T.Ishida
(IPNS, KEK)

Status of the T2K Hadron Absorber Development

KEK IPNS T.Ishida / Y.Oyama / M.Tada
Y.Yamada / H.Yamaoka
CCLRC RAL C.J.Densham / V.B.Francis
D.L.Wark
KEK MEC S.Koike

1. Base design for the hadron absorber core and the helium vessel
2. Analysis results for vessel and shields
3. Summary, Schedule

05.11.18 at the point where the beam dump will be installed

Status

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- ✓ Material property measurements and basic cooling tests finished.
- ✓ Heat and stress simulations for the hadron absorber core have been done and a base design has been established.
- ✓ Base drawings both for the core and for the helium vessel which encloses the core have been drawn taking installation and construction scenario into account.

JFY2006

- ✓ Tender has been done for the graphite production. A successful bid with spec as planned, 49 x 2.4 m bars of SEC Co. PSG-324.

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Beam Dump and Muon Monitor Area

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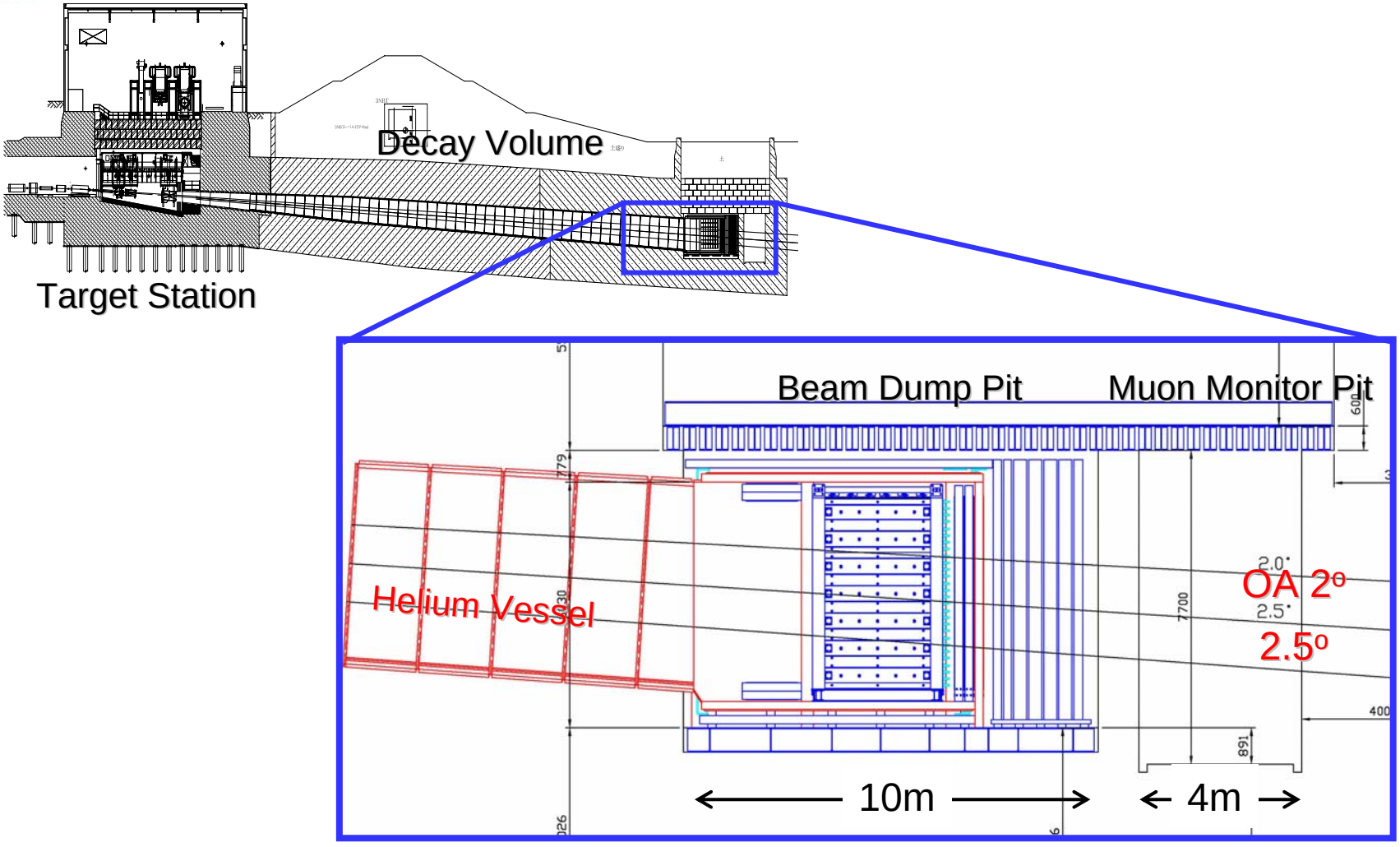
(IPNS, KEK)



- Cover off axis angle between 2degree to 2.5 degree
- Goal: cool down 1MW heat loss for future MW operation (without maintenance in dump pit area !)

The T2K Hadron Absorber

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Core Assembly

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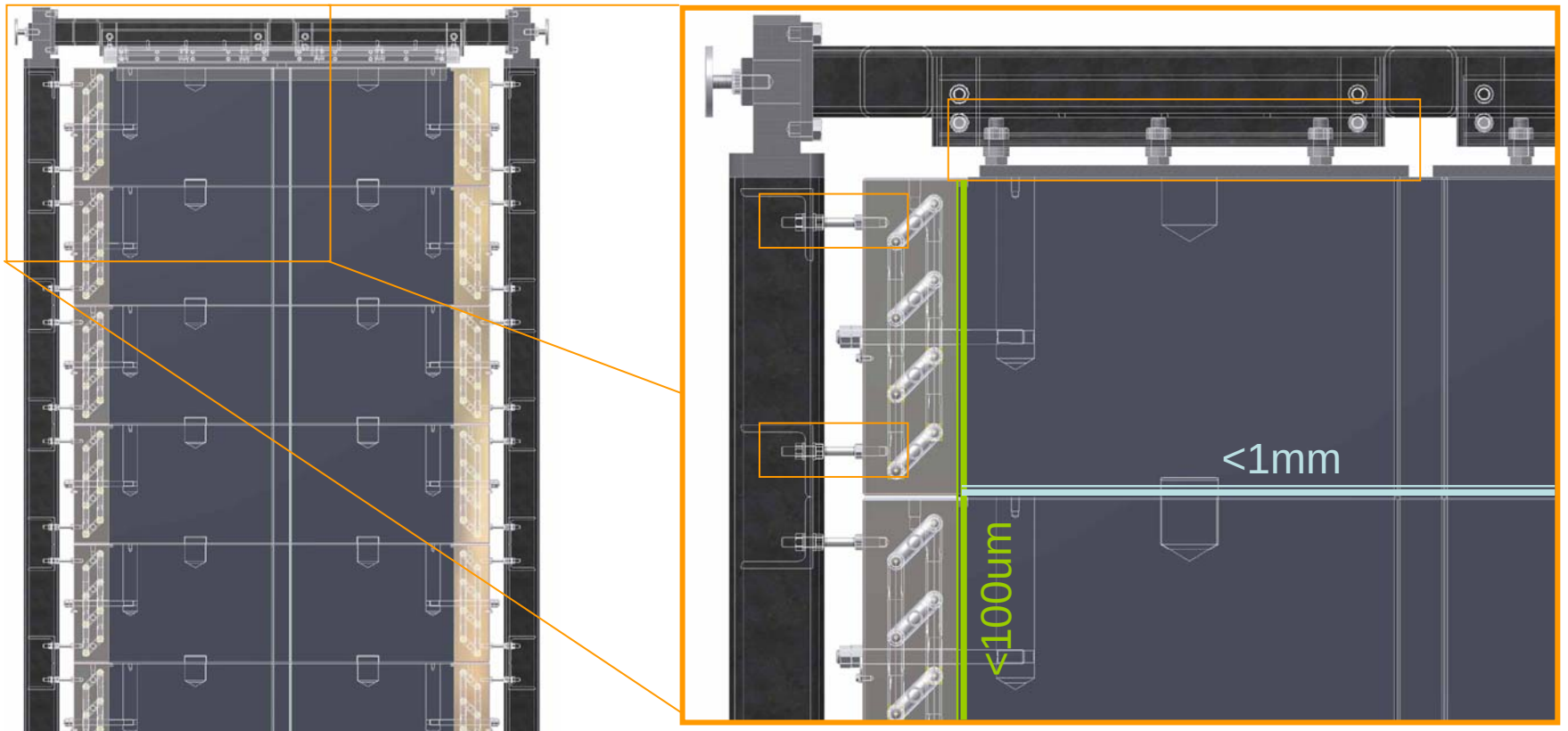

- The blocks will be piled up and fastened to Al cooler from bottom to top on a base frame.
- The core units loosely supported by a steel frame to allow thermal expansion.
- Top of the graphite blocks is held by iron plates + spring washer, in order to bear for the earthquake.

