COMPASS-U: Tokamak Poloidal field coils

v1.1

Institute of Plasma Physics of Czech Academy of Science

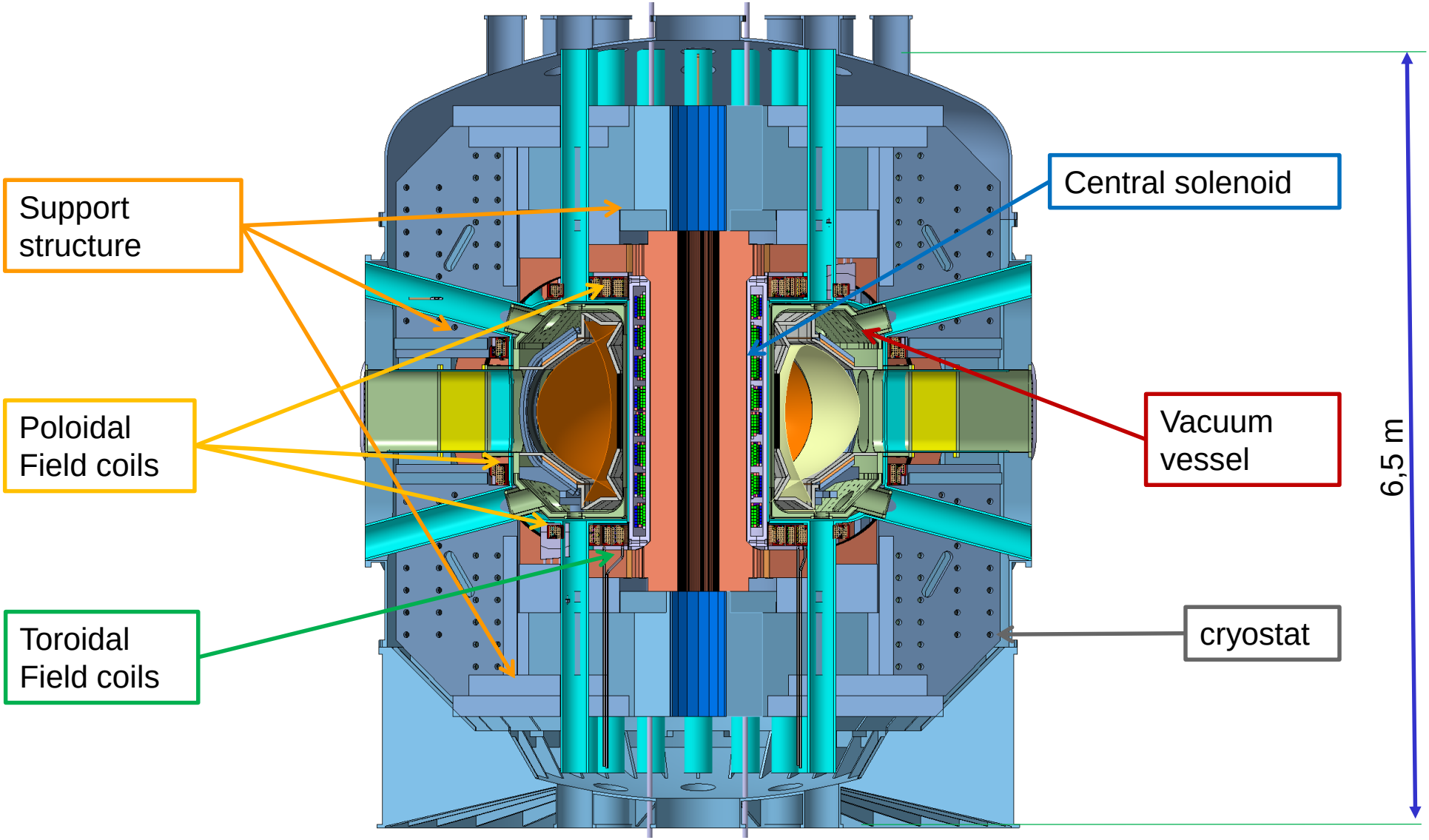
Parameters of a new tokamak

Key properties of COMPASS-U:

