



U.S. MAGNET  
DEVELOPMENT  
PROGRAM

# $\text{Nb}_3\text{Sn}$ SMCT task status

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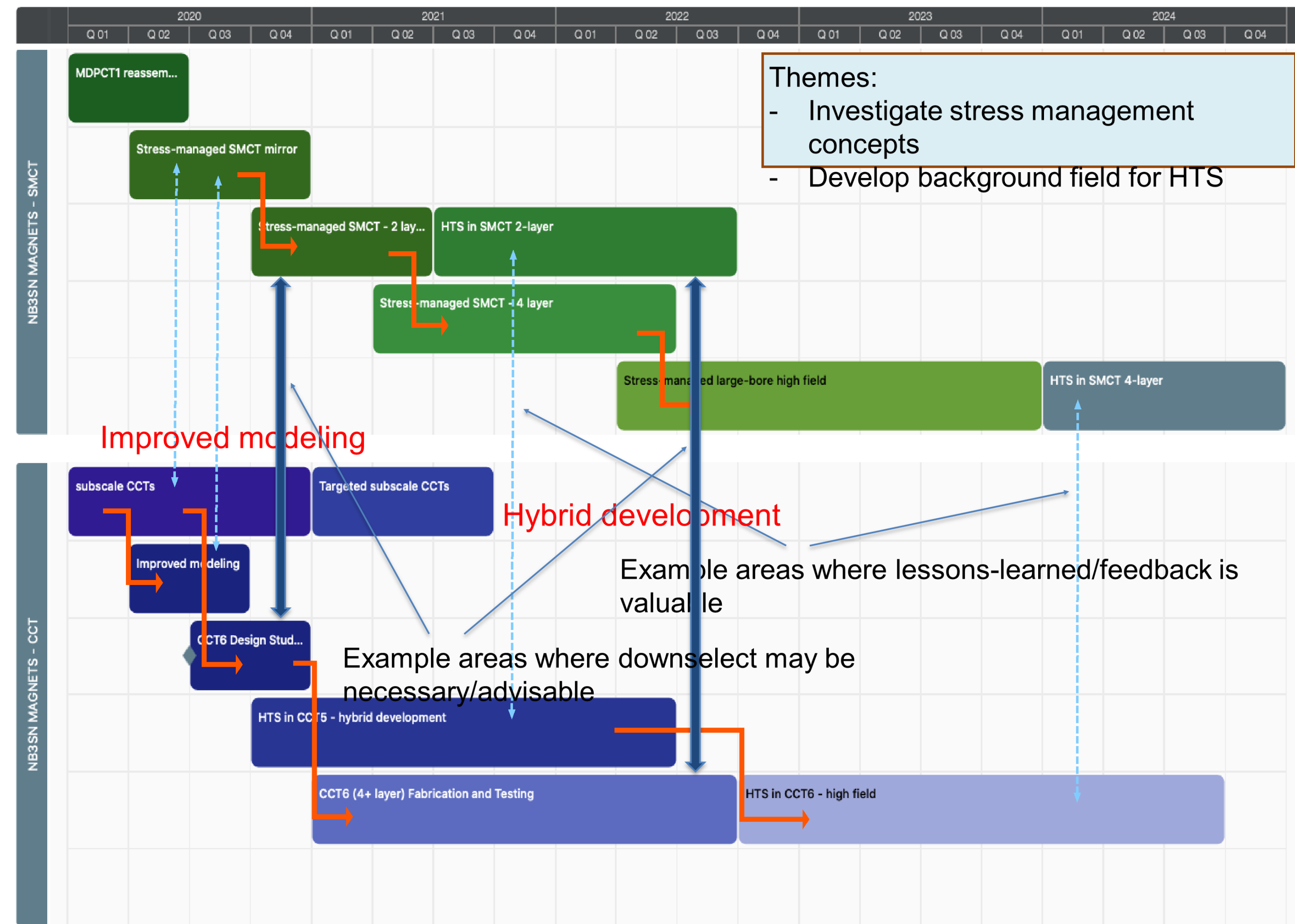
US Magnet Development Program  
Fermi National Accelerator Laboratory



# Updated Roadmaps: Nb<sub>3</sub>Sn Magnets

The updated US-MDP plan includes two directions, which are natural extension of the present Nb<sub>3</sub>Sn magnet R&D:

