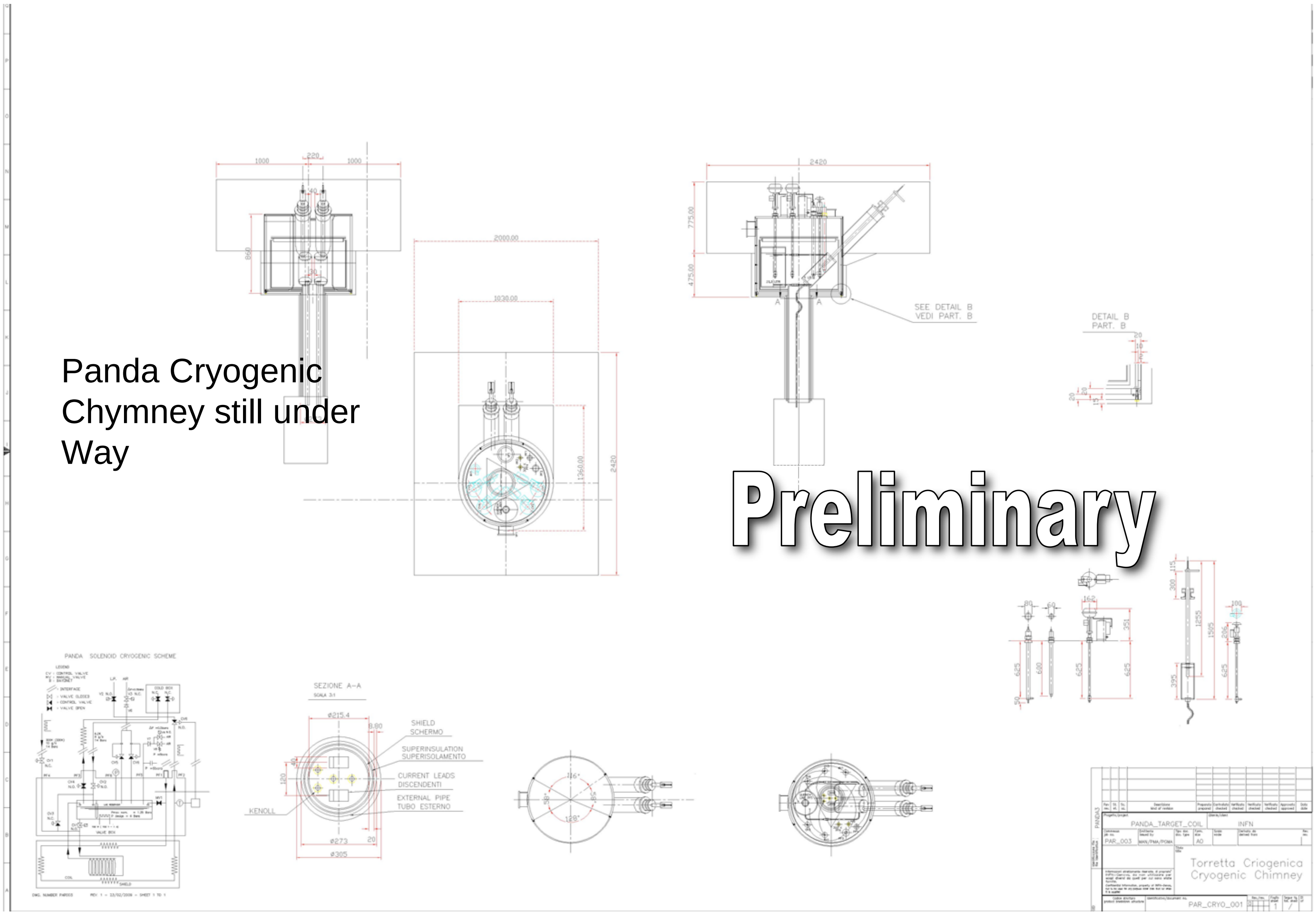
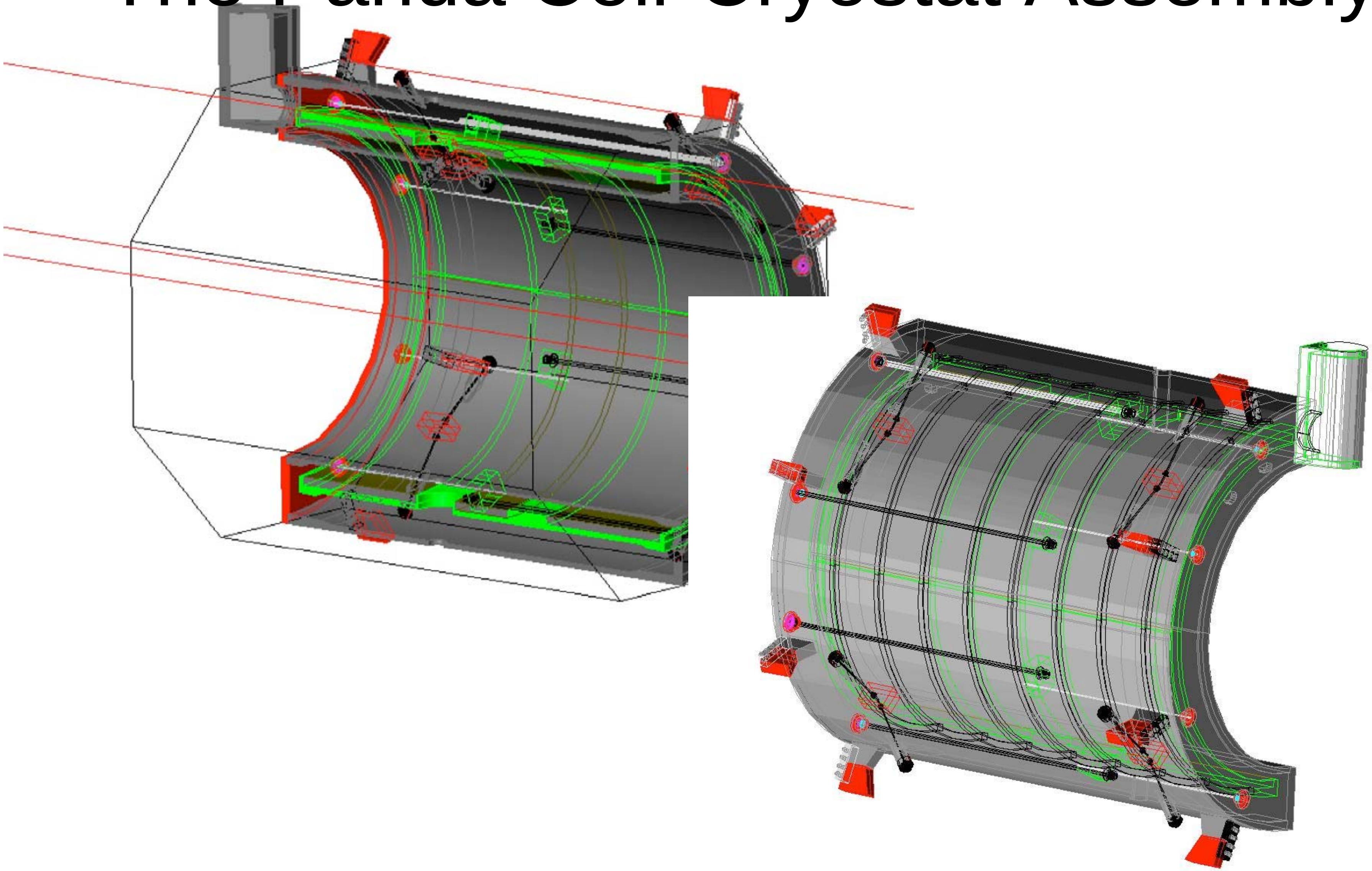
The Panda Coil