- High magnetic field to confine plasma (5 T)
- High plasma current (2 mil. Ampers)
- High currents in toroidal coils up to 200 kA
- High currents in poloidal coils up to 50 kA
- Both coils systems from copper alloy materials (discharge durations up to severals seconds)
- tokamak operate at cryogenic temperature
- Operation with high temperature first wall – up to 500°C
- mid-size device

=> unique capabilities to address DEMO challenges

Cross-section of COMPASS-U



COMPASS-U cross-section

Total weight approx. 250 tons!

Indicative timetable

Key milestones:

Design of the components	2018 - 2020
Vessel, support structure manufacturing	2020 - 2021
PF and TF Coil manufacturing	2020 - 2021
Assembly and installation	2021 - 2022
Commissioning and start of operation	2022

First plasma: end of 2022

Time to a fully commissioned machine: **1.5 - 2 years**

Scientific program will start from the end of 2022

Operation at 5T / 2MA: **end of 2023**

Poloidal coils overview

Presumed scope of work

- Prototype coil to confirm design and manufacture procedure
- Manufacture of 8 individual poloidal field coils from hollow conductor from certain alloy of High conductivity oxygen free copper with different radius of coils (0.5 – 1.5 m)
- Manufacture of 8 individual central solenoid coils from hollow conductor from certain alloy of High conductivity oxygen free copper with same radius of coils (0.42 m). Central solenoid coils will be wound on toroidal field coils (TF core will be delivered by IPP)

