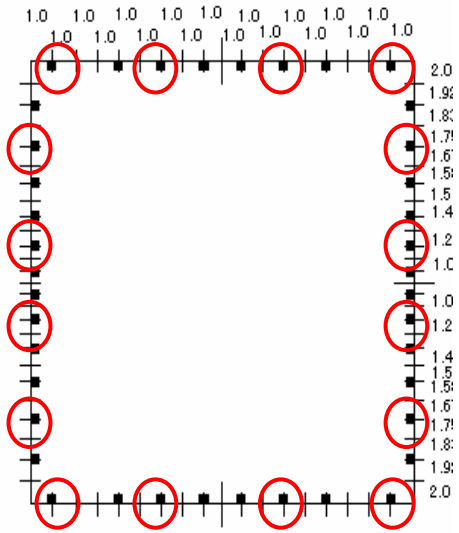
Decay Volume

•94m-long iron helium vessel cooled by water

Iron tunnel cooled by water

All cooling channels connected by 1080 U-shape pipes.



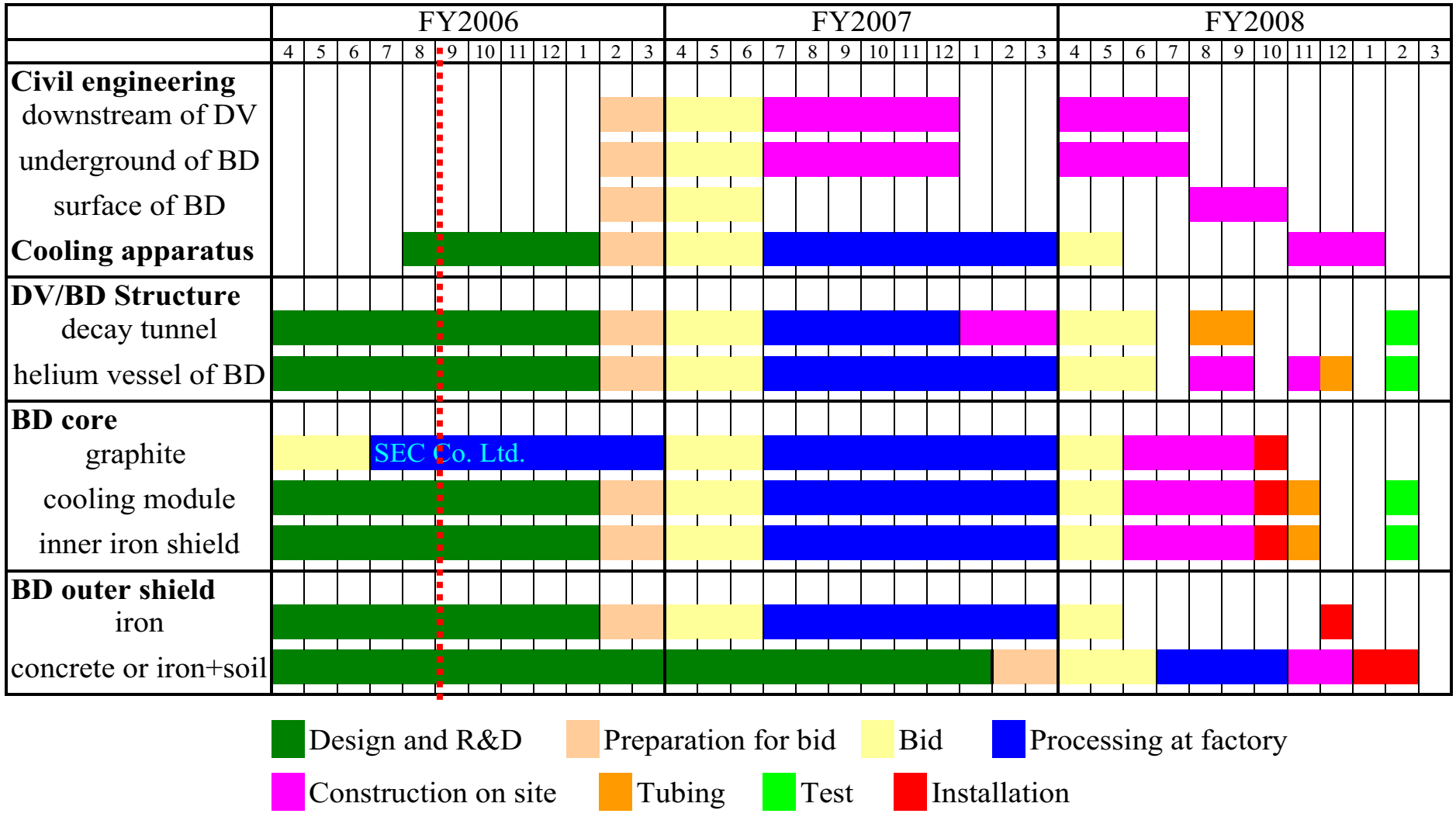


Position of Platecoils (O for 0.75MW:16 out of 40 channels)

- 3m-W, 4~5m-H
- 16mm thick iron plates cooled by water channels inside

Schedule for DV/BD

Status of DV: Middle part (52m) finished.
Status of BD: Production of graphite blocks started.



Summary

- Target Station
  - Helium vessel supports three horns and iron shields inside.
  - Helium vessel and inner iron shields are cooled by water.
  - Air-cooled iron and concrete shields outside helium vessel
  - Design of helium vessel finished and fabrication started.
  - Construction of underground part of building started.
  - Building and helium vessel will be completed in summer 2008.
- Decay Volume
  - 94 m long rectangular iron tunnel
    - 16mm (200mm) thick iron plates cooled by water
    - surrounded by 6m thick concrete
  - 52m-L middle part already finished.
  - Most upstream (16m-L) part will be constructed with TS.
  - Most downstream (26m-L) part will be completed in 2008.