A Core Unit

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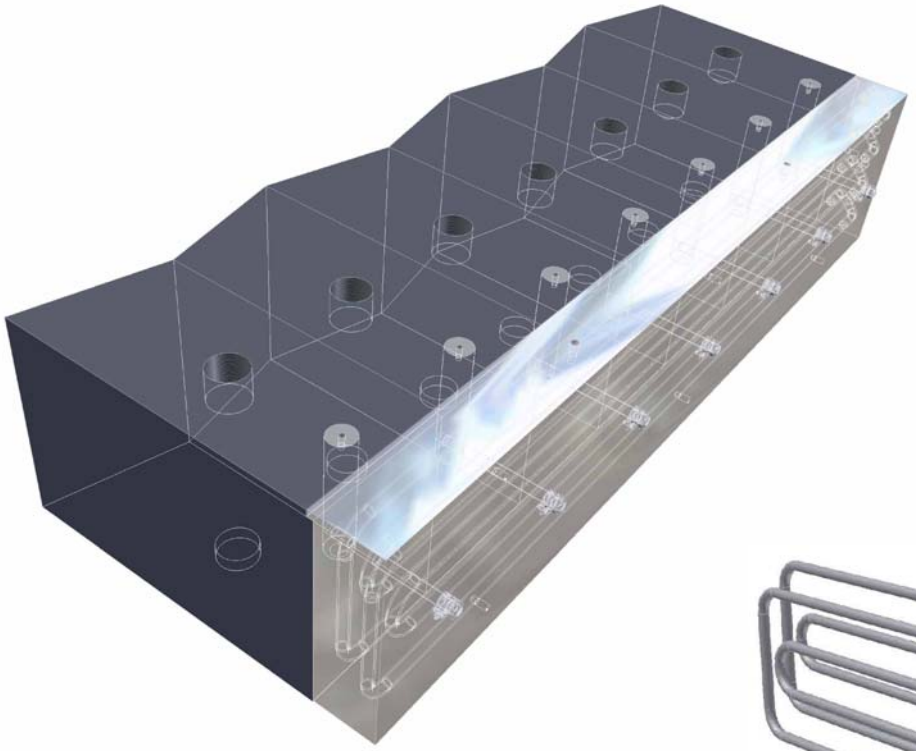
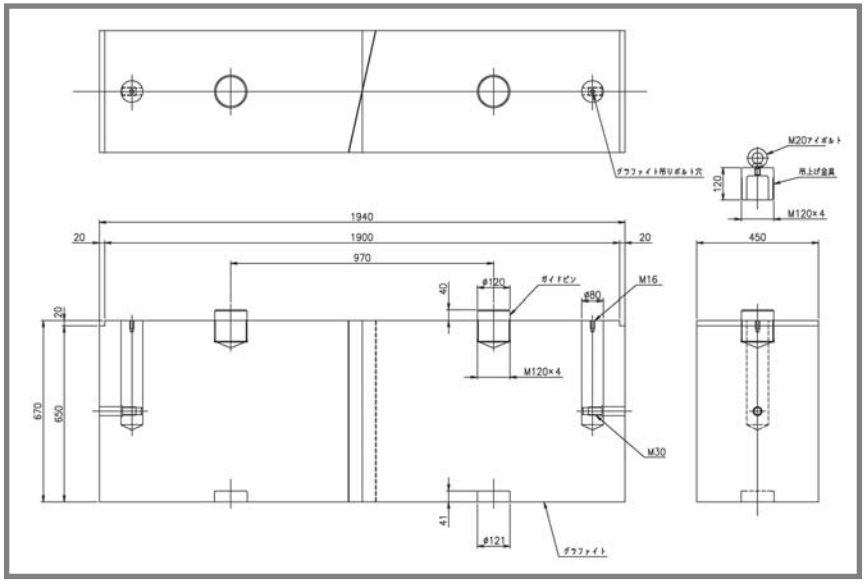
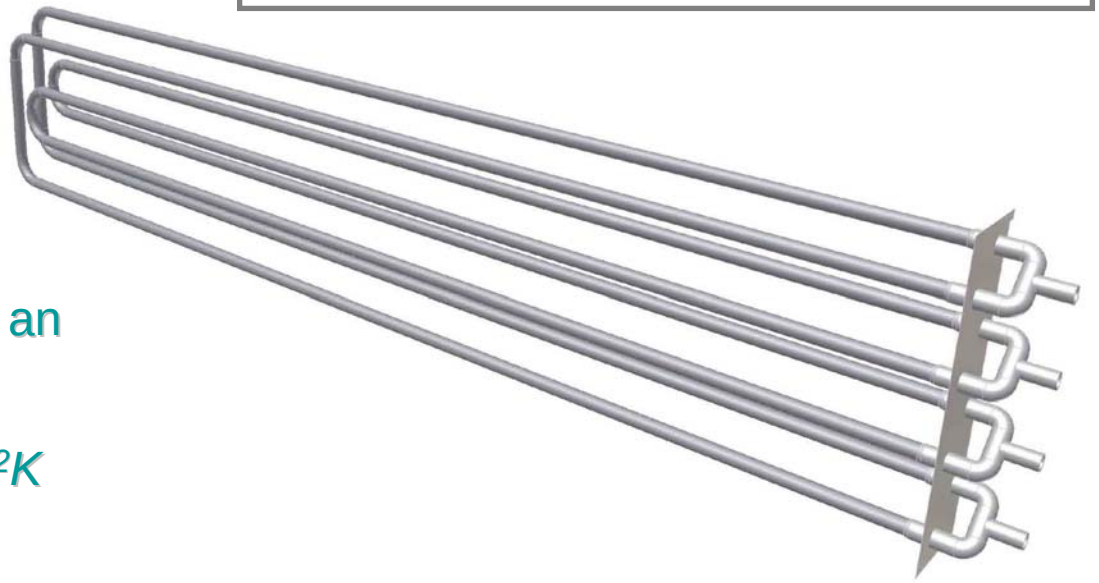
(IPNS, KEK)







- 7 graphite blocks fastened to an water-pipe casted aluminum cooler by screws.
- This is to realize *a few kW/m^{2}K heat transfer between them*

Heat and Stress Analysis for the Absorber Core

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(IPNS, KEK)