1. Cos-theta magnets with coil stress management (SMCT)
2. CCT magnet development

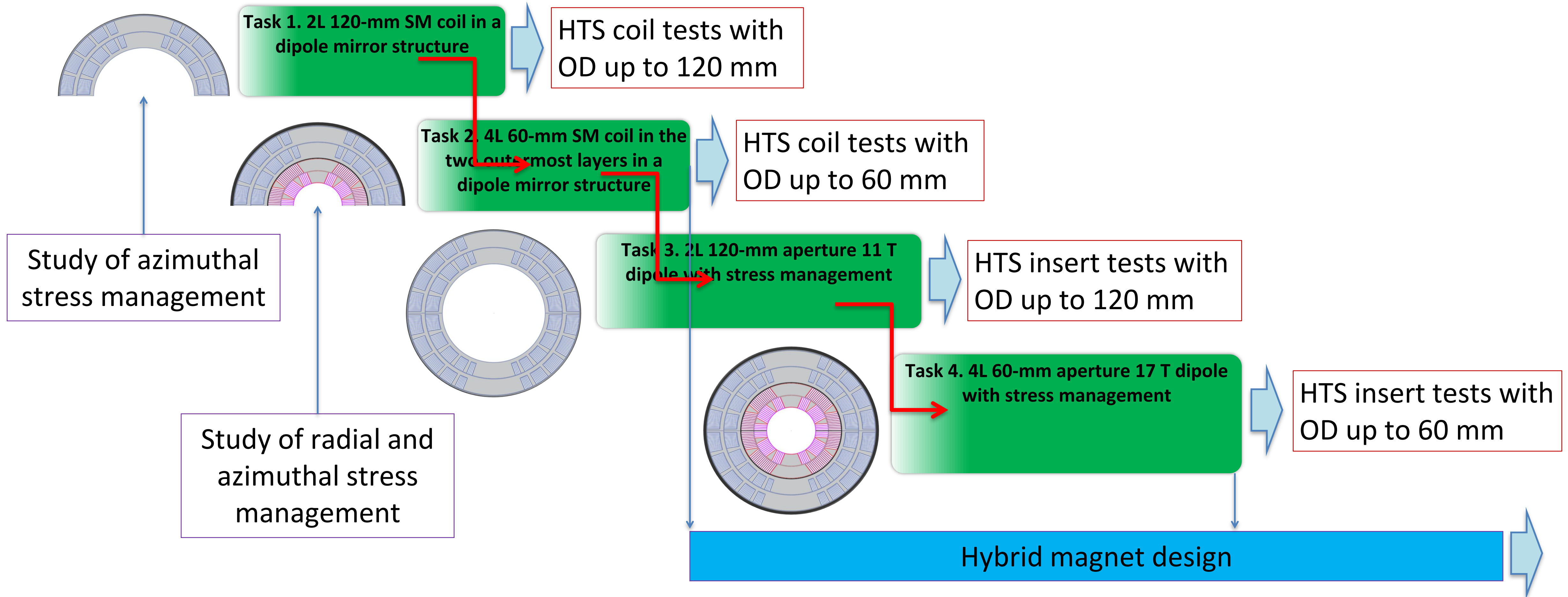


## The program plan consists of 4 tasks:

- **Task 1.** Development and test of a 2-layer 120-mm aperture SM coil in a dipole mirror structure.
- **Task 2.** Assembly and test of a 4-layer 60-mm aperture coil with SM in the two outermost layers in a dipole mirror structure.
- **Task 3.** Development, fabrication and test of a 2-layer 120-mm aperture 11 T dipole with stress management.
- **Task 4.** Assembly and test of a 4-layer 60-mm aperture 17 T dipole with stress management.