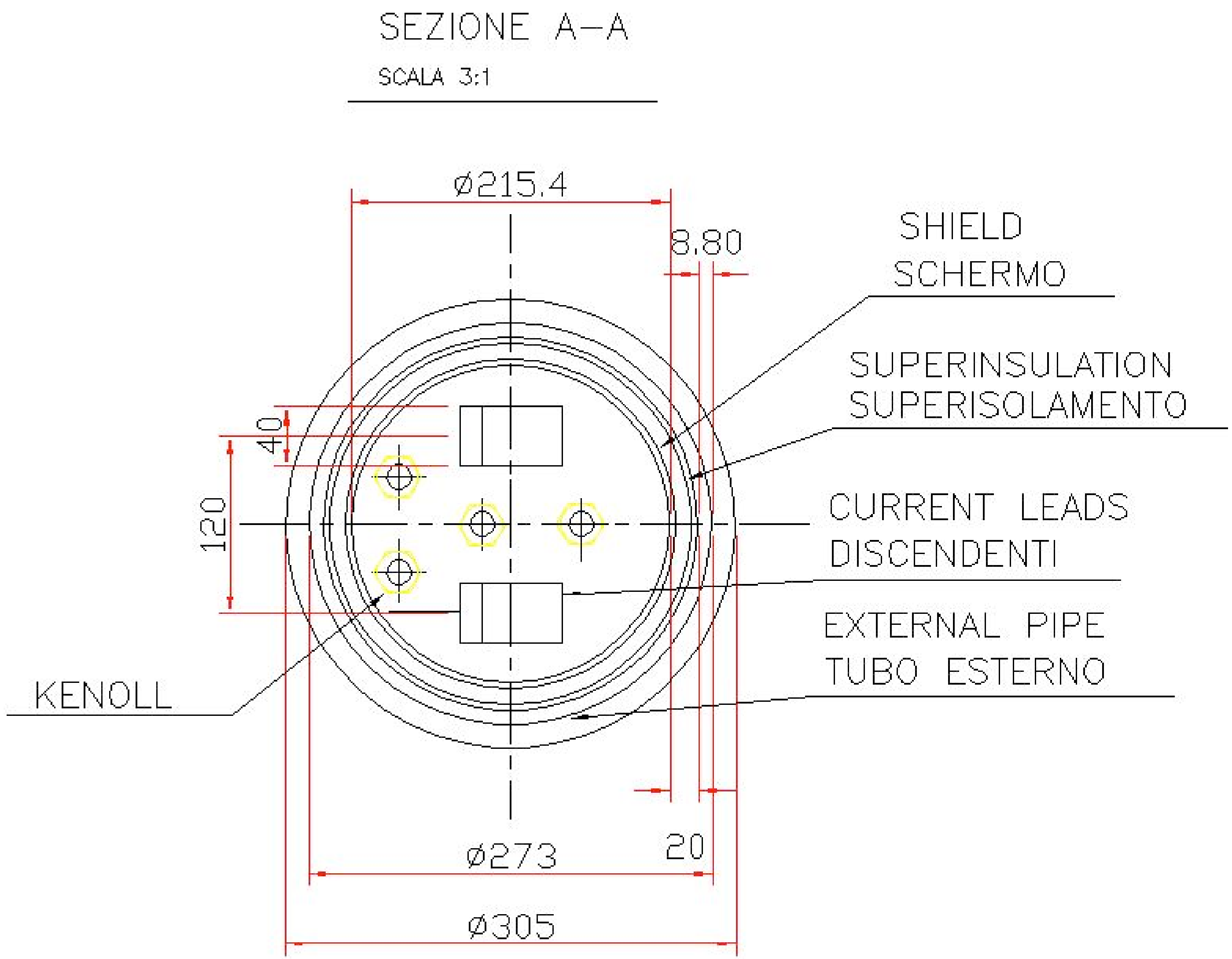
Toward a Reasoned Design.

Panda Cryogenic Chymney still under Way

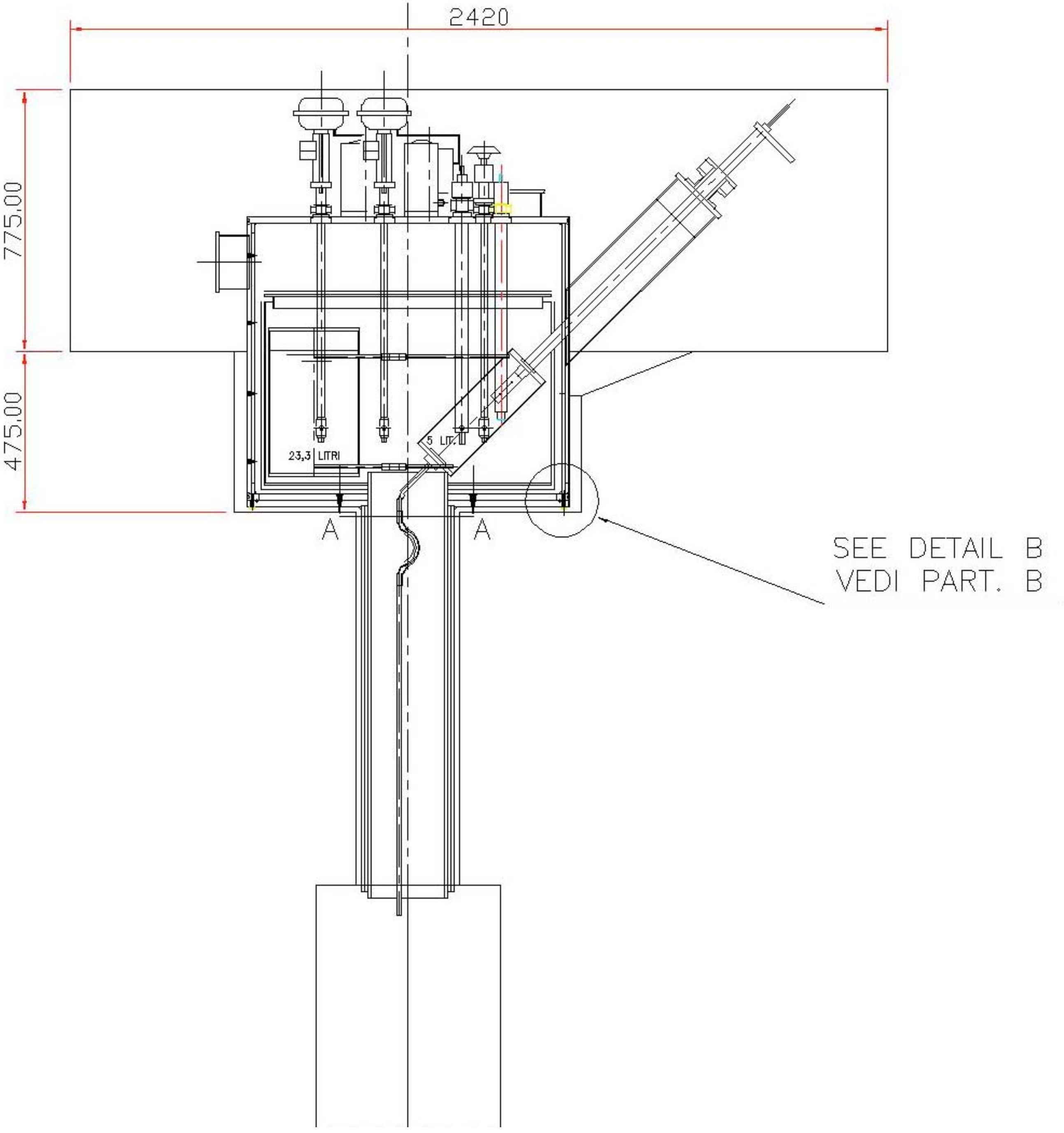


The Panda Coil-Cryostat Assembly





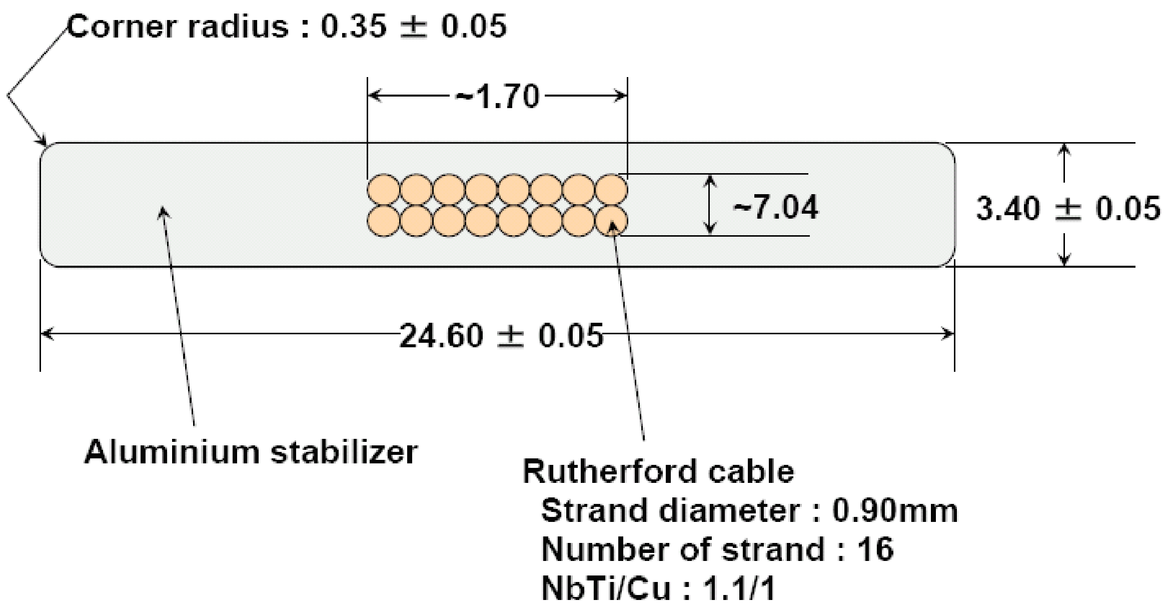
Cross section of the Cryo Chimney at the Junction box level



C

C

A possible Cable (from a cable producer)