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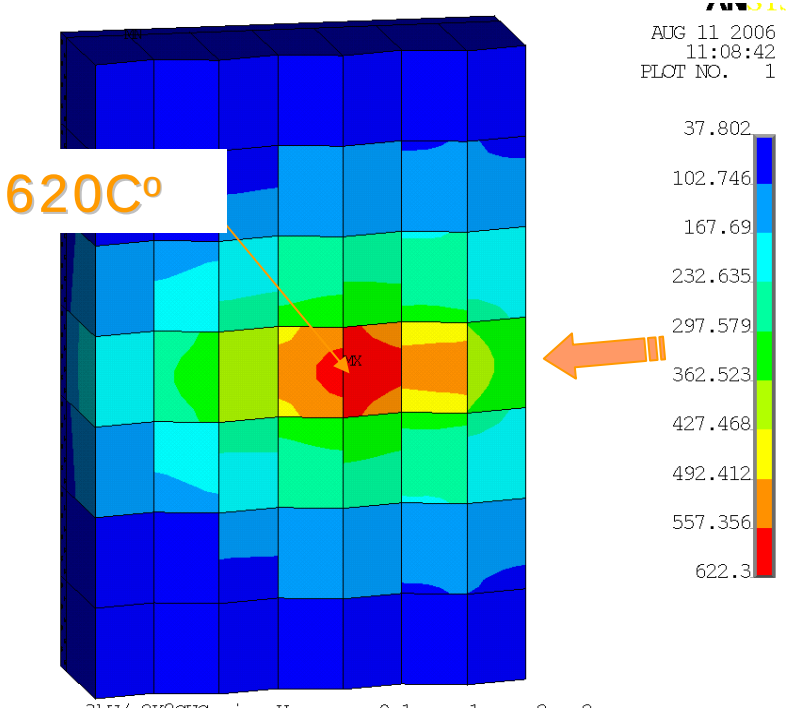
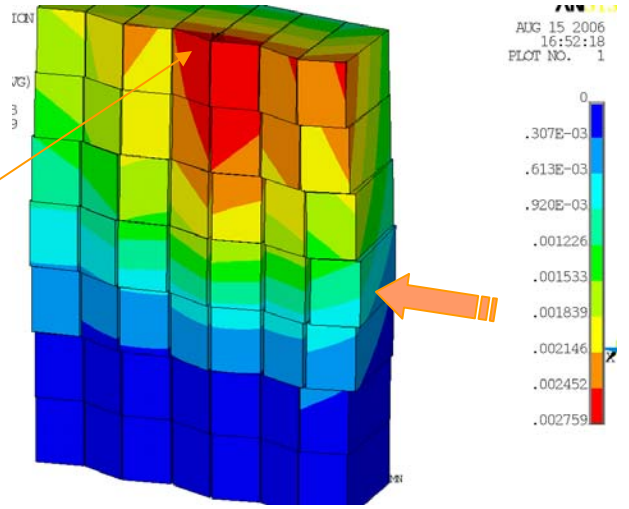
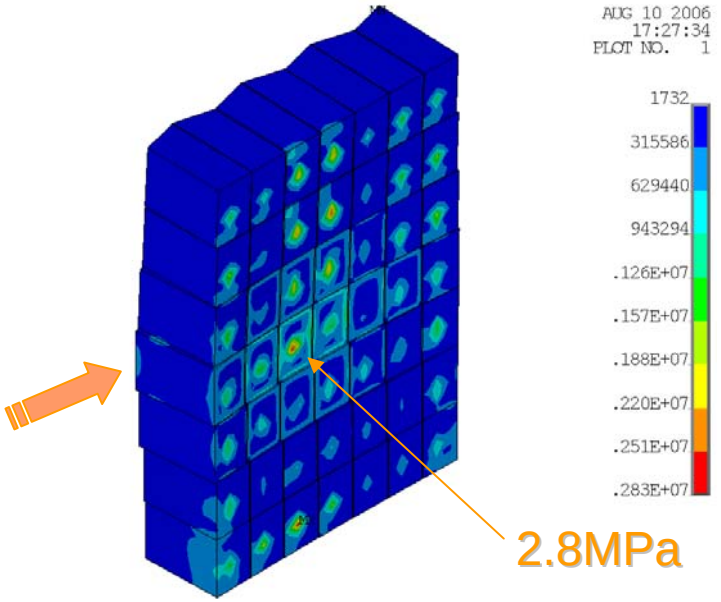
3 MW / 30 GeV / 94 m DV





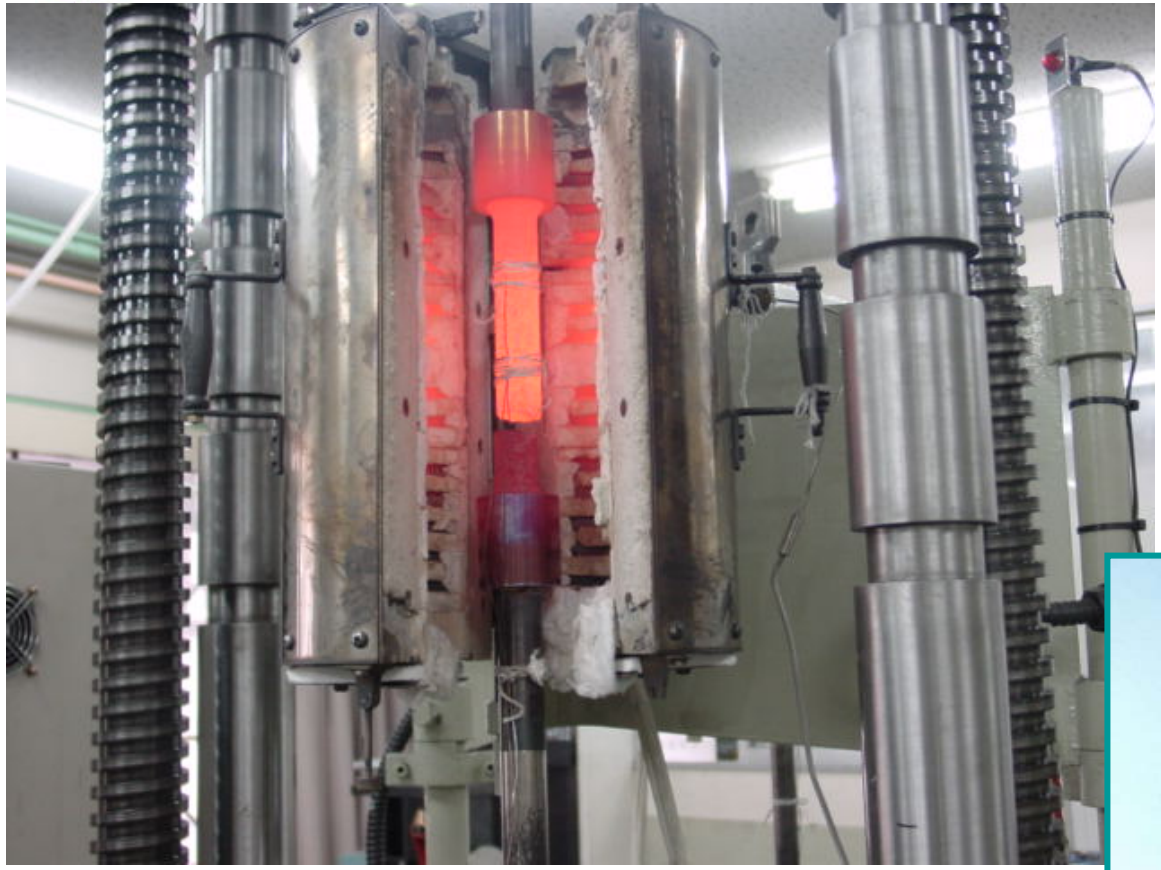


- Thermal Links between blocks correctly taken into account
- Can survive for 3MW/30GeV

Assumption: current target and horns

Tensile Strength at High Temperature

T. Ishida
(IPNS, KEK)



RT~900degC
Parallel/Perpendicular to Extrusion
2 measurements each, 16 samples

Tensile Strength: 7~8.5MPa(//) 4~5.5MPa (perp.)

Cf. Bending Strength: 14.7MPa(//) 9.8MPa(perp.)

Oxidization (in the Air)