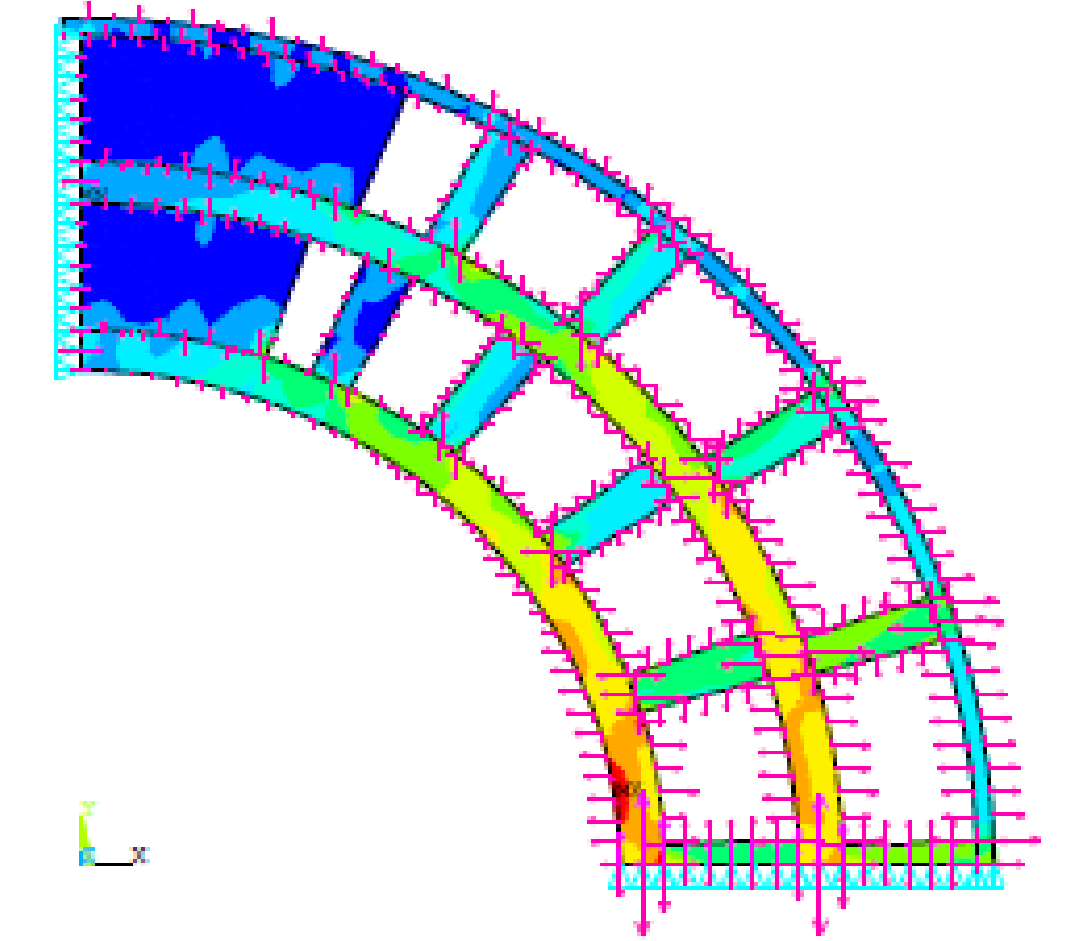
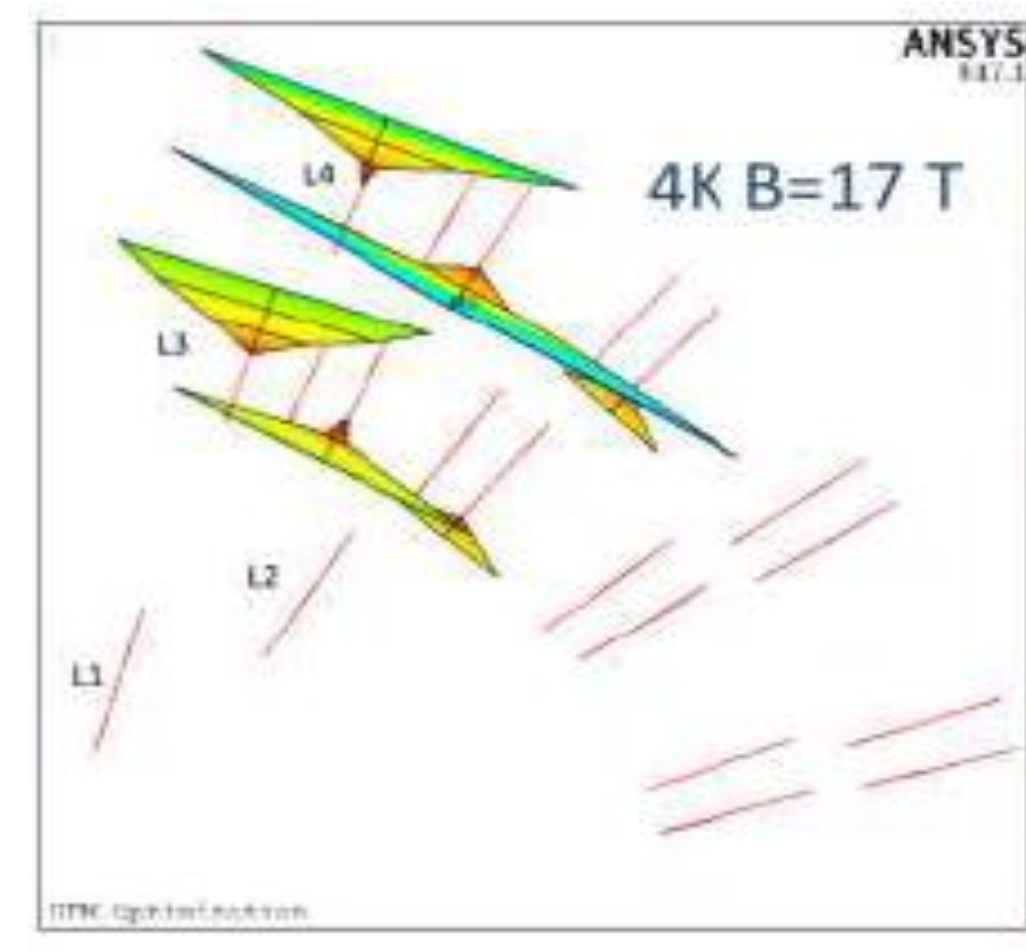