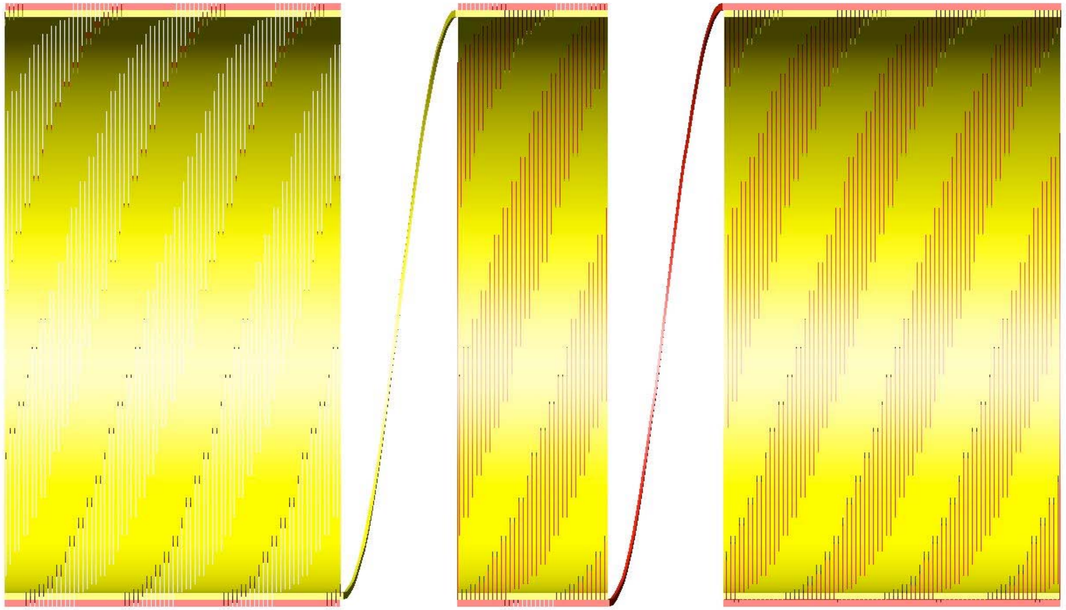
Schematic cross section of Aluminium Stabilized Cable

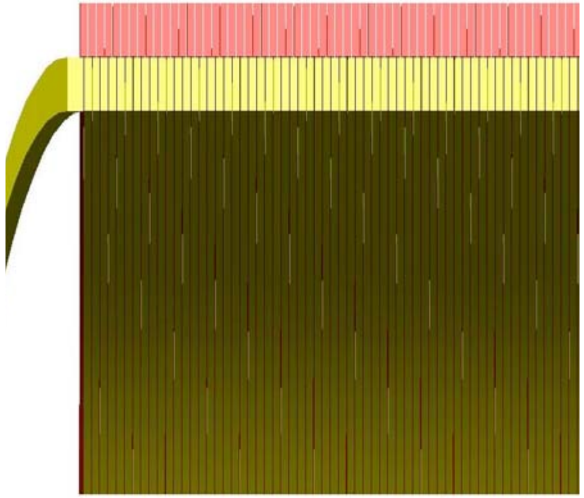
Outline Specification of Aluminium Stabilized Cable for the PANDA Solenoid

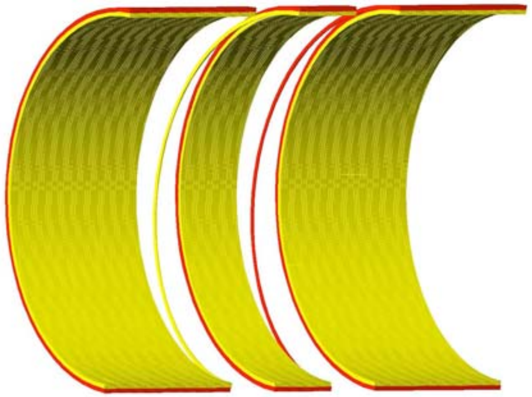
The Furukawa Electric Co., Ltd.
Date : February 11, 2009
Spec. No. : SEH-0902A

Item		Unit	Specification
Supeconducting Strand	Diameter (*in finished conductor*)	mm	0.80±0.03
	Superconducting material		Nb-47wt%Ti
	Stabilizer material		Oxygen free copper
	Cu/NbTi ratio		1.1±0.1 / 1
	Filament diameter (*in finished conductor*)	μm	27 nominal
	Number of filament		620 nominal
	Twist pitch (*in finished conductor*)	mm	27 nominal
	Twist direction		Left hand screw (S)
	RRR of Copper (*in finished conducto r*)		≧50 (Extracted)
	Critical current at 5.6T, 4.2K (*in finished conductor*)	A	≧693 (Extracted)
Supeconducting Rutherford Cable	Number of strands	pcs	18
	Thickness (*in finished conductor*)	mm	1.70 nominal
	Width (*in finished conductor*)	mm	7.04 nominal
	Transposition pitch (*in fisnished conductor*)	mm	105 nominal
	Transposition direction		Right hand screw (Z)
	Packing factor	%	86 nominal
Aluminium Stabilized Conductor	Manufacturing method		Co-extrusion
	Material		5N-Al (≧99.999% purity)
	Thickness	mm	3.40±0.05
	Width	mm	24.60±0.05
	Corner radius	mm	0.35±0.05
	Al/Cu/NbTi ratio		16.2 / 1.1 / 1
	Critical current at 5.6T, 4.5K	A	≧10,000
	Critical current at 5.6T, 4.2K	A	≧11,080
	RRR of Aluminium		≧1,000
Insulation	Insulation of conductor		None
Other items	Piece length	m	A) ≧1,700 , B) ≧900
	Piece number	pcs	A) 4 , B) 2
	Total length	m	≧8,600
	Shipping spool		TBD
	Packing material		TBD