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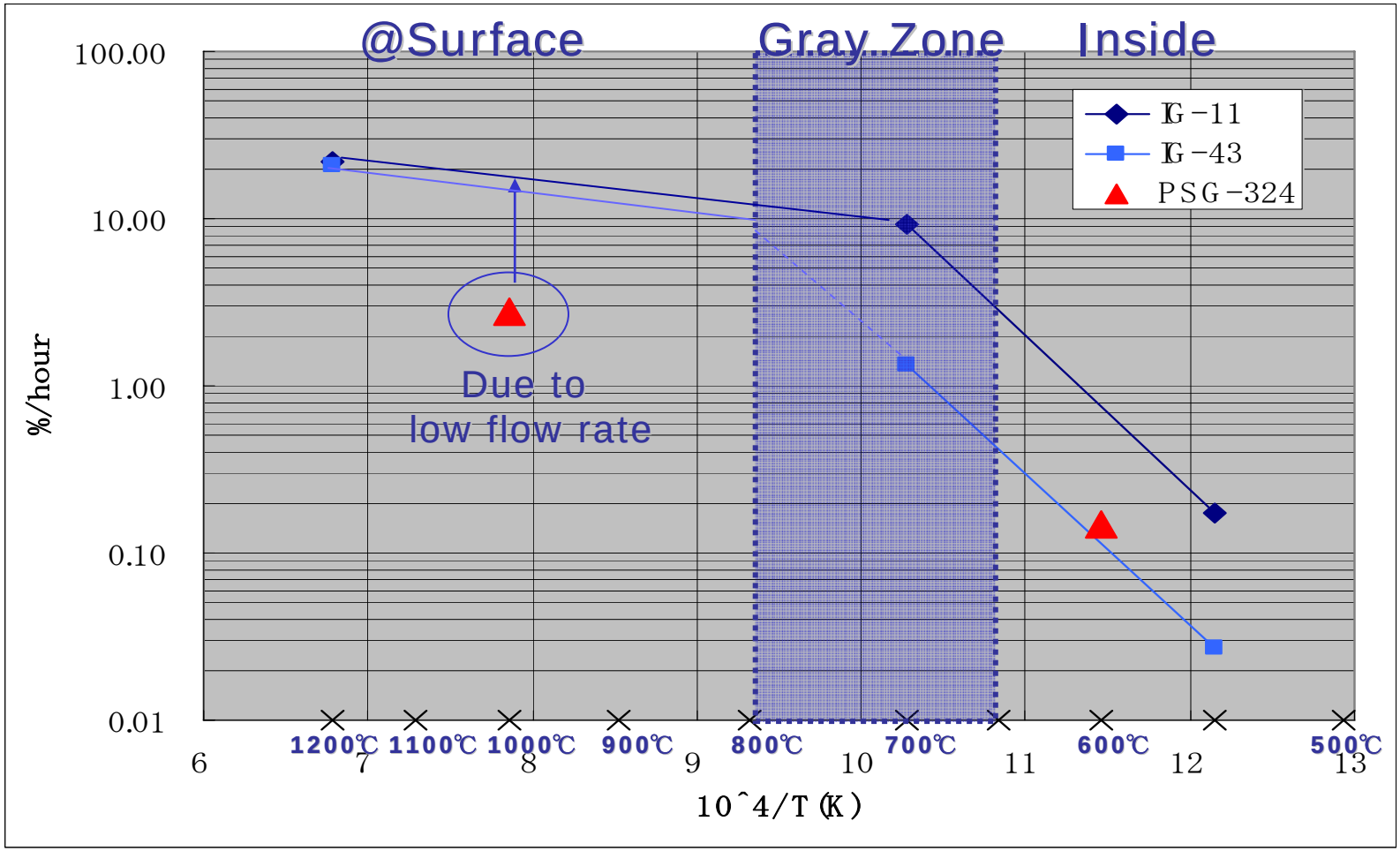

600degC: Helium should be < 30ppm O_2, 650degC: <10ppm O_2 (1~5% loss for 20yrs)
Measurememts under 1,000 ppm O_2 at 800degC/650degC are going on.

Cooling Test

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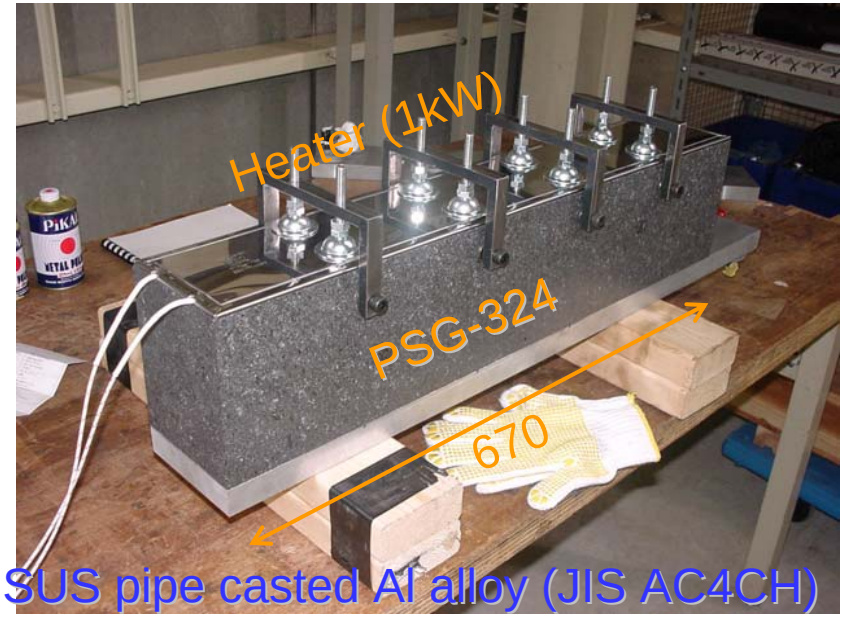

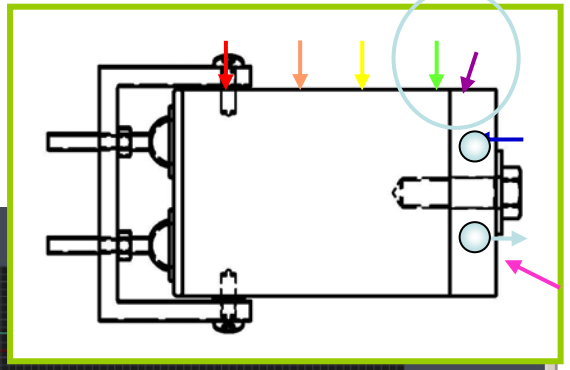

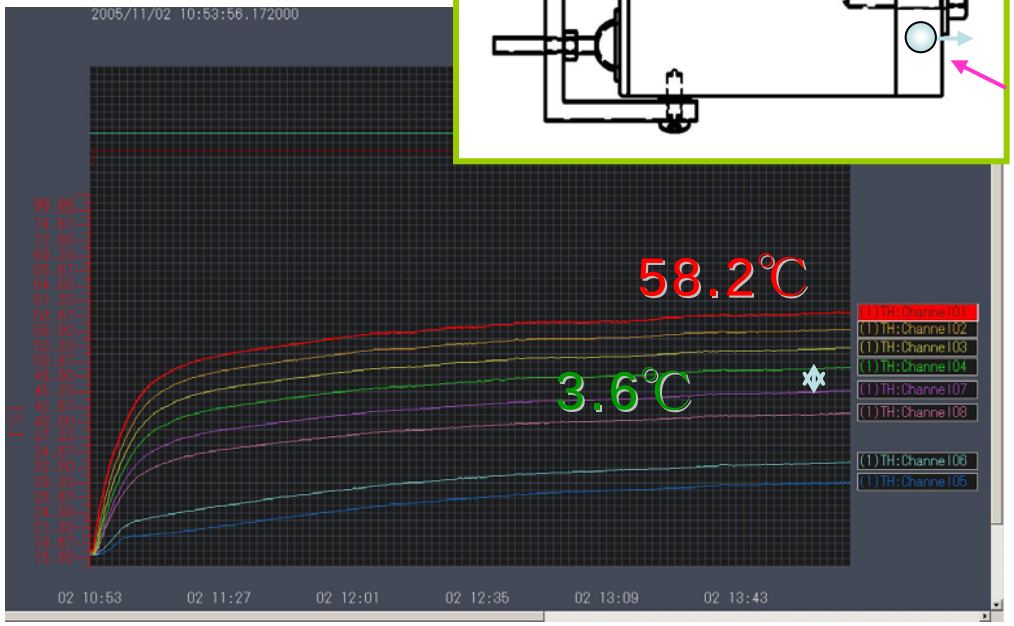

- Heat flow rate at cooling surface with screw-fastening is measured to be >4.5kW/m^{2}K
- Similar measurement in Helium soon.