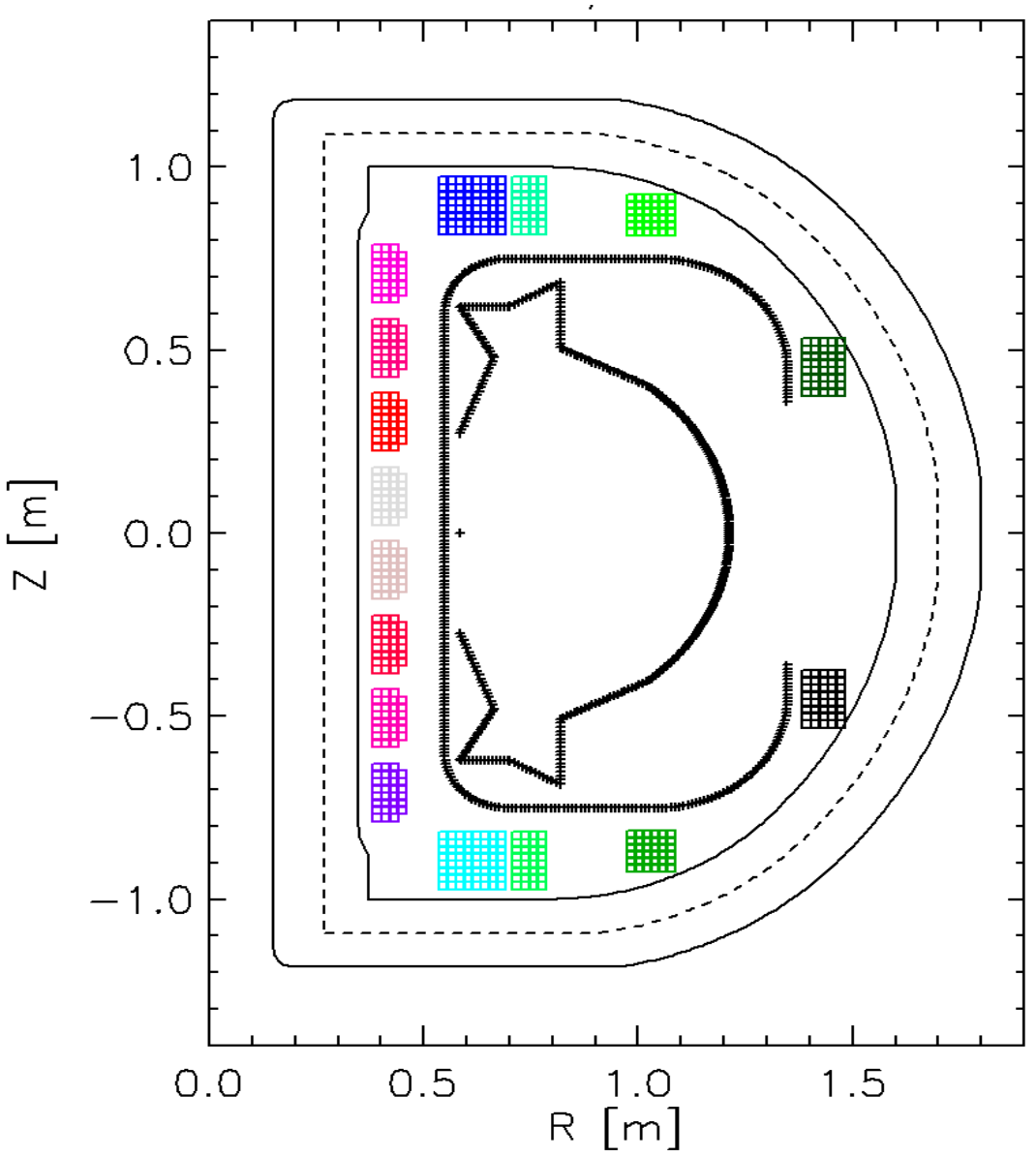
Presumed scope of work on the coil

- Winding
- Insulation
- Vacuum pressure impregnation
- Electrical testing
- Transport to IPP

Note: on depicted models of coils are models of coils holders these **are not part of the delivery**.

Poloidal coils overview

coil	Copper turn crossection [mm^2]	Coil mass [kg]	Positions of coil center dR [m]	Positions of coil center dZ [m]	dR [m]	dZ [m]
CS1U	485.52	391	0.42	0.1015	0.095	0.208
CS2U	485.52	391	0.42	0.3215	0.095	0.208
CS3U	485.52	391	0.42	0.5415	0.095	0.208
CS4U	485.52	391	0.42	0.7615	0.095	0.208
PF1U	185.66	300	0.5765	0.895	0.15	0.15
PF2U	185.66	481	0.749	0.895	0.075	0.15
PF3U	185.66	481	1.060	0.87	0.120	0.1
PF4U	275.52	1145	1.42	0.412	0.121	0.195