The Intracoil Splices



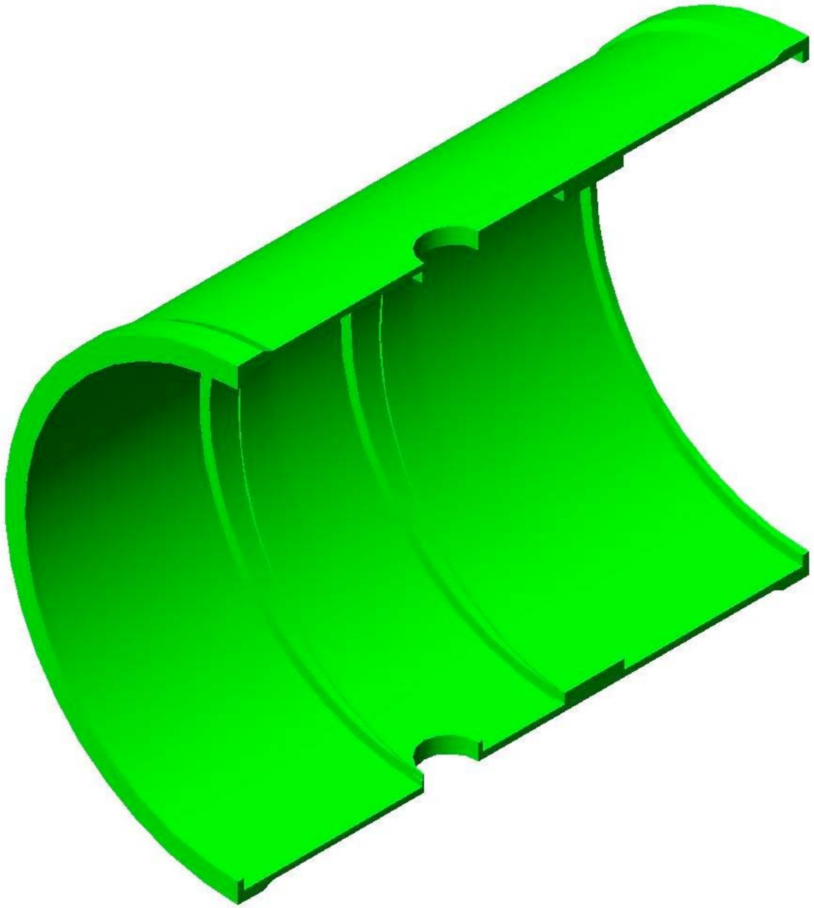


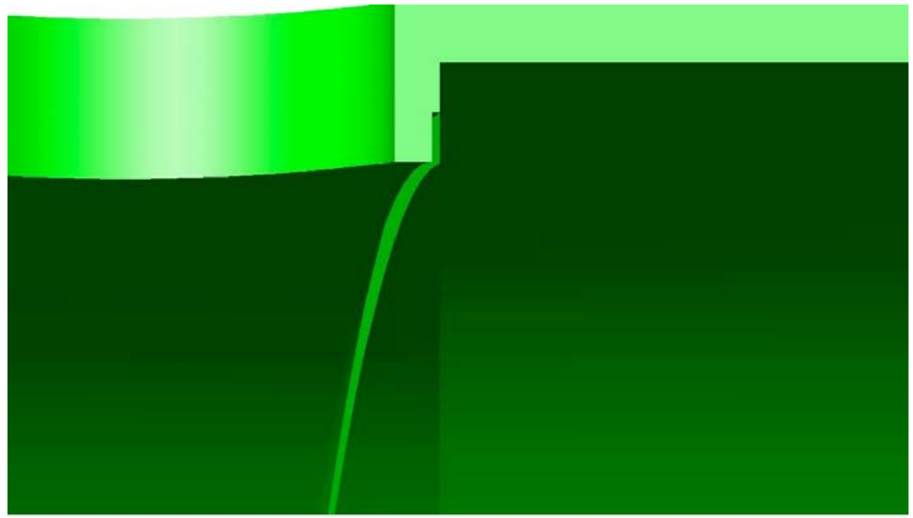


Two side by side S/C cables Tig-Welded together on ~3 metres length

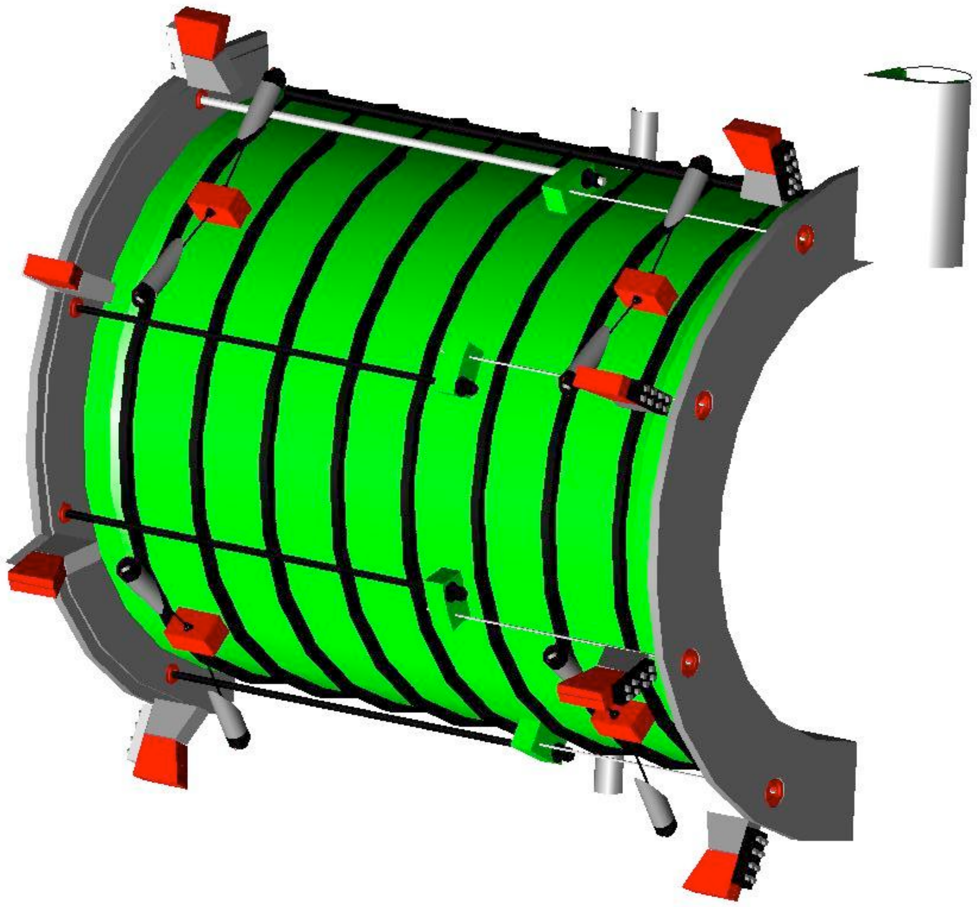
R~ 10^{-10} W At Least (Babar, Atlas, CMS)

The Coil Former





The Coil Suspensions



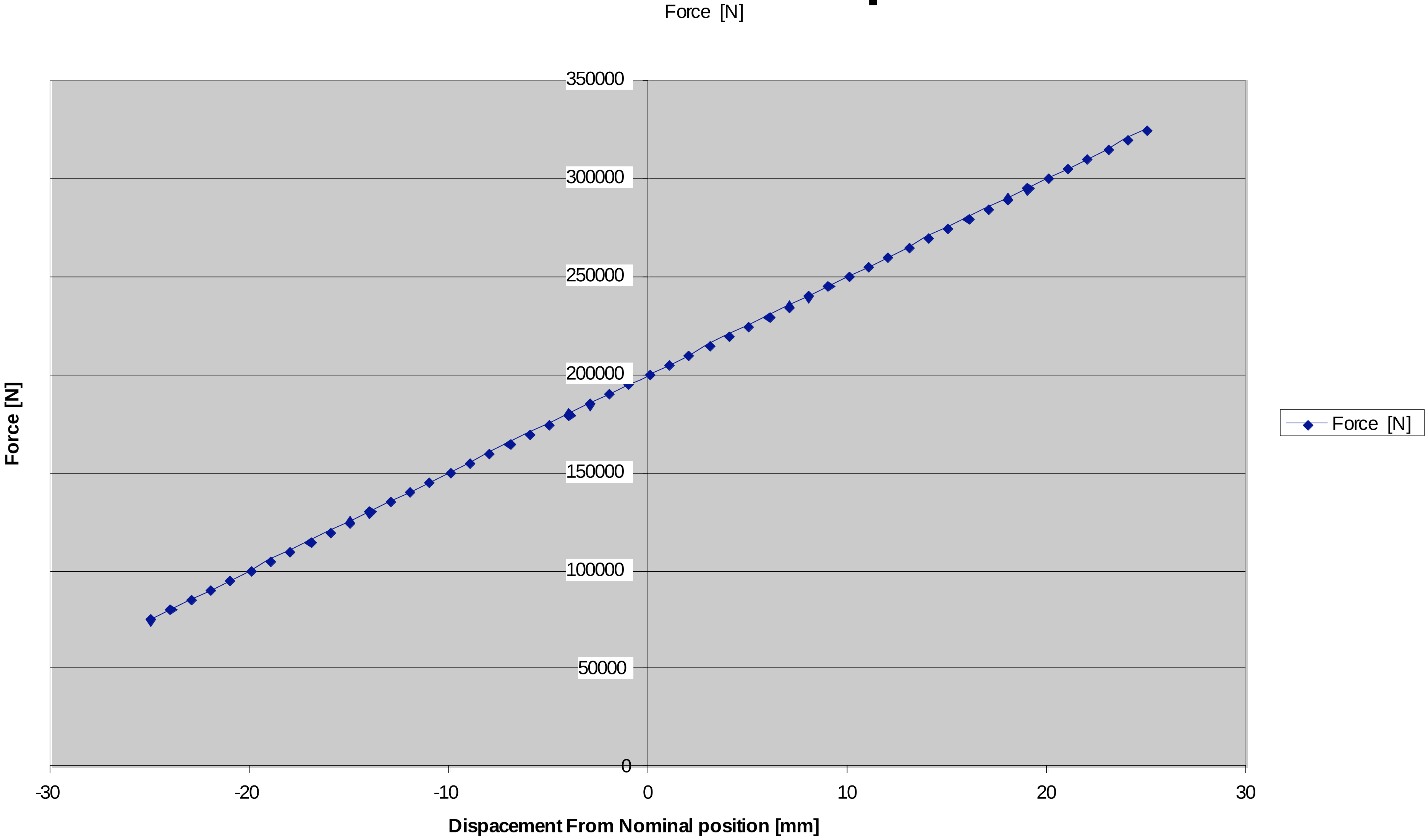
Titanium Grade 5 alloy Rods

Unsimmetrical suspension to keep to a minimum the displacement of the Target Vias during the Cool Down.

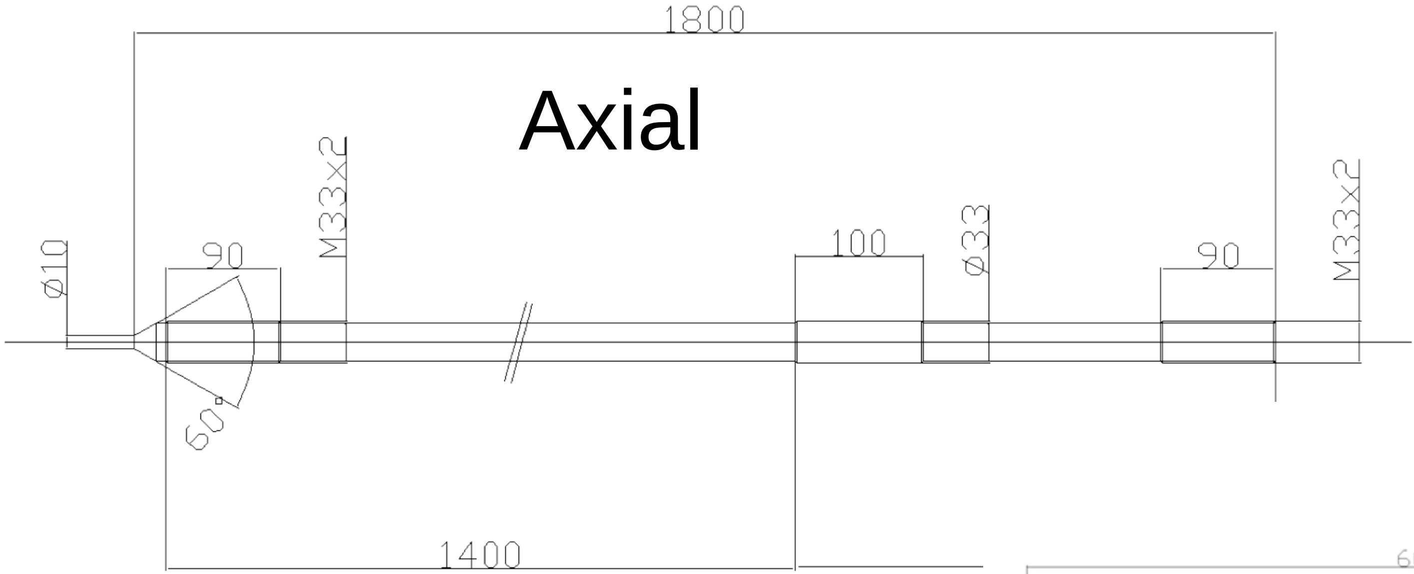
The Dowstream Tie Rods keep the net axial force Upstream produced by the Unsimmetric Iron distribution and by 10mm misalignement effect in the Coil Position

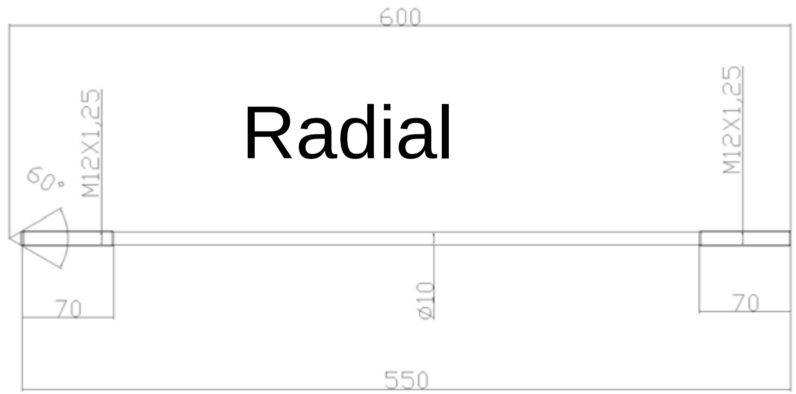
(safety factor 3)

Axial Force plot



Tie Rods design.