Graphite Machining Plan

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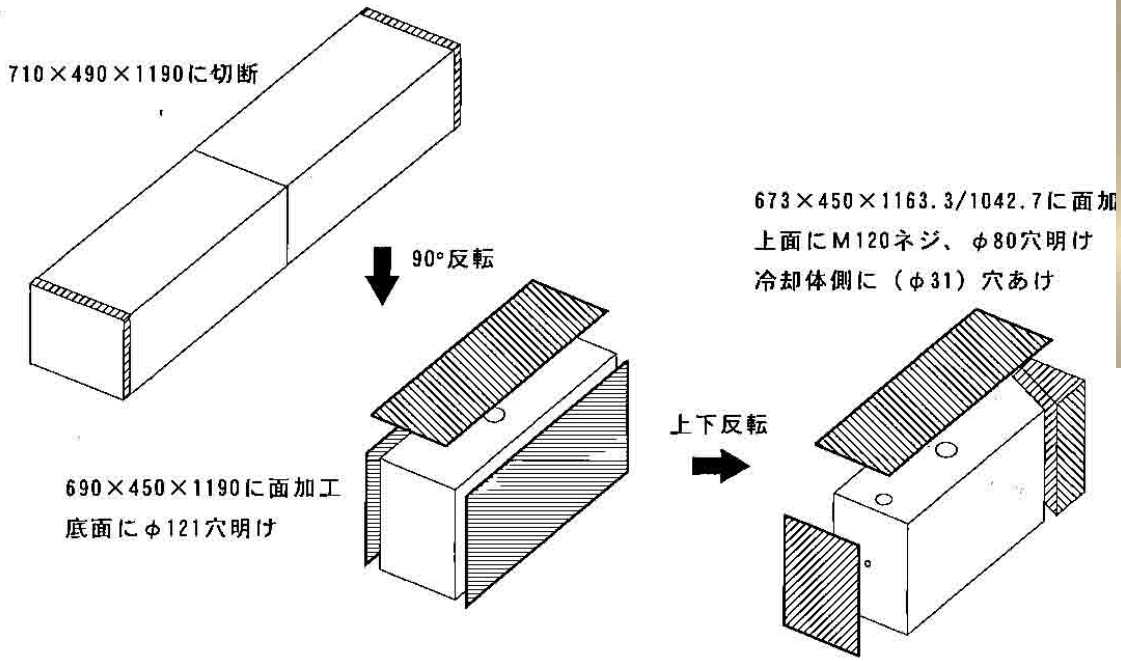
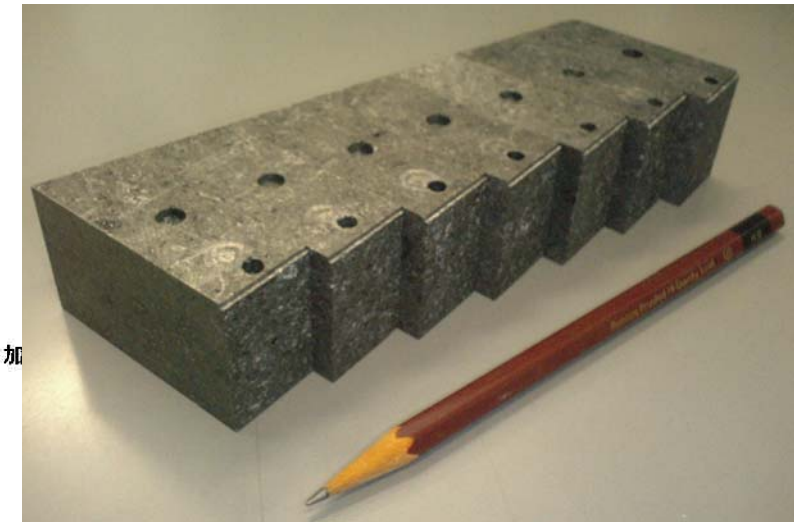
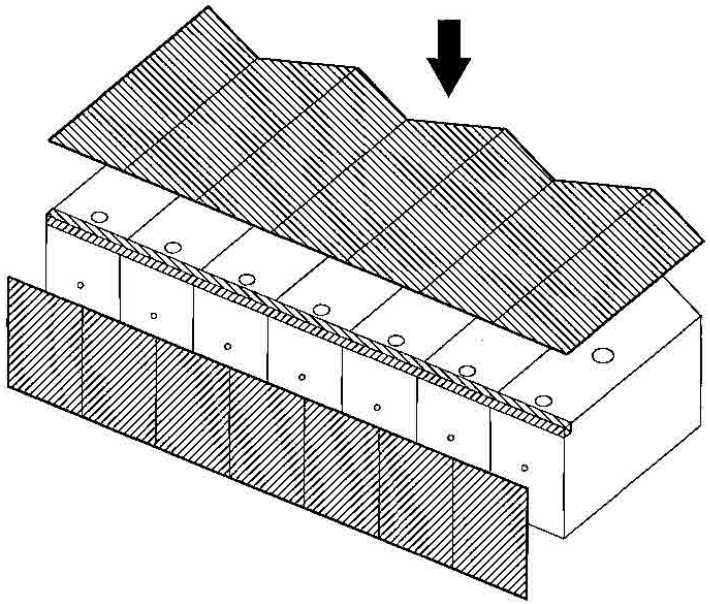
(IPNS, KEK)







- 7 blocks will be machined at once, to make good surface quality ~ 100um

Helium Vessel

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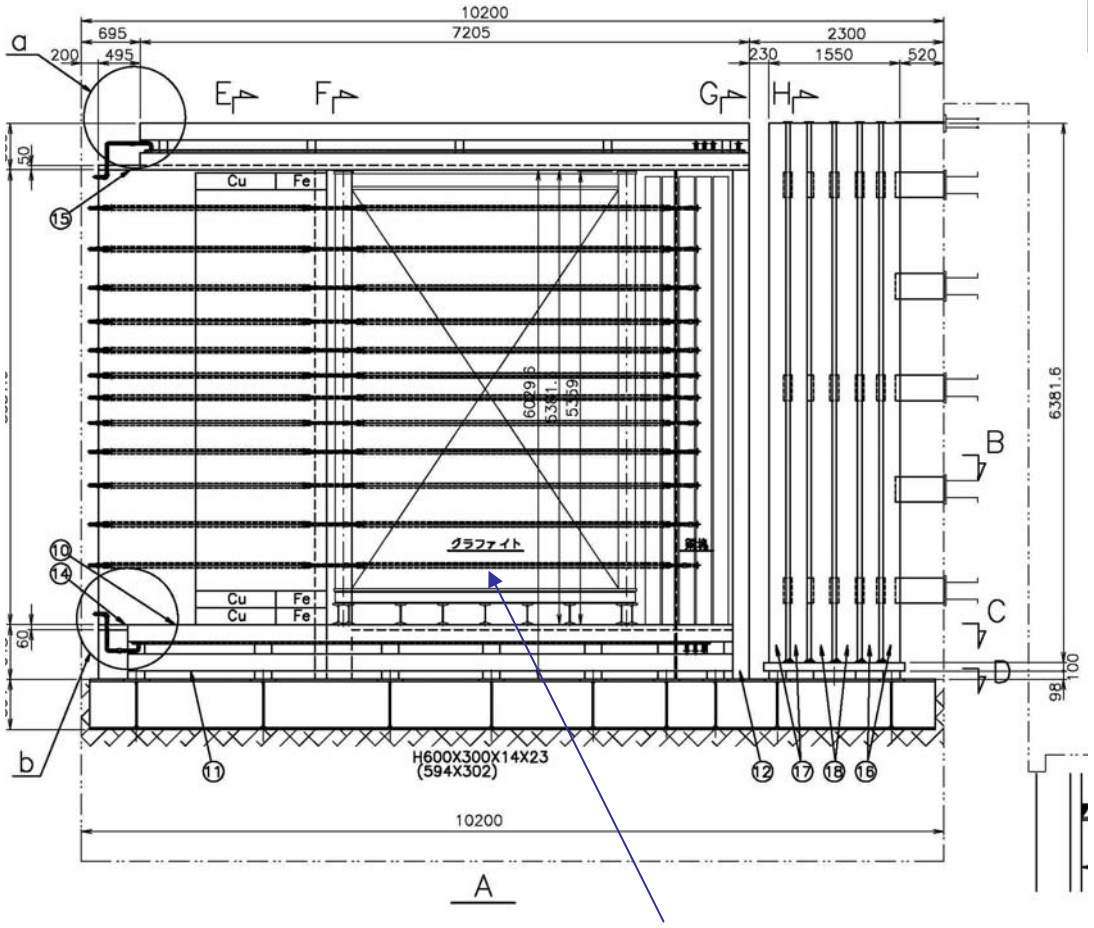
(IPNS, KEK)