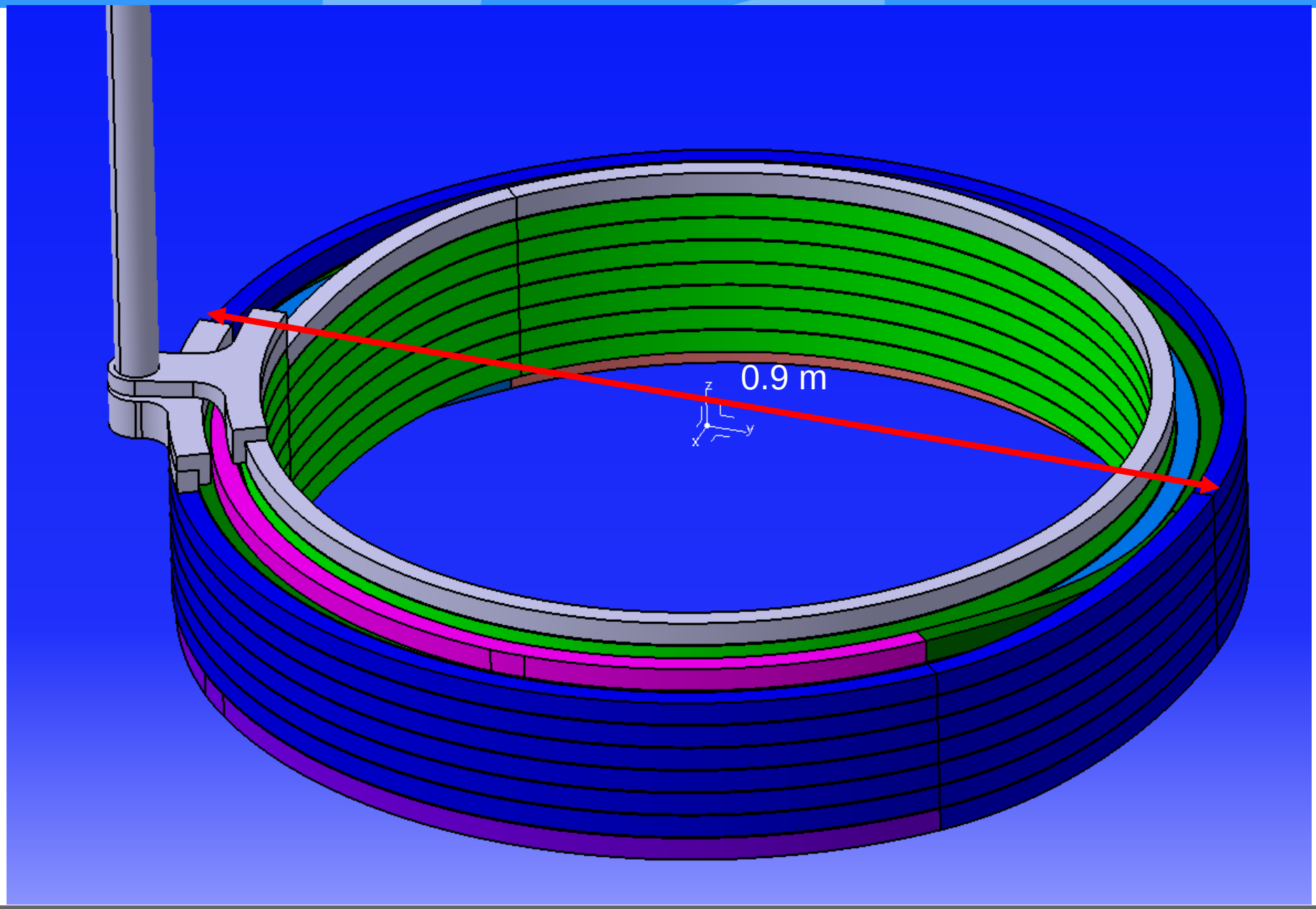
Coils design overview:

coil and quantity	material of the conductor	Height [mm]	width [mm]	dia of hole [mm]	radius of corner [mm]	numb. of turns	medium radius of the coil [m]	length of the conductor [m]
8 x CS	C10700	22	25	9	1	30	0.42	90
2 x PF1	C10700	15	15	7	1	64	0.576	150
2 x PF2	C10700	15	15	7	1	36	0.749	100
2x PF3	C10700	15	15	7	1	36	1.06	208
2x PF4	C10700	20	17	9	1	40	1.42	380