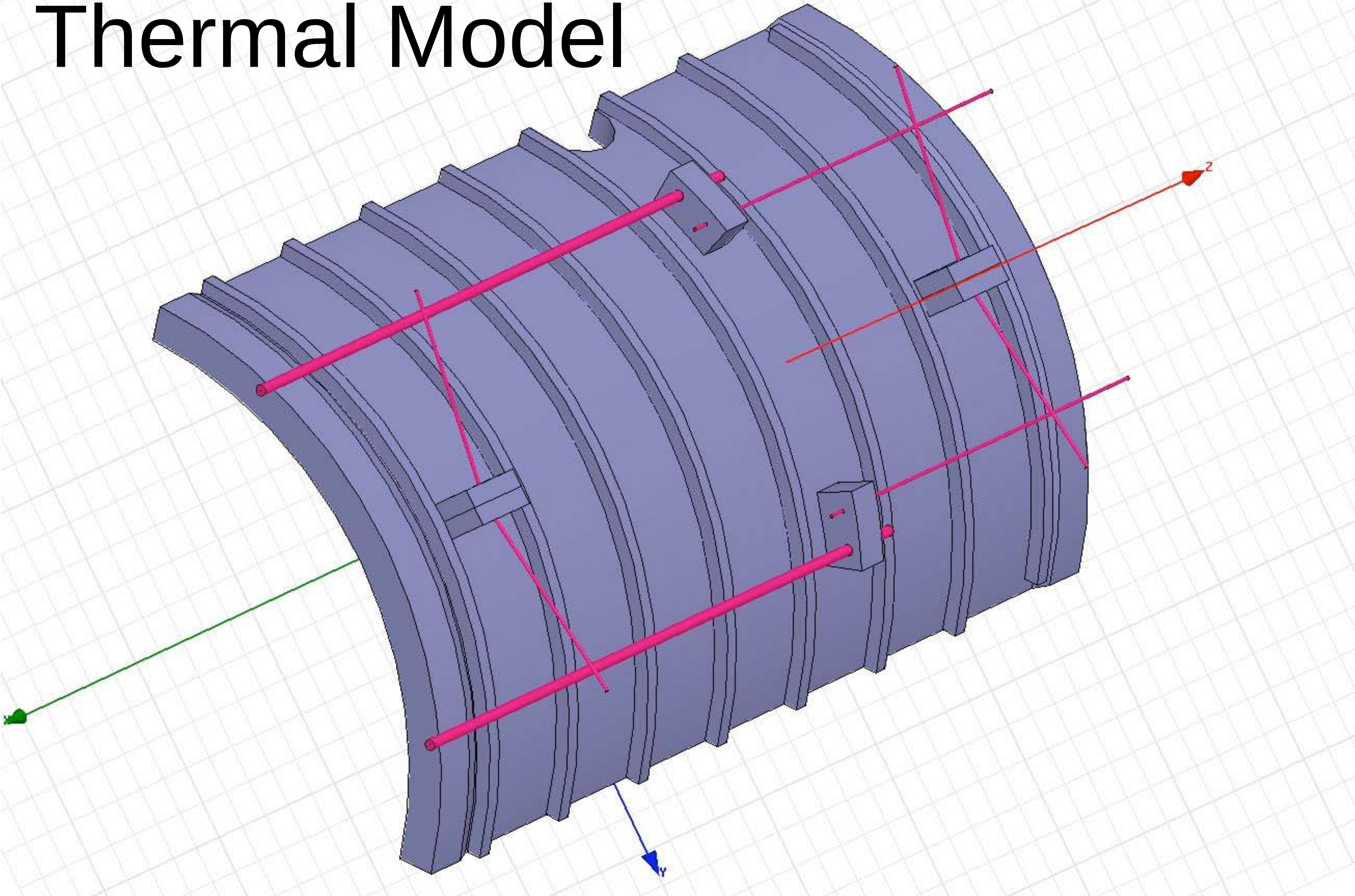




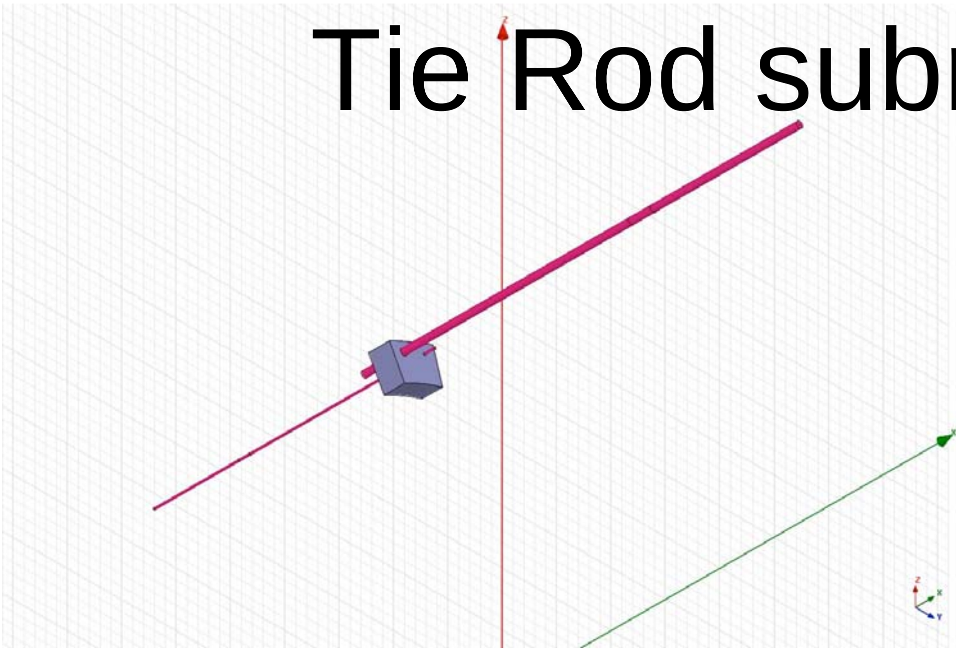
Coil Thermal Budget

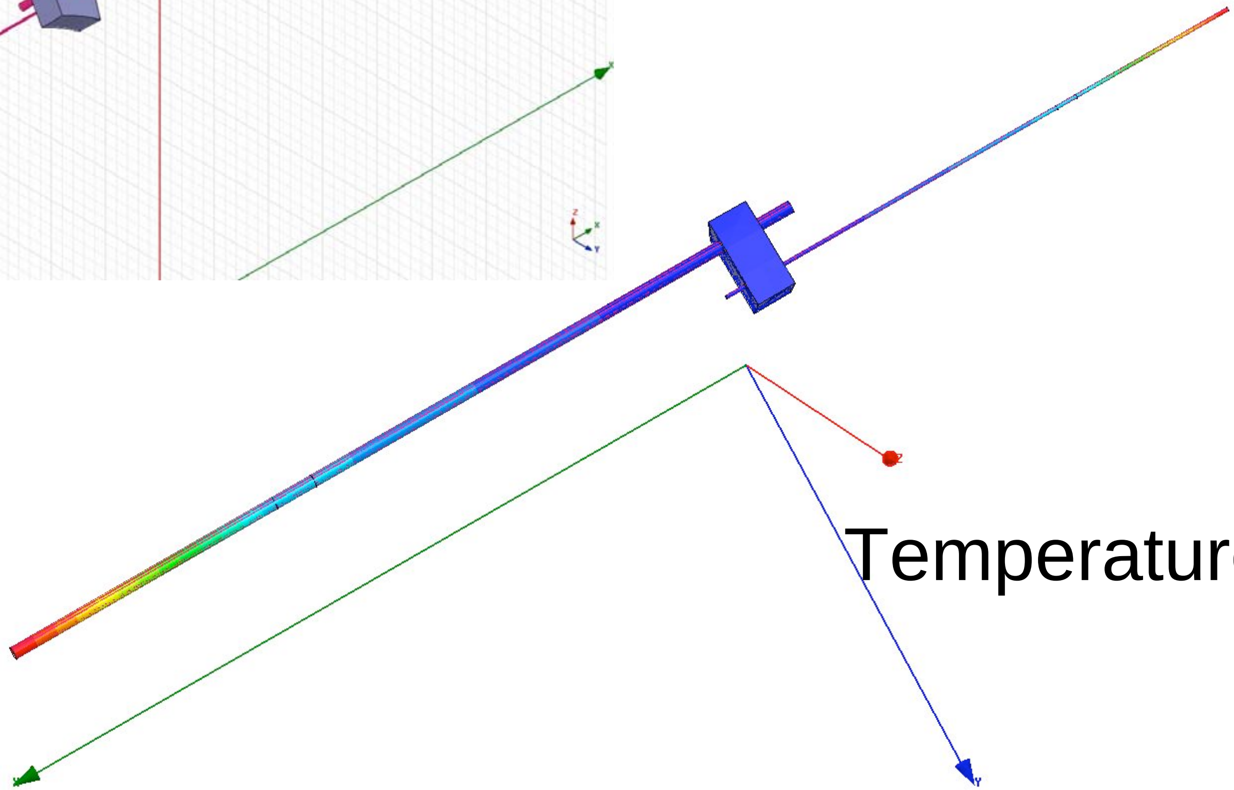
- Symmetry in the coil longitudinal cuts
- Fixed temperature (50K) at the tie Rod Intercepts
- Fixed temperature (4.5K) on the outer surface of the coil loops.
- Distributed heat Load 0.07 W/m^2 on the whole surface of the coil to account for the radiation heat
- A insulation boundary condition at the coil-Coil-Former interface corresponding to an epoxy glass layer 1 mm thick using the Temperature dependent thermal conductivity values at low temperature for the composite..
- Anisotropic Thermal properties of the coil windings to account for the different thermal conductivity in the Axial, radial and Azimuthal directions.
- The heat load is increased by a factor 2 (0.14 W/m2) on the end flanges of the Coil, and by a factor 3 (0.21 W/m2) in the Bore of the target insertion