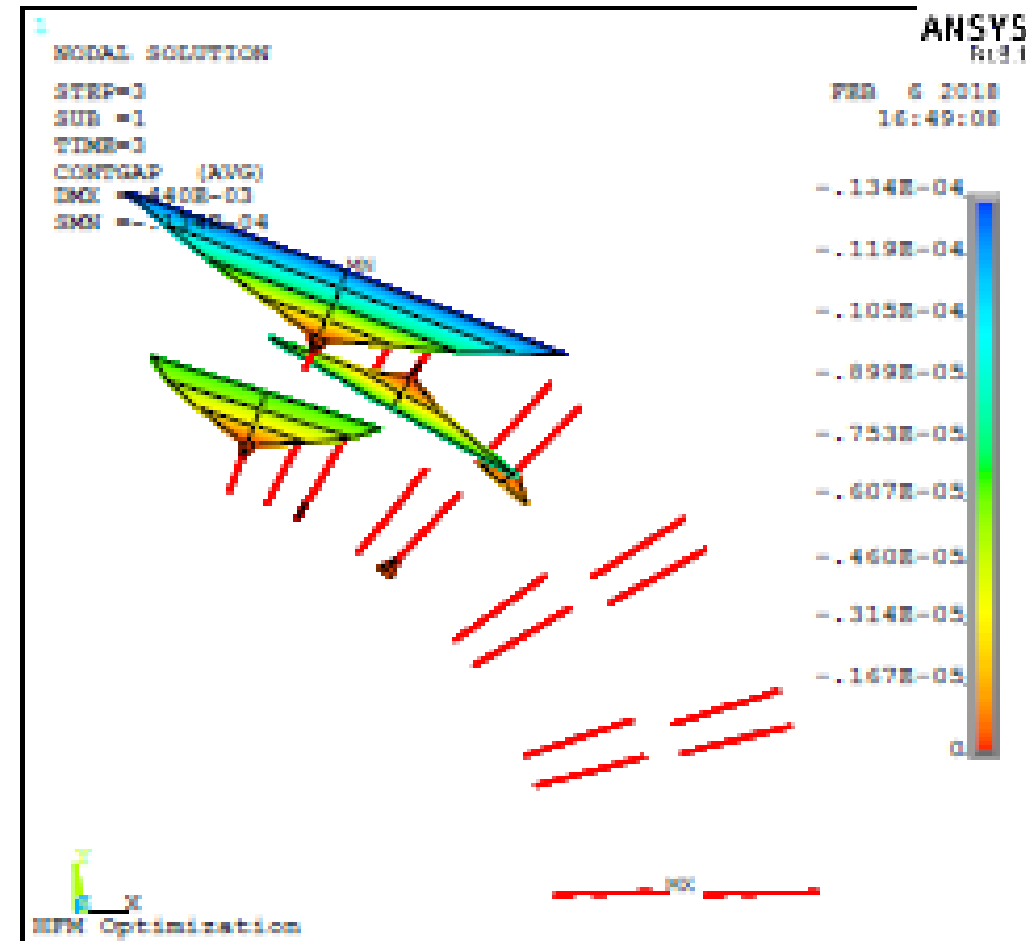
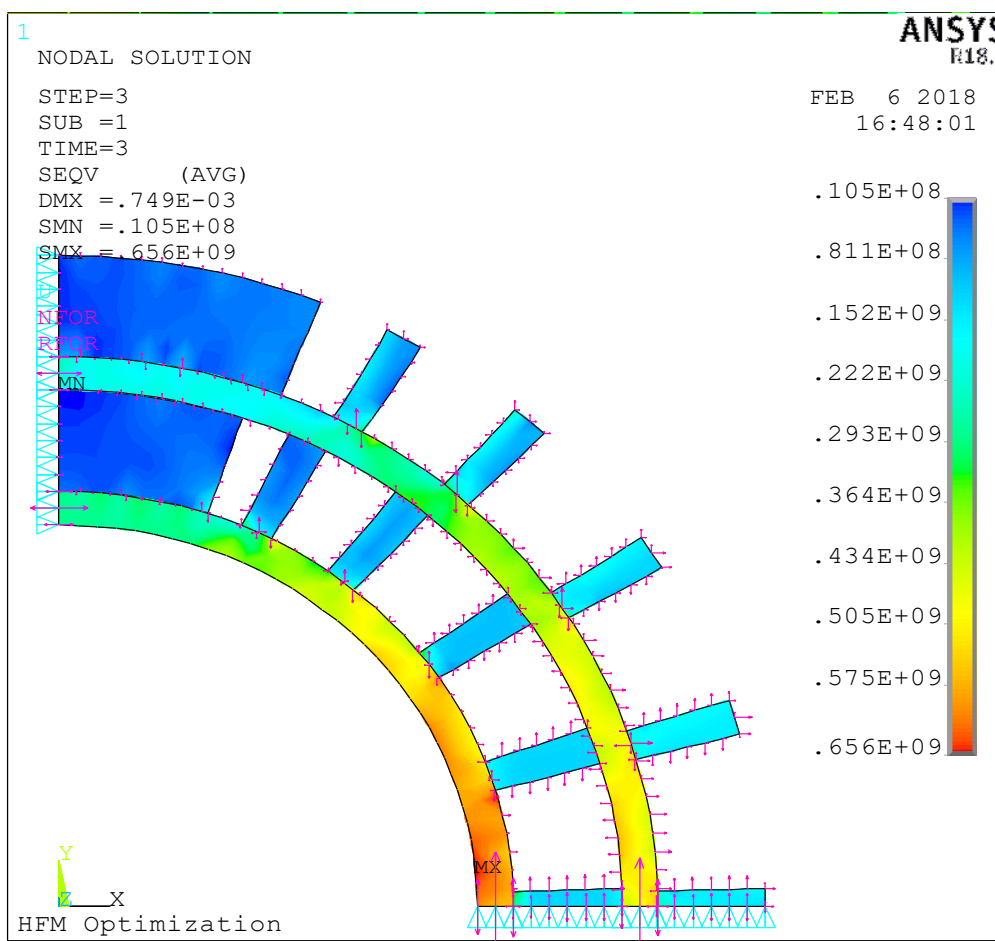