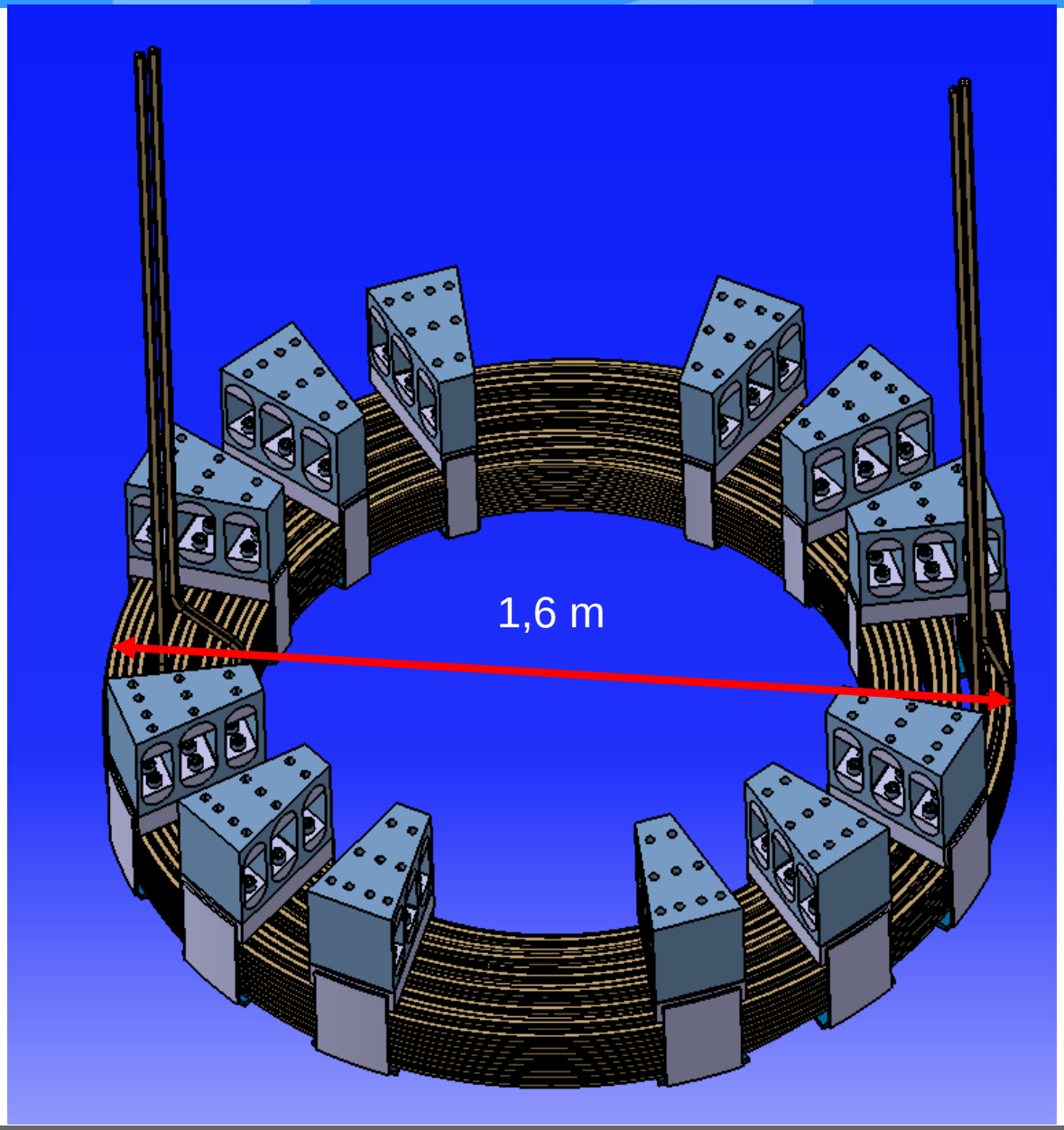
Presumed insulation material

- S2 glass fiber tape
- Kapton tape
- Primer for improved bonding to copper
- Cyanite eser or epoxy resin as impregnation