Thermal Model



Tie Rod submodel (axial)



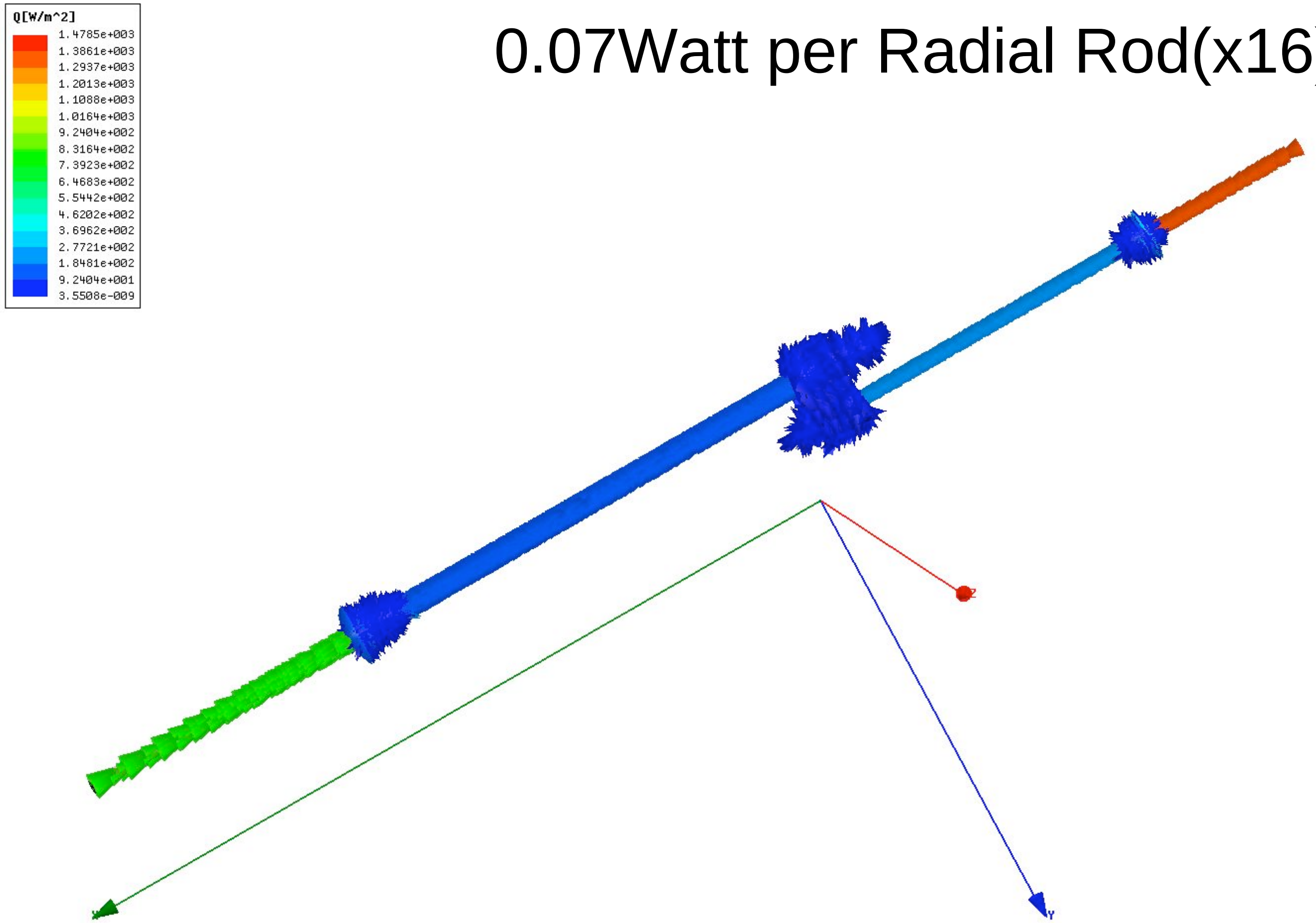


Temperature Profile

Heath Flux from suspensions

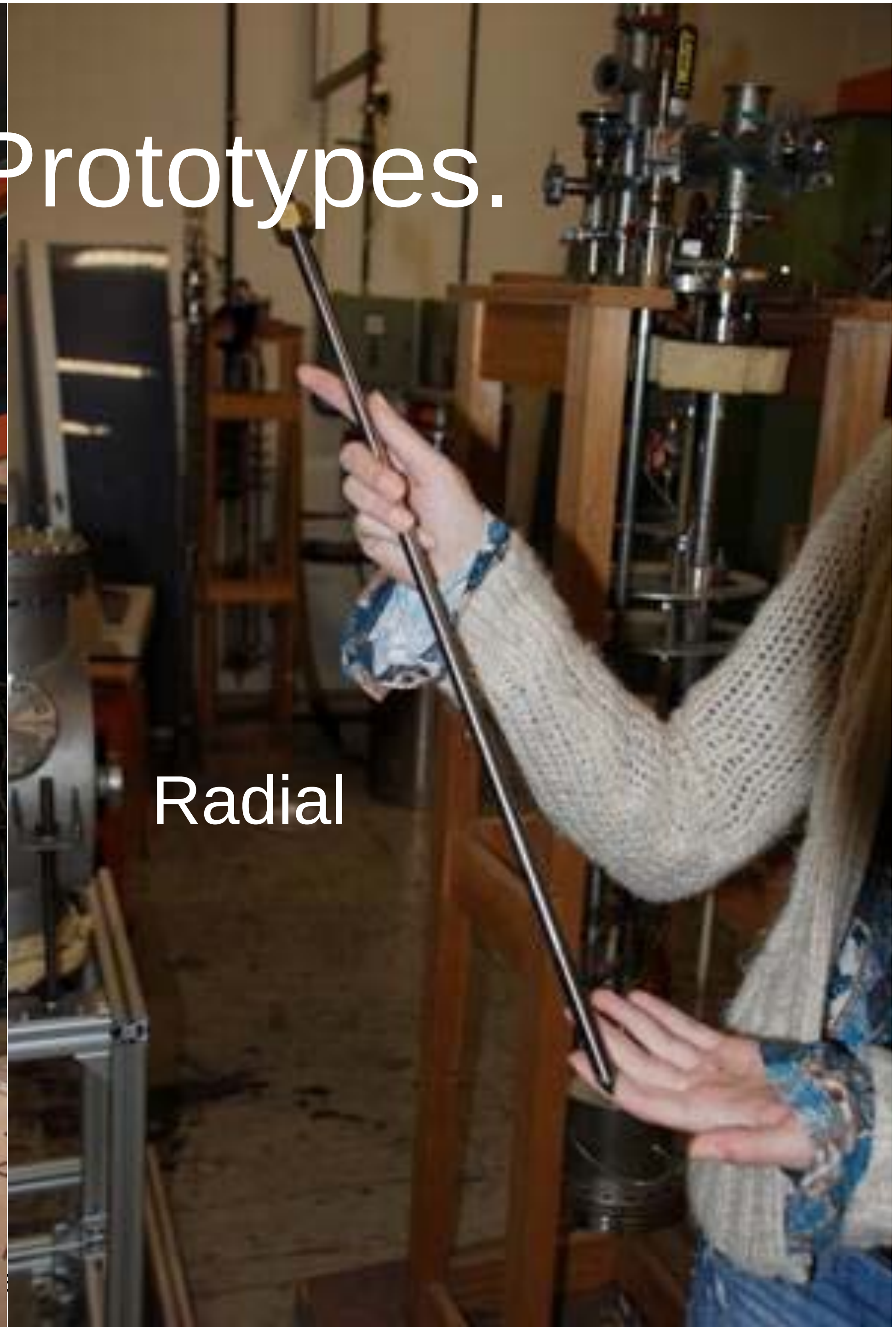
Termal Input 0.13Watt per Axial Rod (x8)

0.07Watt per Radial Rod(x16)



Tie Rods Prototypes.