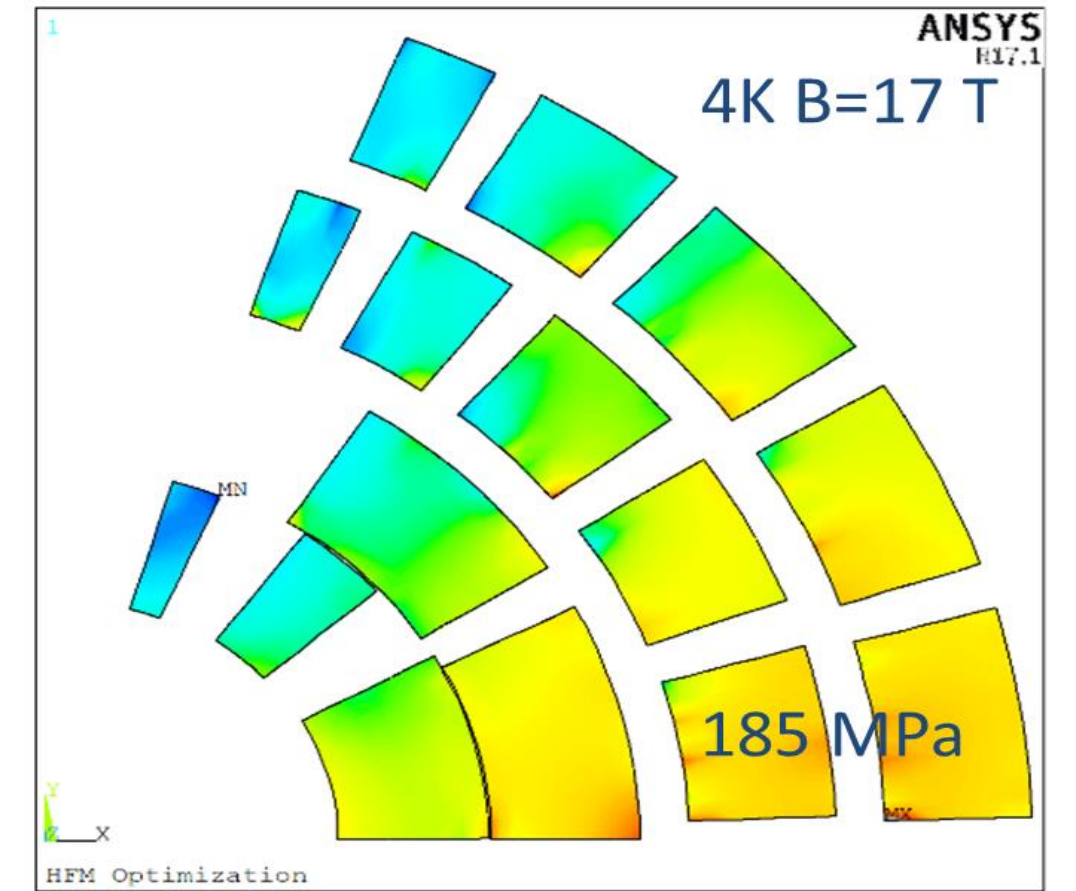
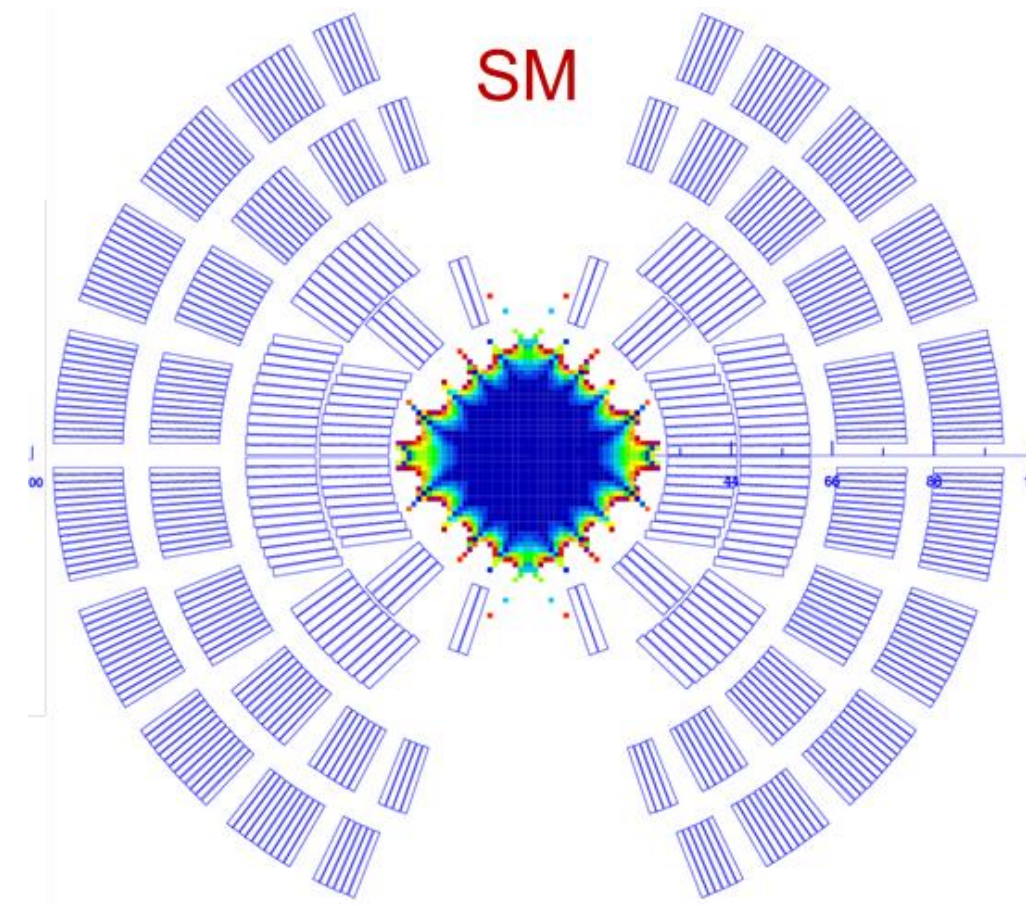