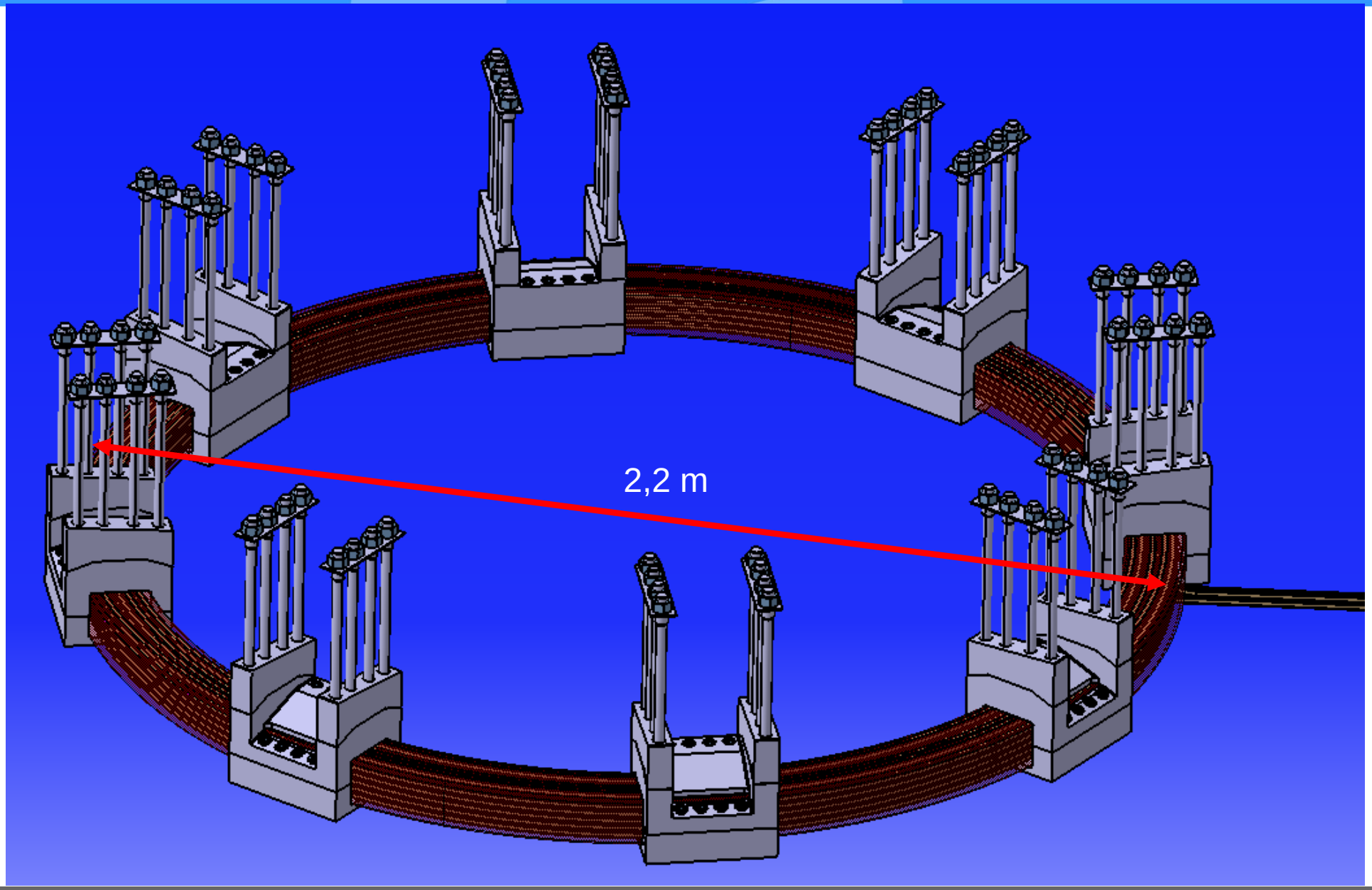
Coils design overview: CS1



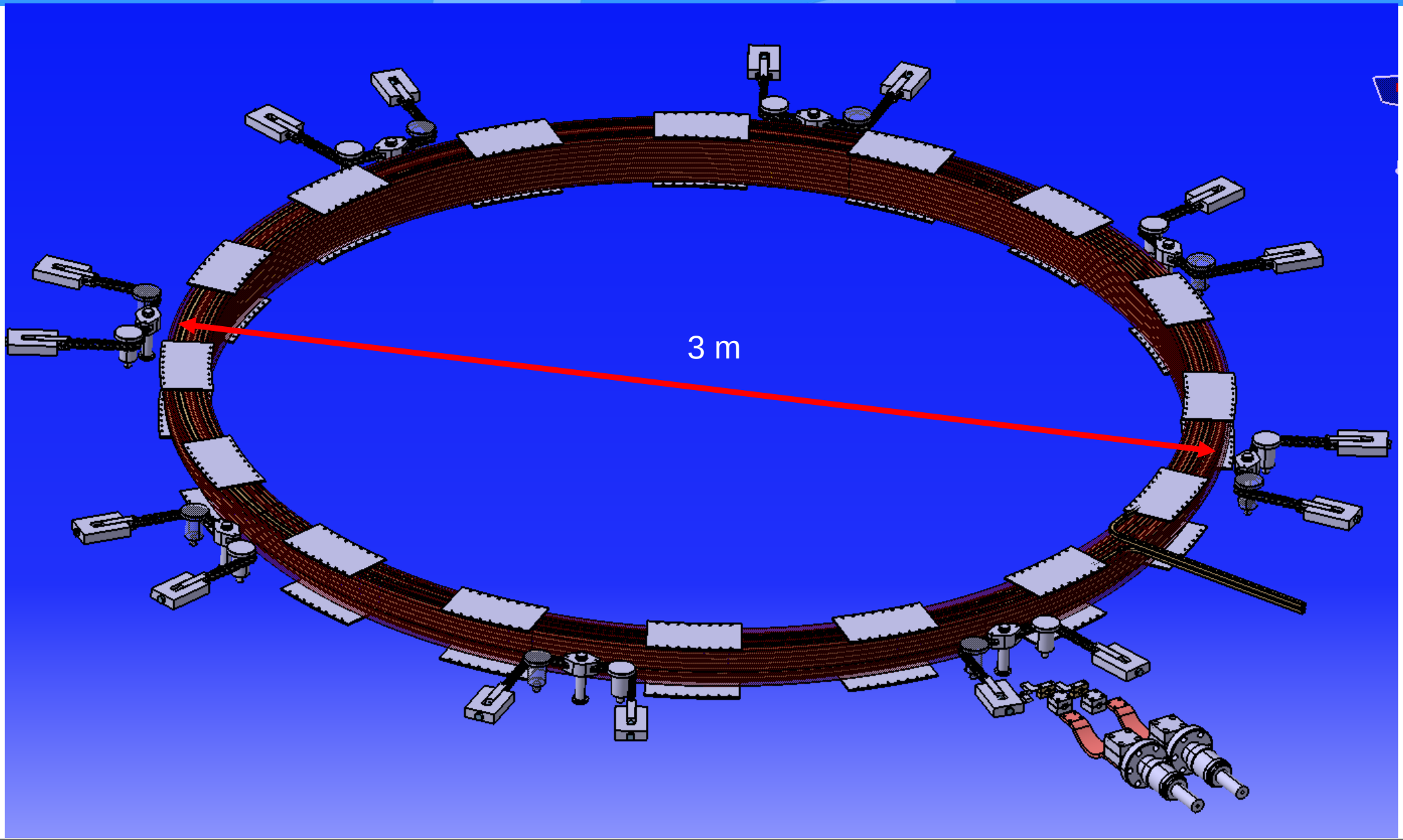
Coils design overview: PF1 and PF2



Coils design overview: PF3



Coils design overview: PF4



More informations about the preliminary market consultaion can be found at:

http://www.ipp.cas.cz/o-ufp/Verejne_zakazky/doc.html

Official announcement of the preliminary market consultation is on web site of The Tenders Electronic Daily (TED): https://ted.europa.eu/TED/search/searchResult.do
Notification number at The Tenders Electronic Daily: **2019/S 113-276588**

Contact persons :

Ivan Nemec email: nemec@ipp.cas.cz

Pavel Junek email: junek@ipp.cas.cz