Axial



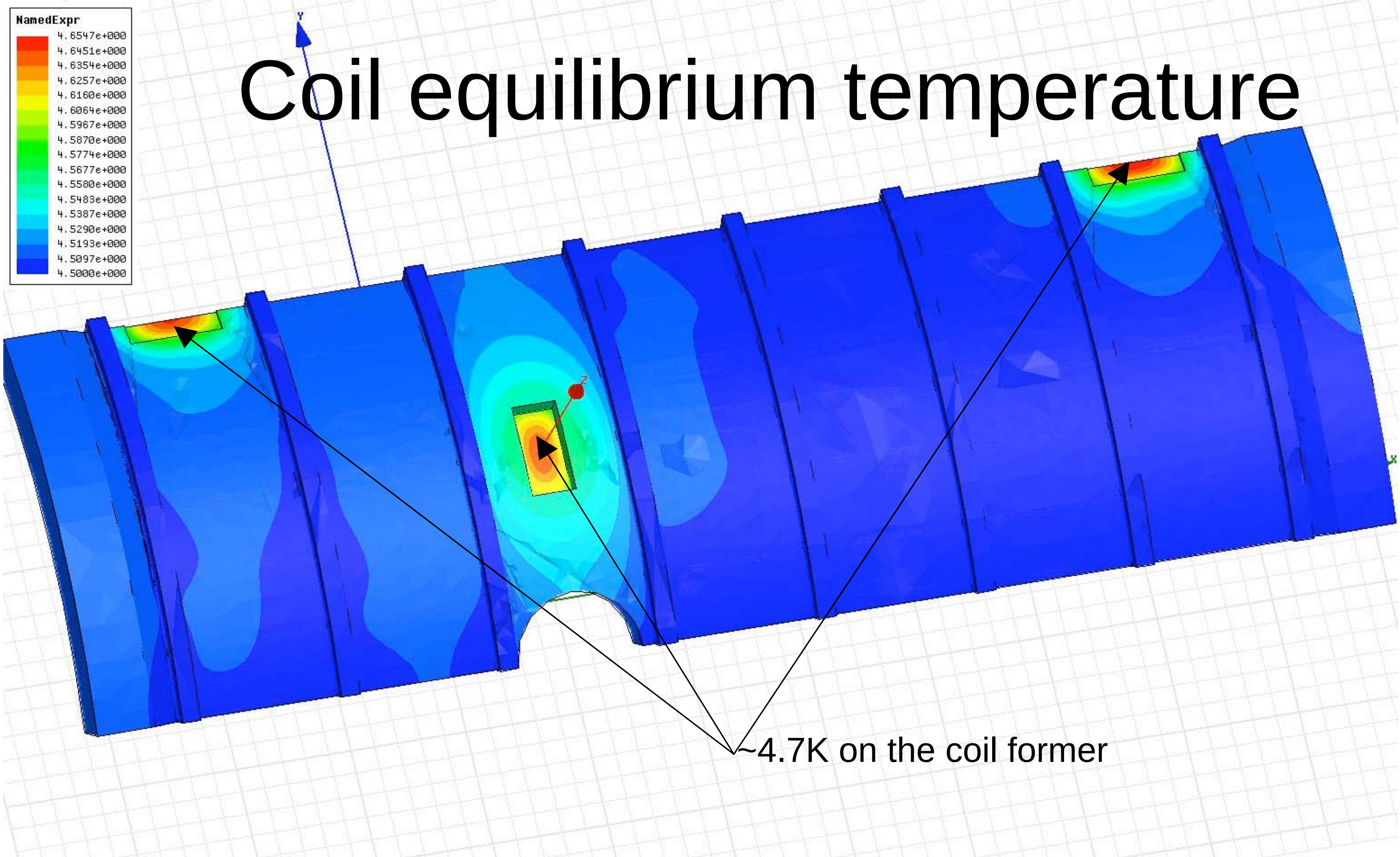
Radial

We measured

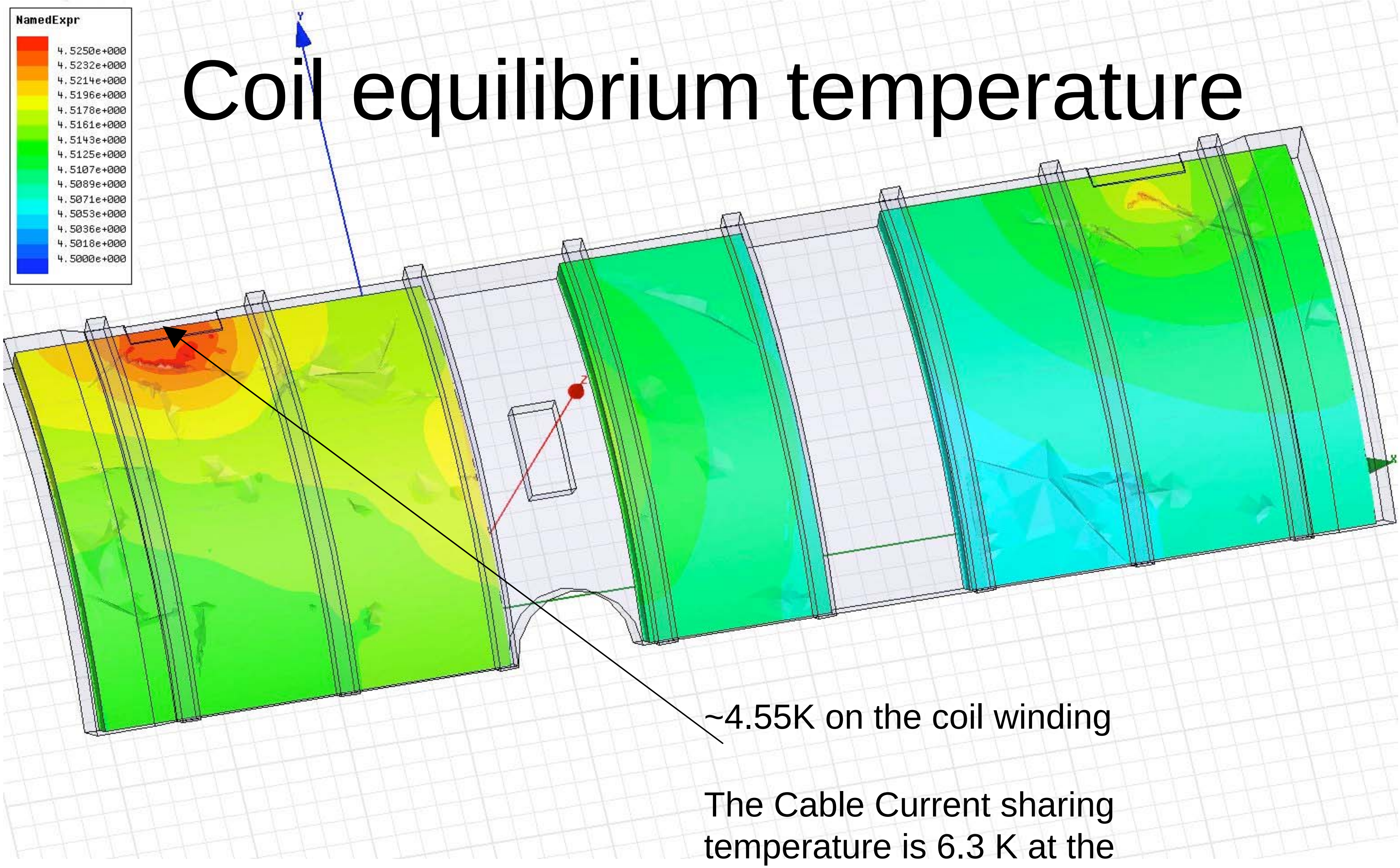
0.14±10% Watt in the Axial Rod Test

0.06±5% Watt Radial Rod

Coil equilibrium temperature



Coil equilibrium temperature

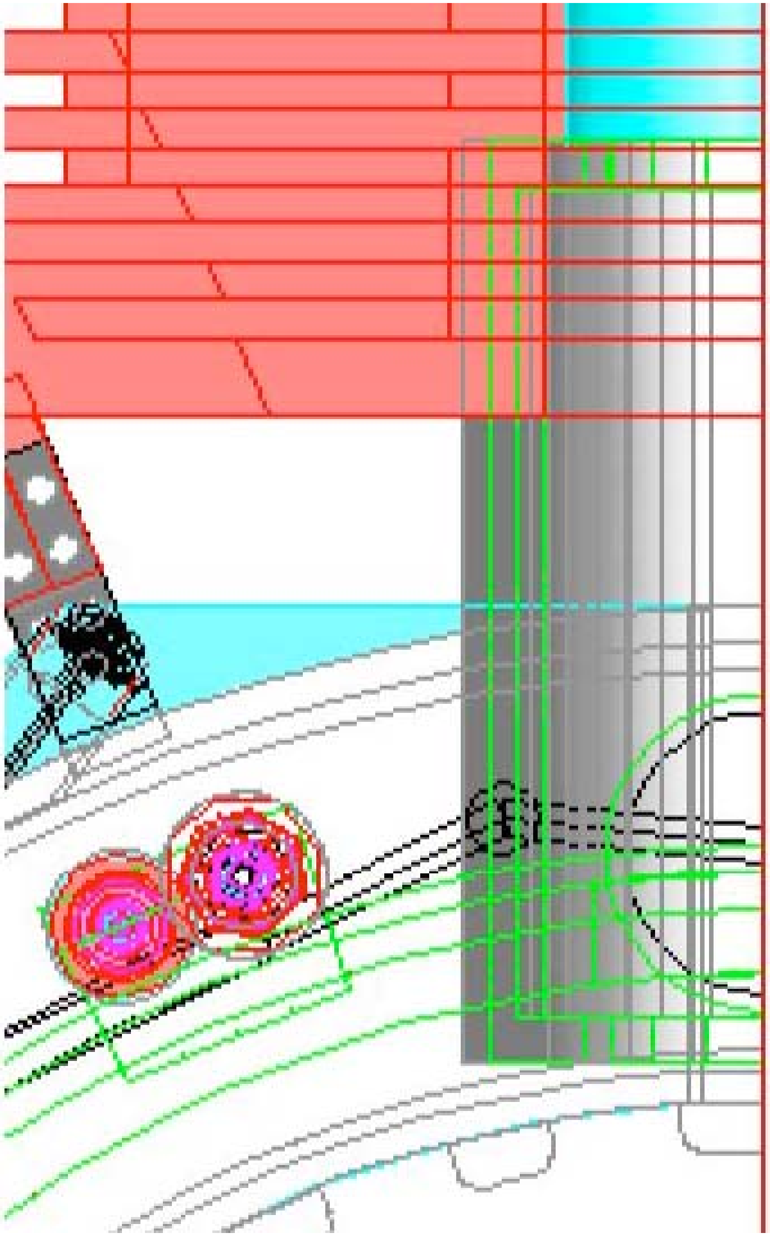


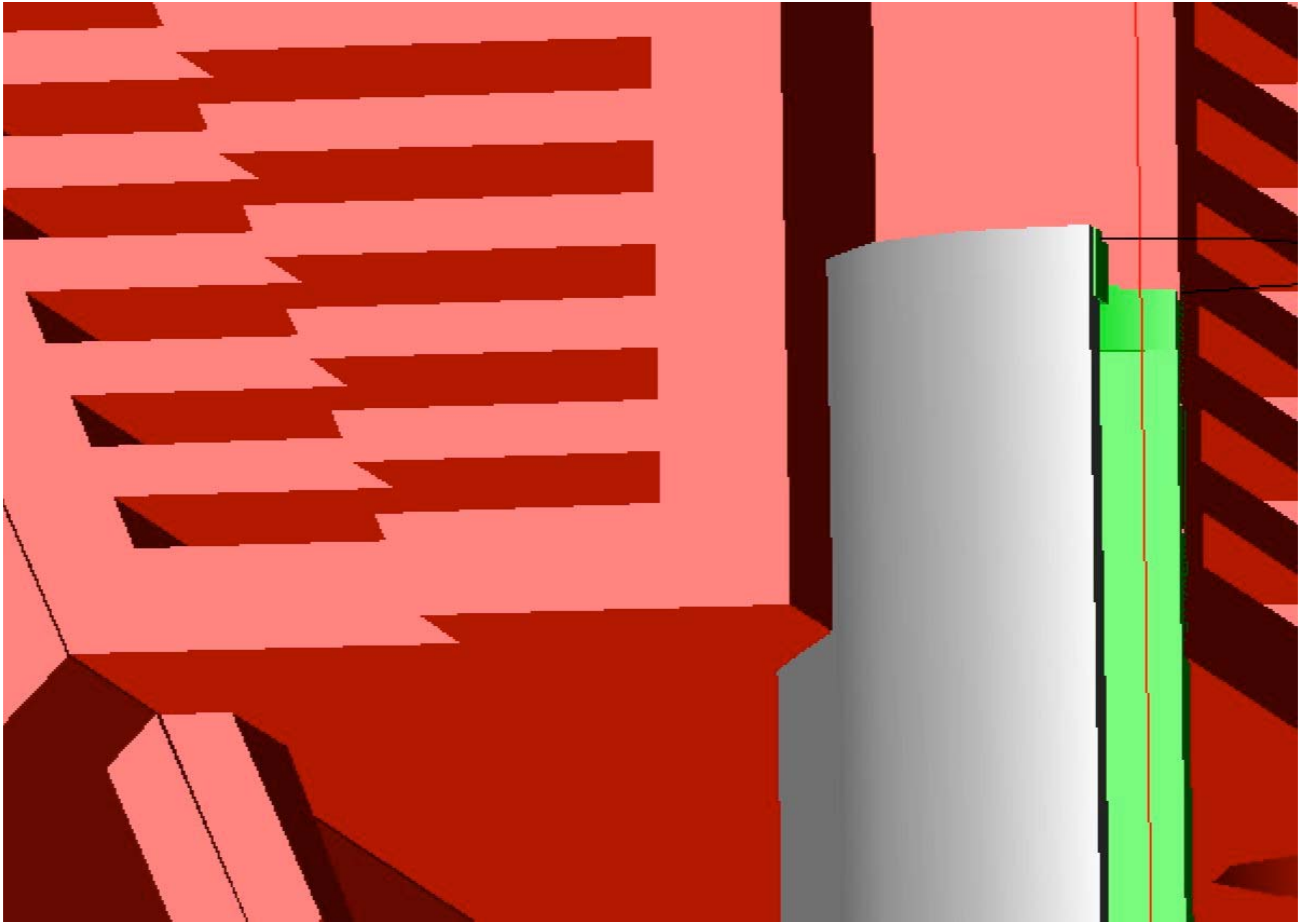
~4.55K on the coil winding

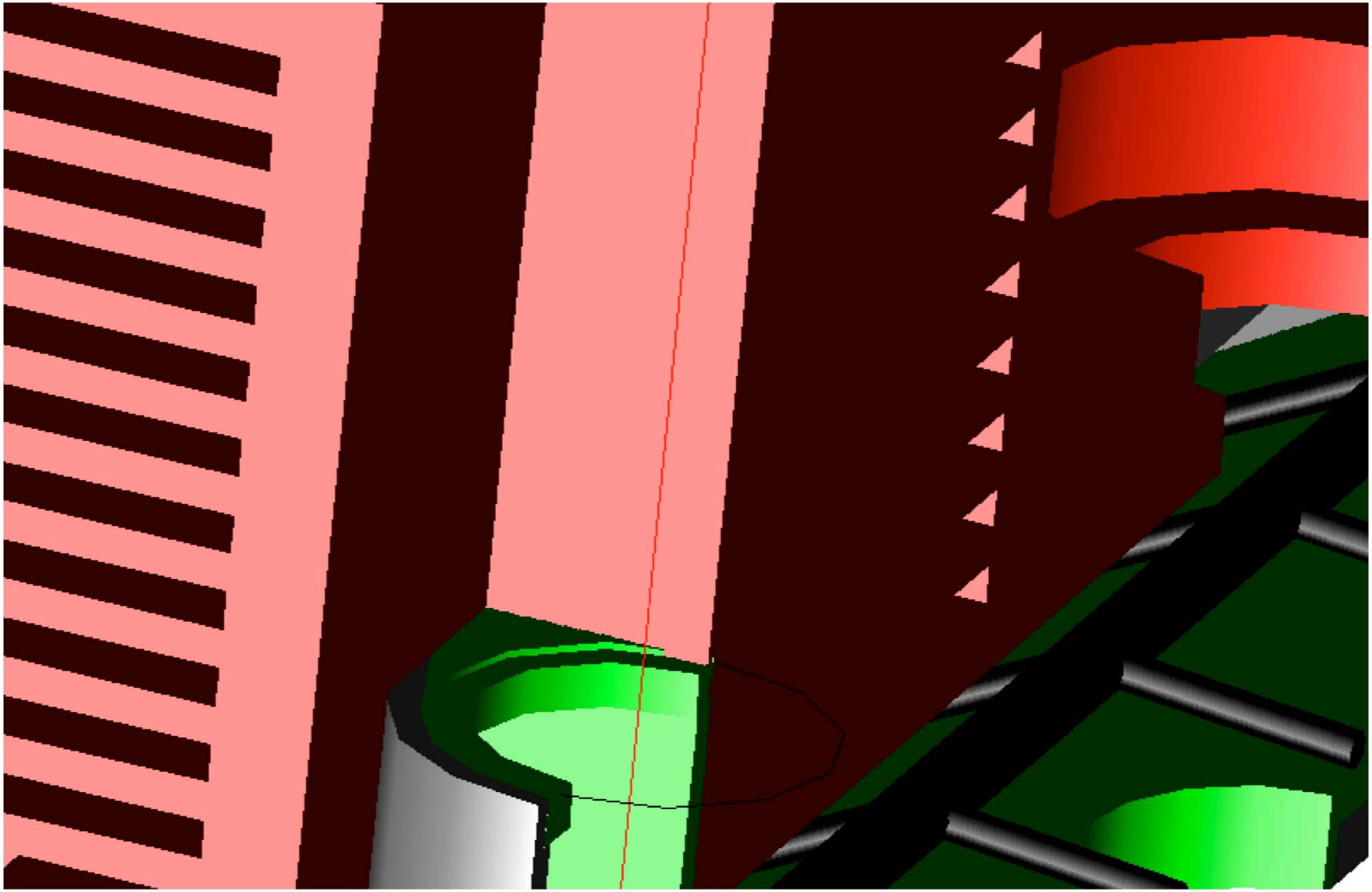
The Cable Current sharing temperature is 6.3 K at the rated current and field.

Conflicts with the existing design??

- Minor Clashes In the Chimney to Cryostat Connection – Junction Box
- Few more centimetres in the Iron Chimney aperture will be very usefull.
- Some space is needed around the Cylindrical box outside of the Iron, In the Target Forepump region.







Suggested Space for the Coil