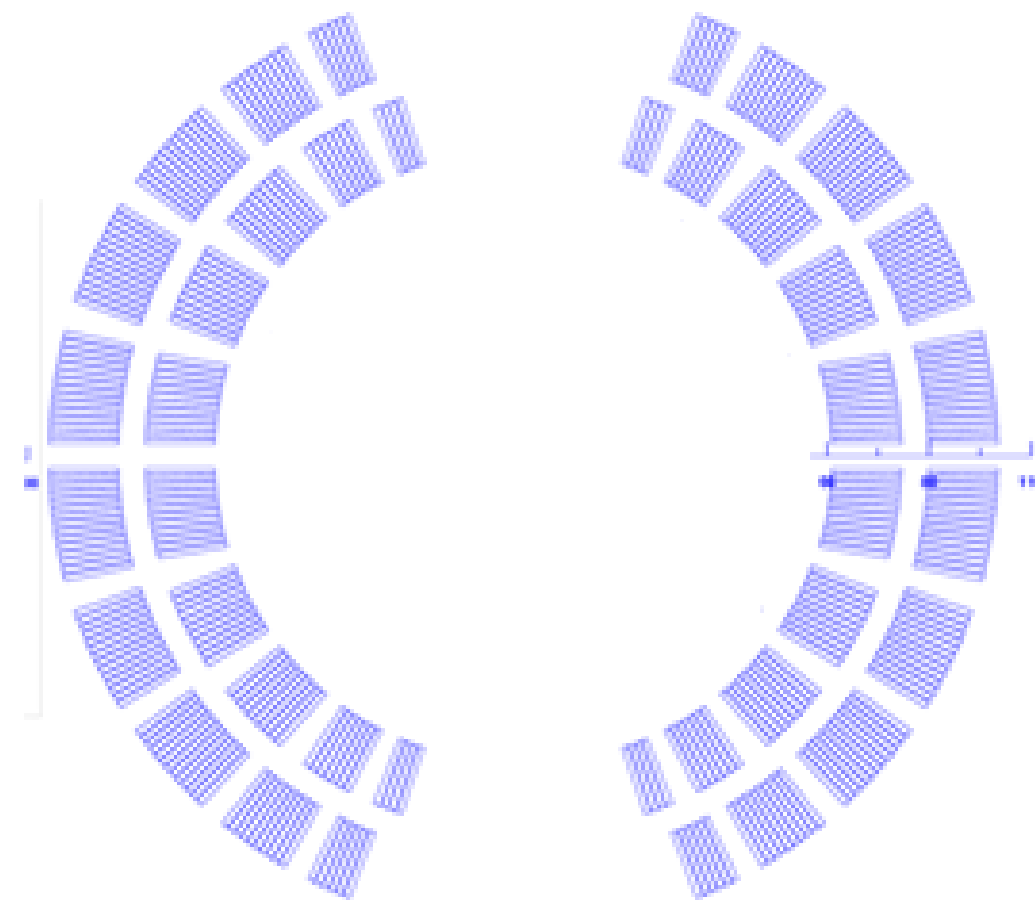
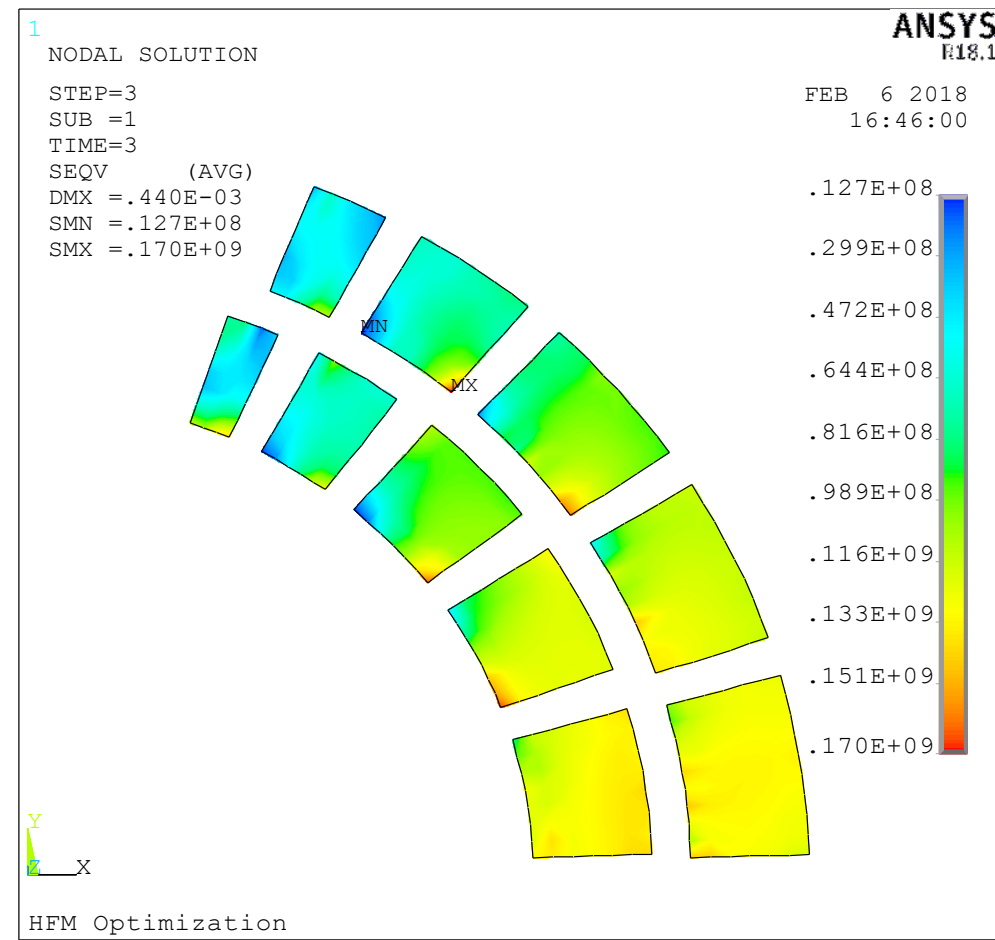
# Roadmap