- Vessel is composed of 200mm-thick recycled iron plates from K2K MRD

40channels of water paths (outside)
Serially connected to DV plate coils

Inner Iron Shields

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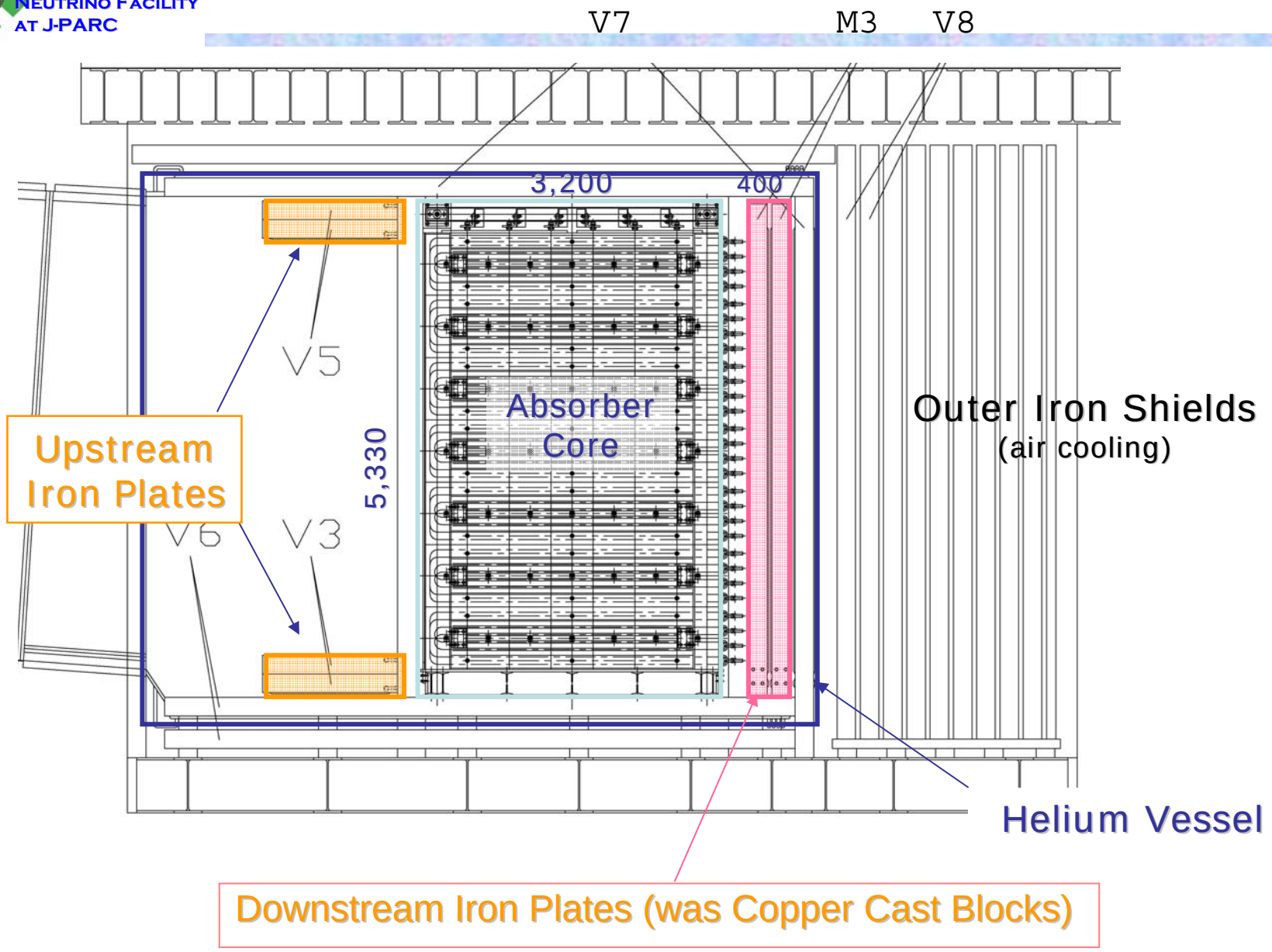

Heat and Stress Analysis for 1st downstream plate (1)

T.Ishida
(IPNS, KEK)

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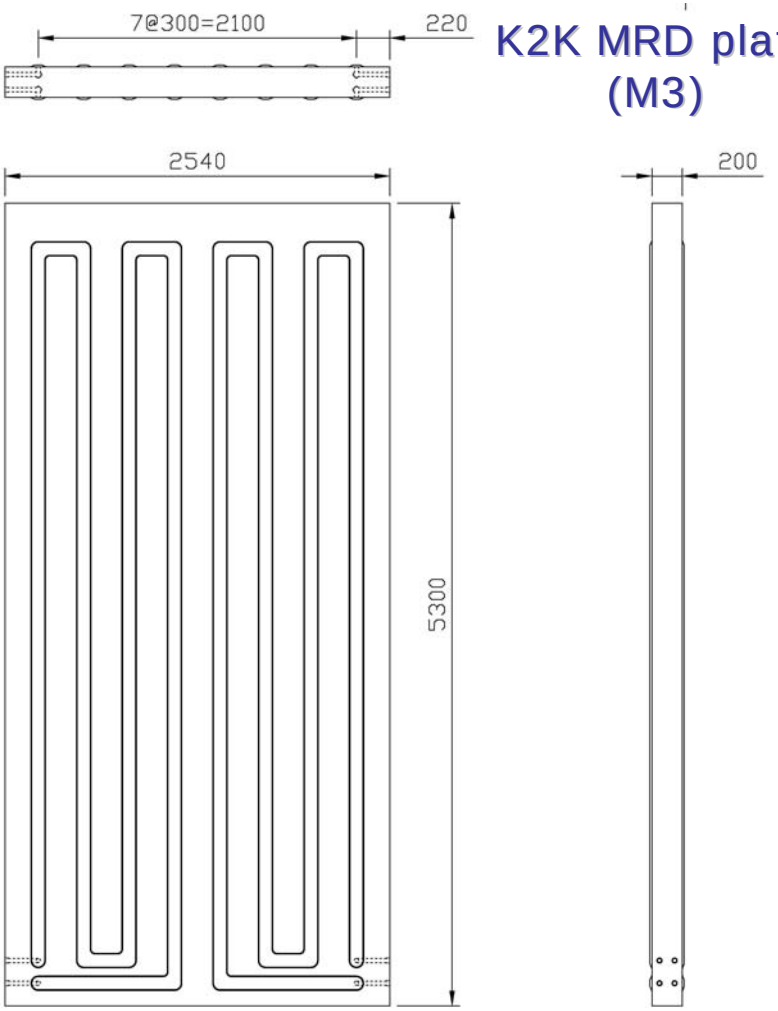
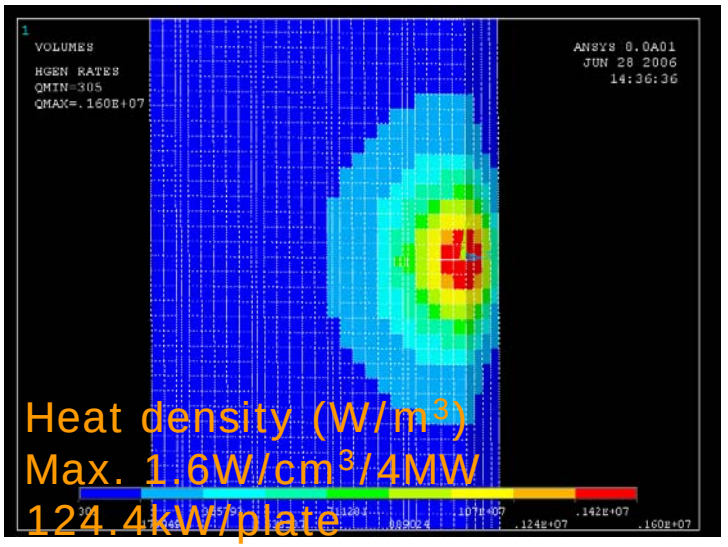


K2K MRD plate (M3)