FY20				FY21				FY22				FY23			
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4





# 120-mm/11 T and 60-mm/17 T dipole analysis has been completed and feasibility demonstrated



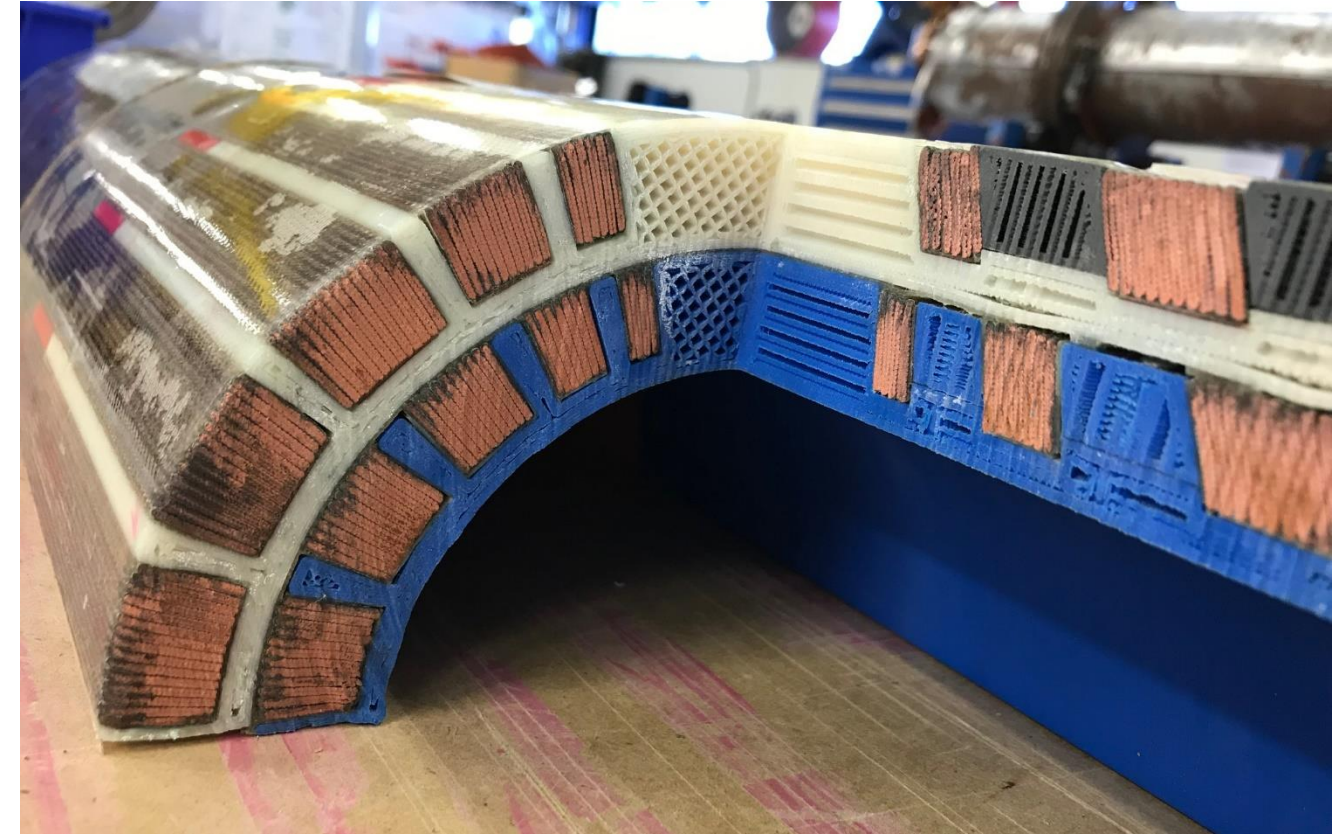
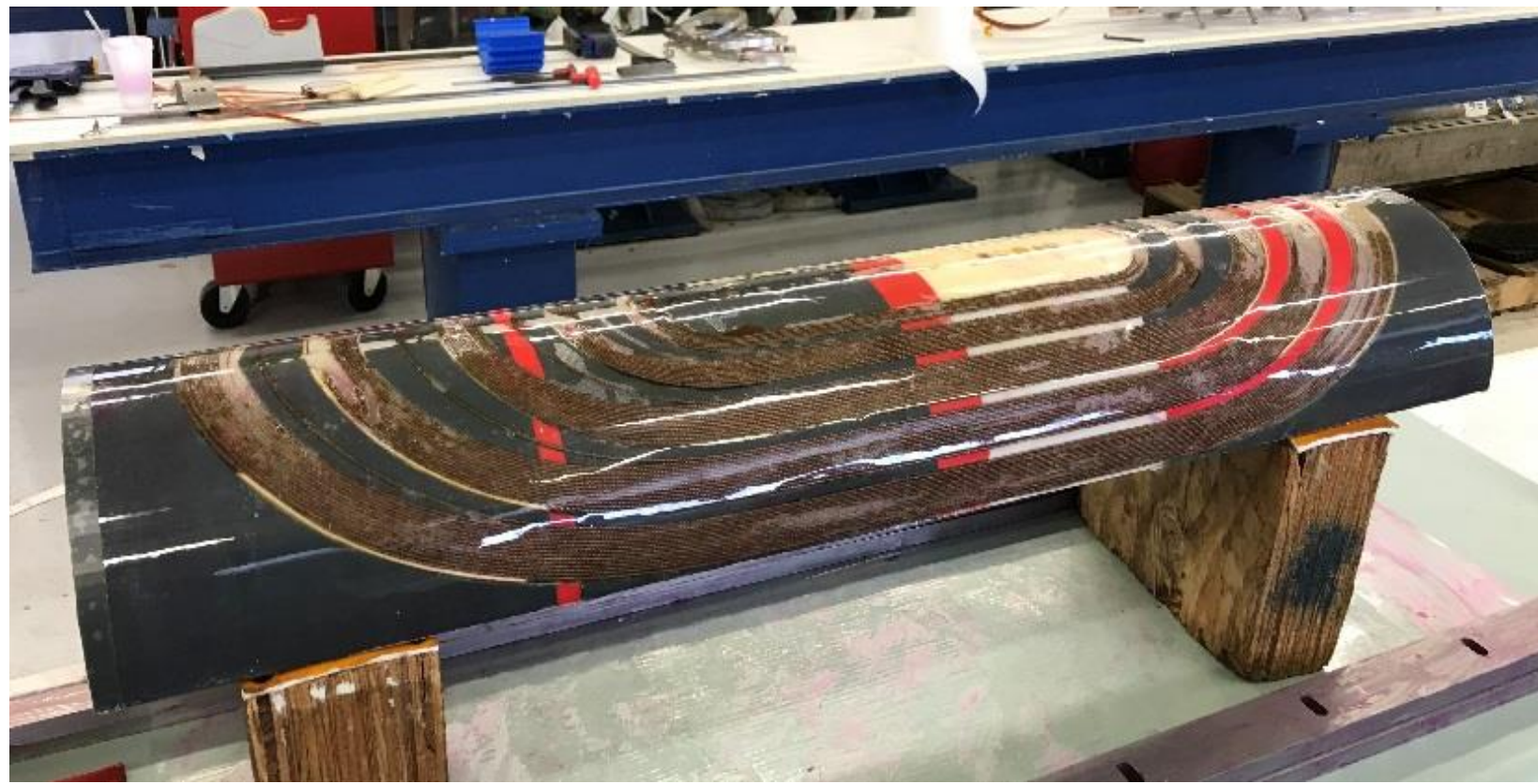
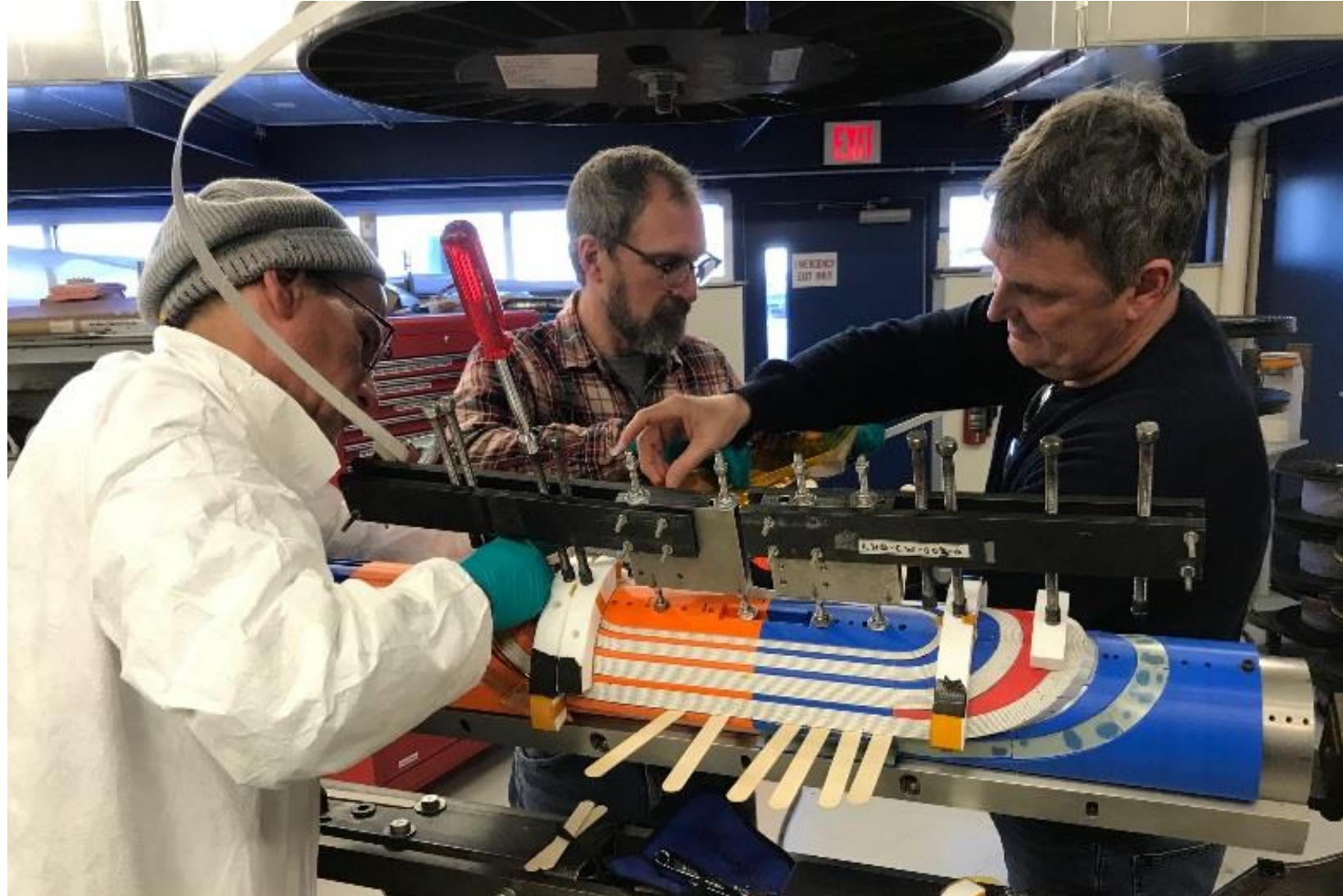