Heat density (W/m^3)
Max. 1.6W/cm^3/4MW
124.4kW/plate

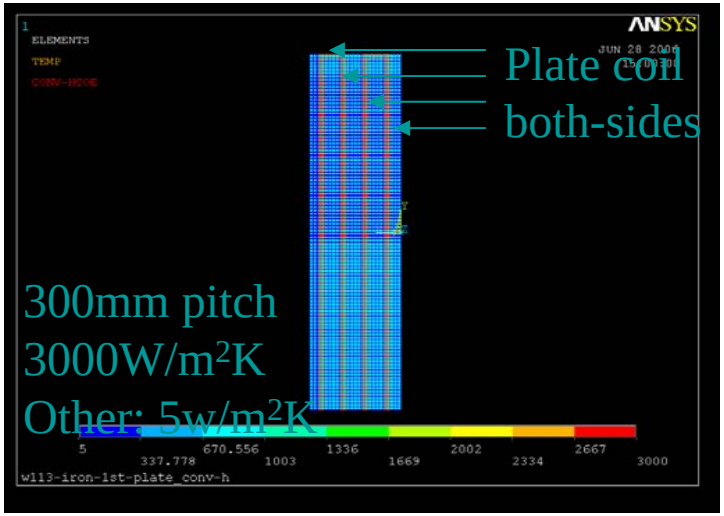
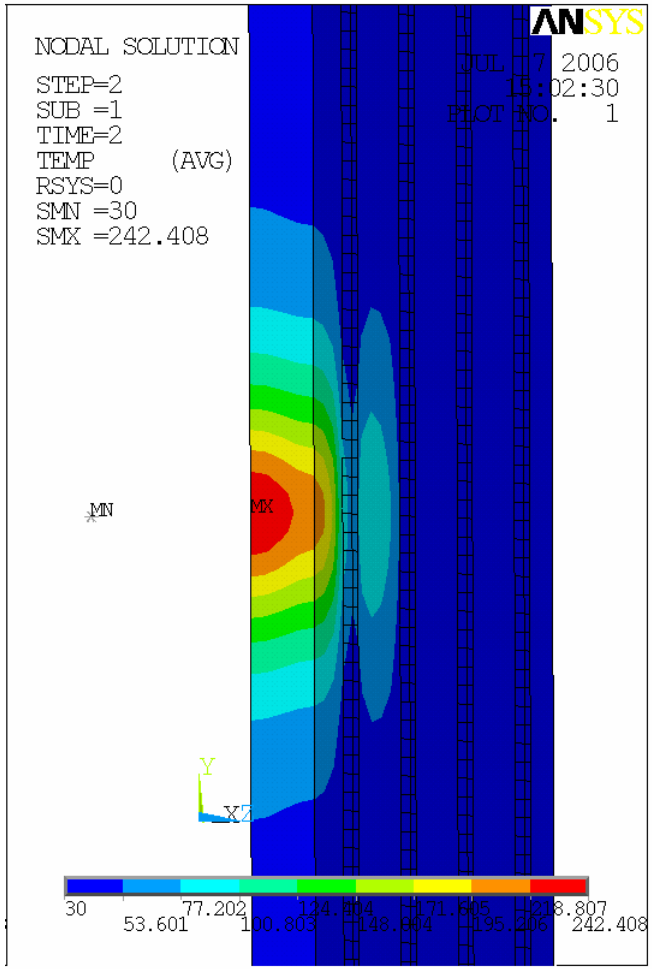


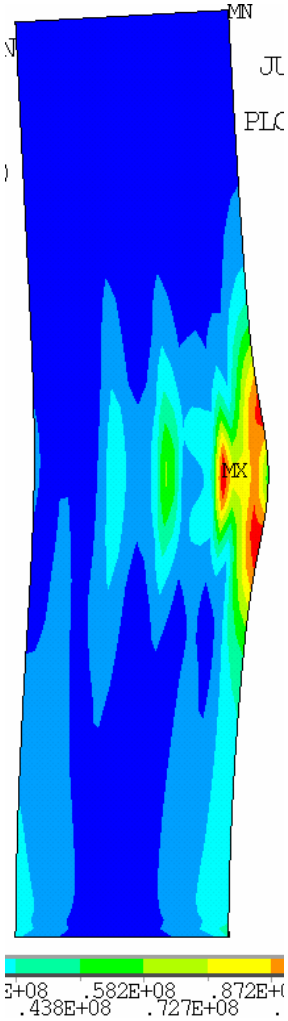
Plate coil both-sides

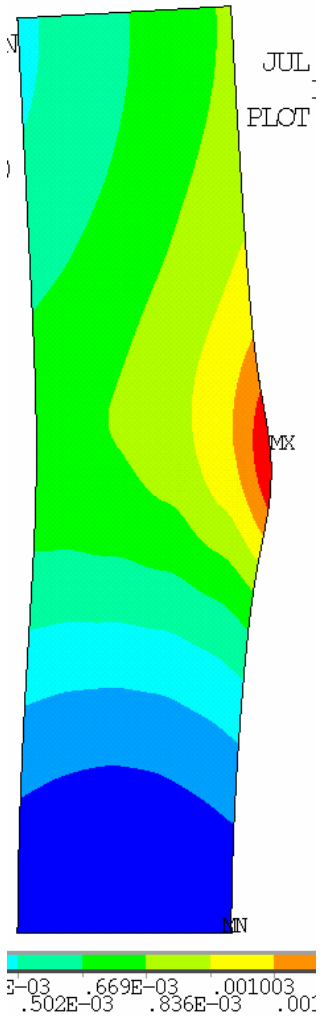
300mm pitch
3000W/m^{2}K
Other: 5w/m^{2}K

Heat and Stress Analysis for 1st downstream plate (2)

T. Ishida
(IPNS, KEK)







- 242C° with 40GeV/3MW

116MPa

1.3mm

Heat and Stress Analysis for the upstream shield plates

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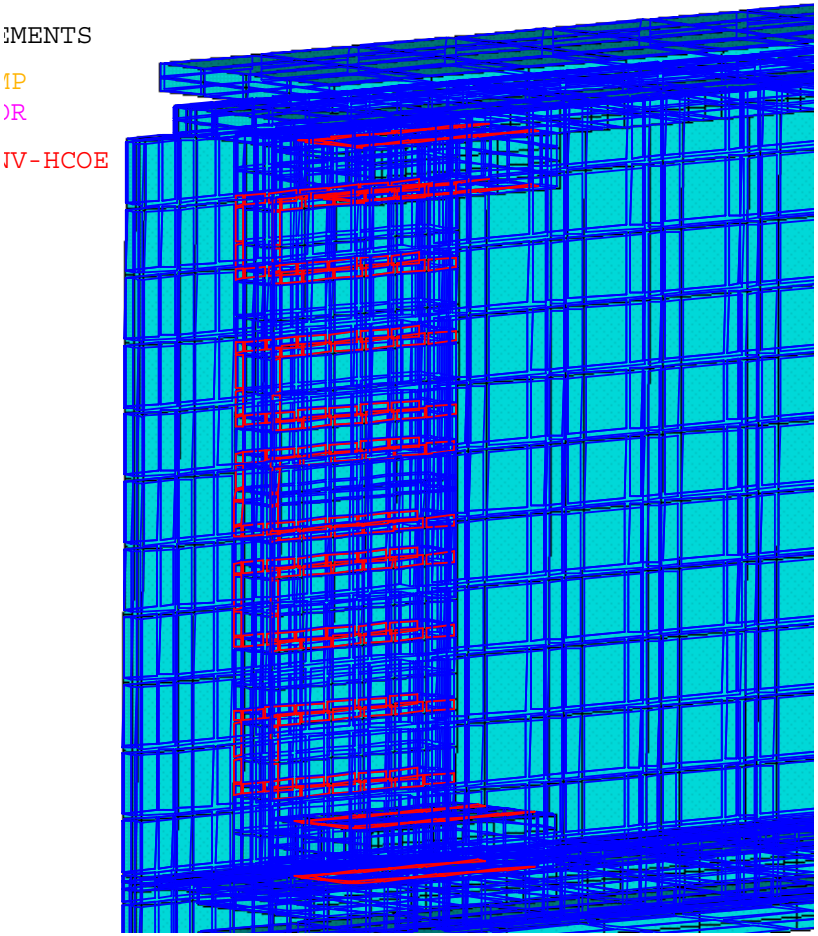
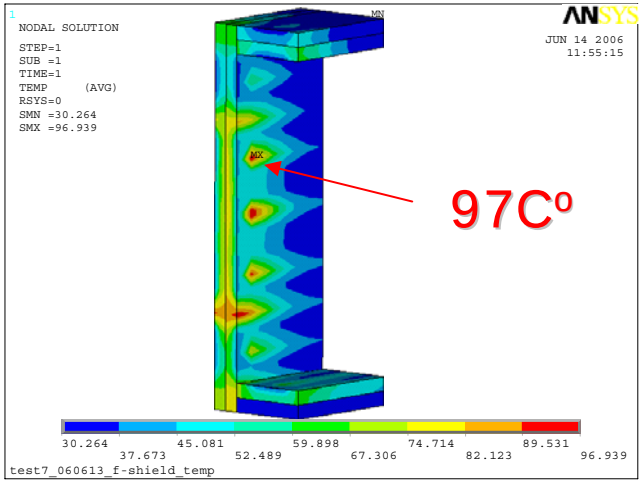
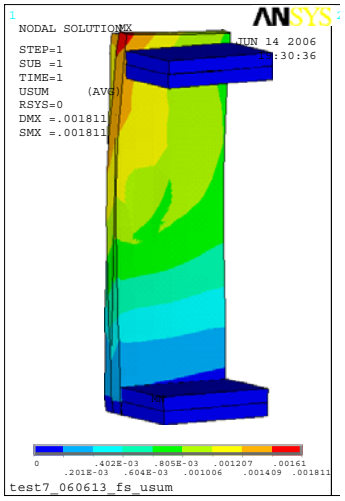
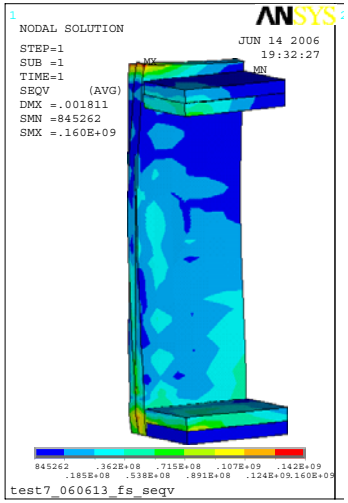




1.8mm



160MPa



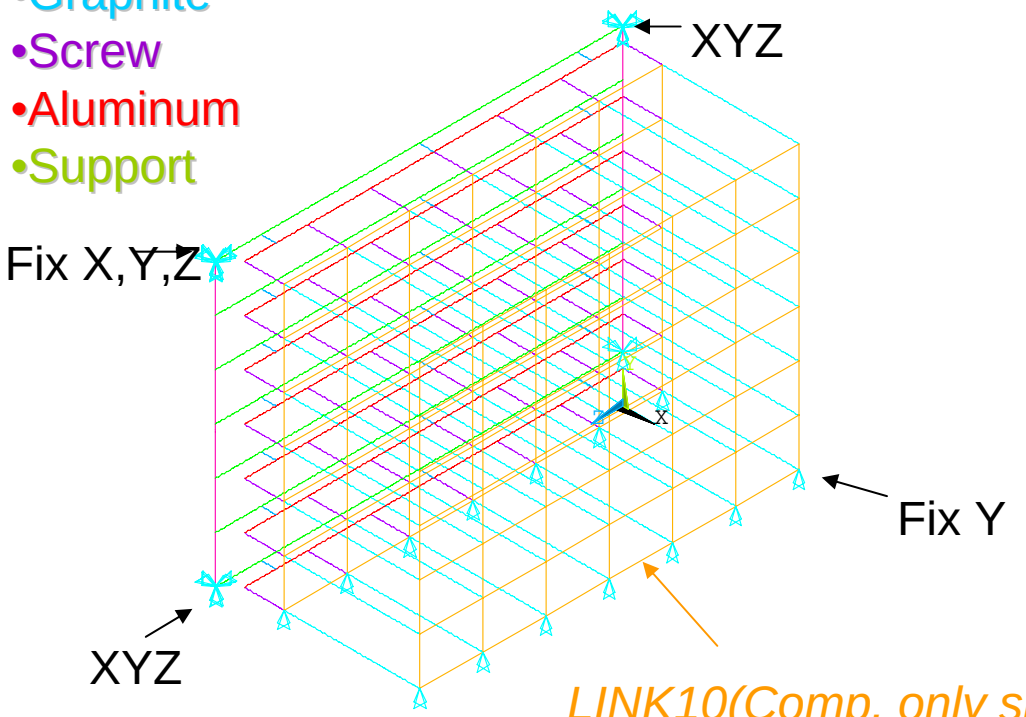
- 40GeV, 4MW

Seismic Analysis

T. Ishida
(IPNS, KEK)

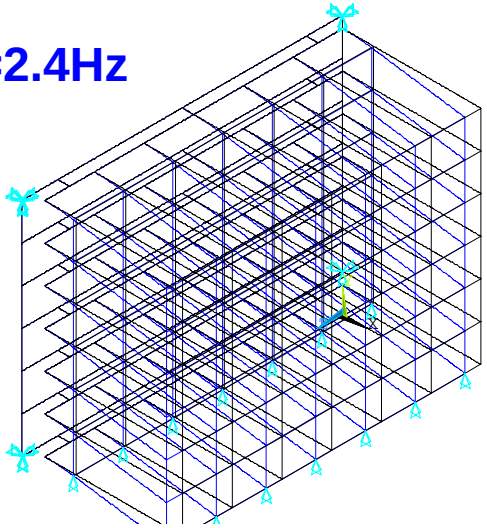
Half wire-frame model
With rigidity of components

- Graphite
- Screw
- Aluminum
- Support

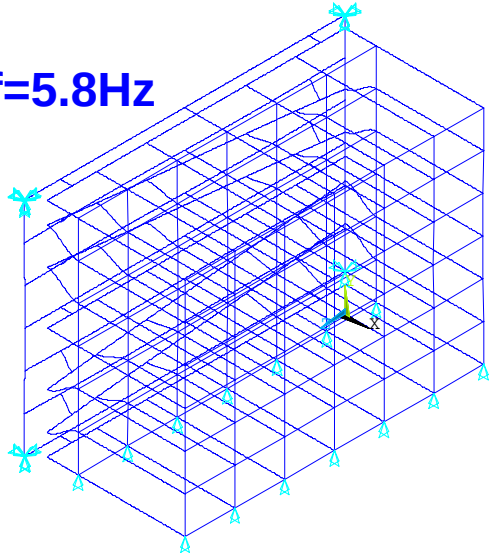


Eigen Frequencies

f=2.4Hz



f=5.8Hz



Summary

T. Ishida
(IPNS, KEK)

- Working base design in hand. Production of all graphite blocks started, towards the completion within this FY.
  - Machining will pay good attention to the surface quality.
- R&D works for the graphite core are still continuing.

  (1) how to fasten (2) how to support (3) cooling module design
  - Goal is to make one of real graphite core units within the FY.
- Detailed design works for the helium vessel is also going on towards the completion until next January with a company.
  - We will install water-cooling iron shields in the vessel

    Design work to be completed also at the same time.

Schedule (FY06)

T. Ishida
(IPNS, KEK)

主要項目 Item	2006 July	August	September	October	November	December
1. 冷却コア開発 Core Development						
ヘリウム環境冷却試験 Cooling test in Helium		Test			締結構造決定 Screw fastening design▽	
締結試験 Screw design R&D	Tender	Design	Production		Test	Cooling test
1号機設計・製作 1st unit production				Tender	Design	
解析 FEM	冷却配管・支持構造の決定 Cooling pipe, support structure▽					
仕様 Specifications						
2. ヘリウム容器 Helium Vessel						
設計 designing	Tender	Design				
解析 FEM	真空引・地震構造解析 Earthquake resistant structure ▽					
仕様 Specifications						

主要項目 Item	2007/Jan	February	March	(April)	Staff	Company
1. 冷却コア開発 Core Development						
ヘリウム環境冷却試験 Cooling test in Helium					MT/TI	–
締結試験 Screw design R&D					–	MHI
1号機設計・製作 1st unit production	Production	Assemble	Cooling Test		TI/MT	MHI(?)
解析 FEM					CJD/SK	MHI(?)
仕様 Specifications	仕様書準備 Specification				All	–
2. ヘリウム容器 Helium Vessel						
設計 designing	Design				HY/TI	IHI
解析 FEM					HY	IHI(?)
仕様 Specifications	仕様書準備 Specification				All	–

- Production (FY07) Installation(FY08)
- Need to finish whole R&D and design within this FY.