# SMCT coil technology has been demonstrated



Coil parts

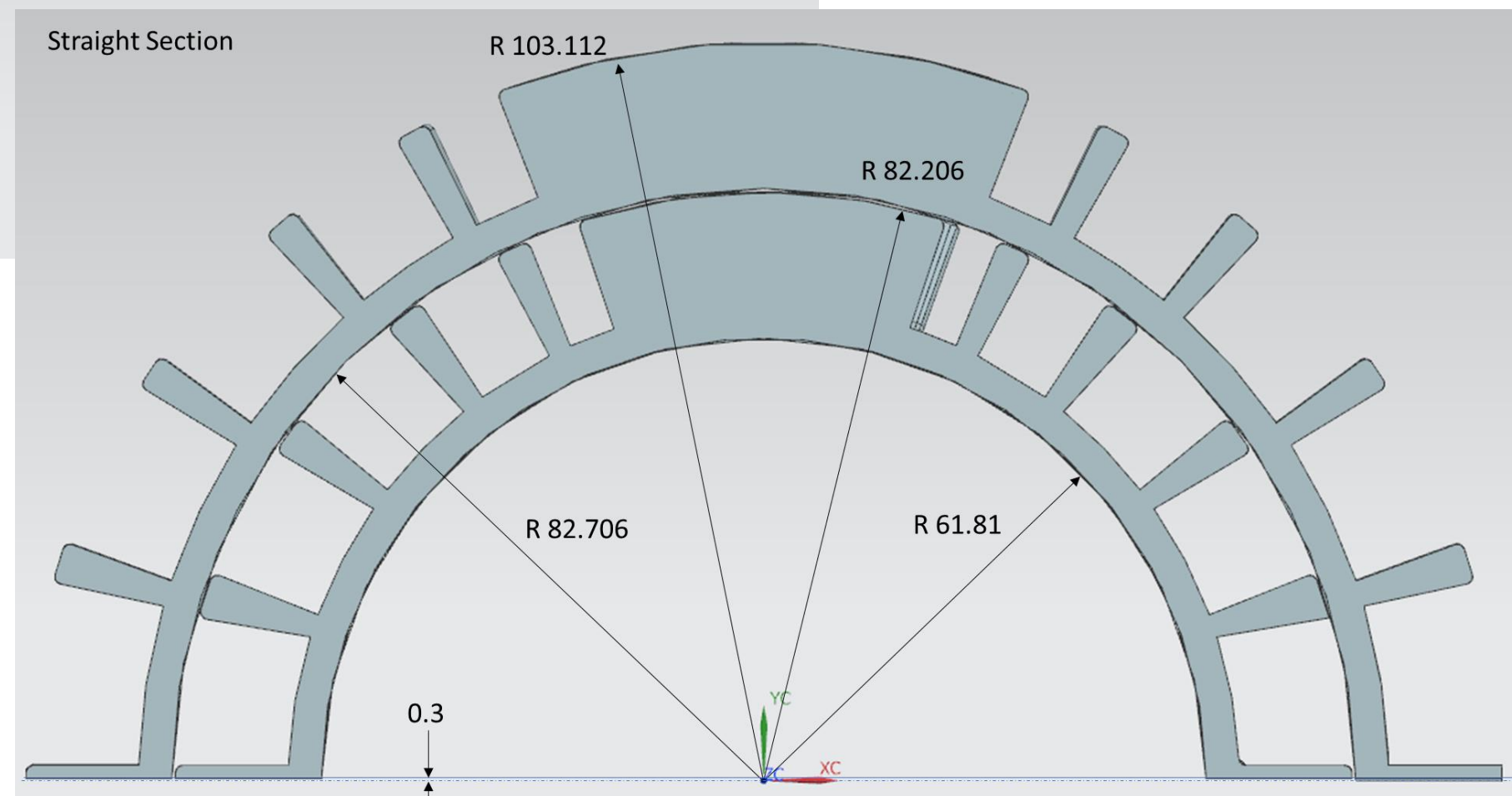
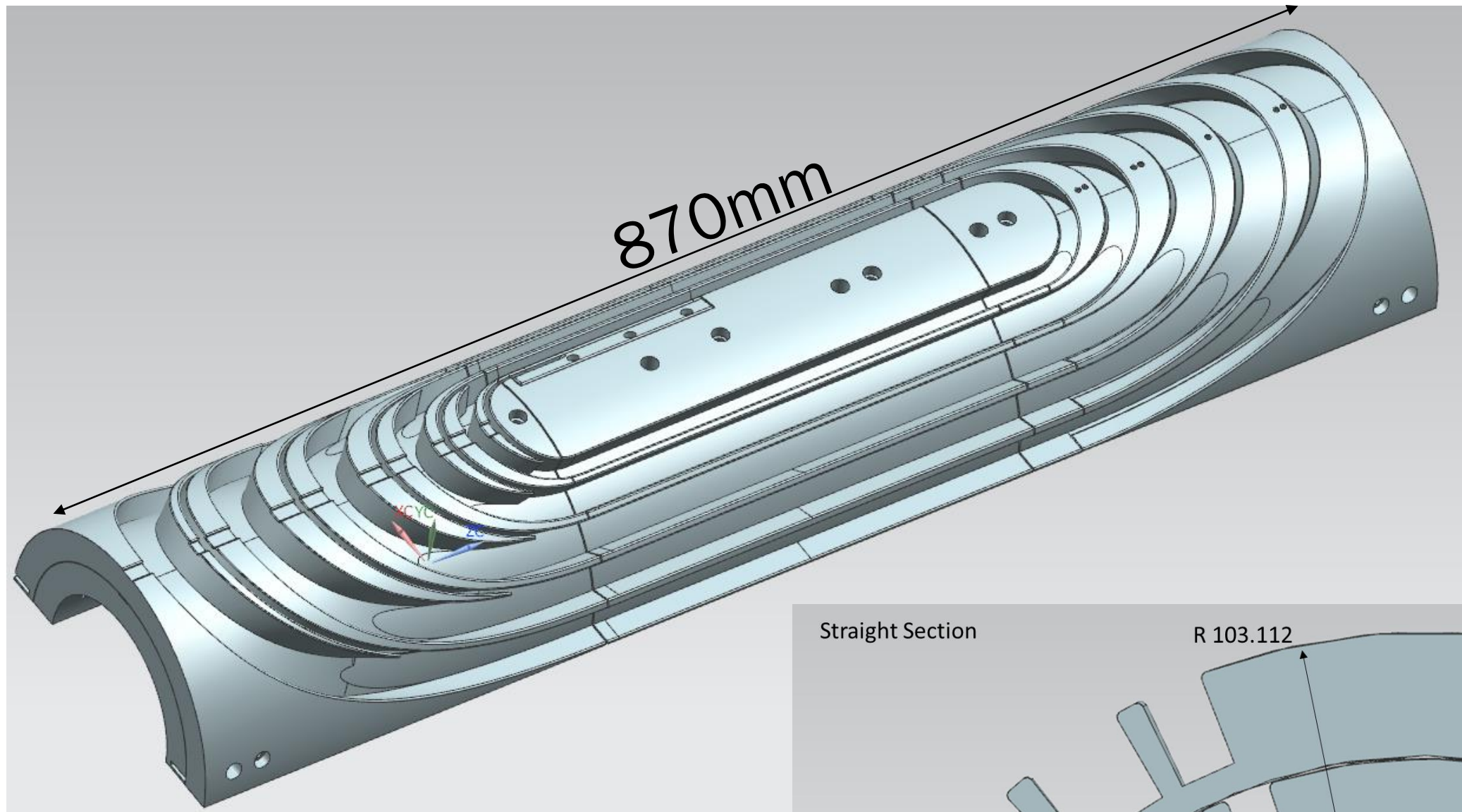


Coil winding, impregnation with epoxy and cross-section analysis

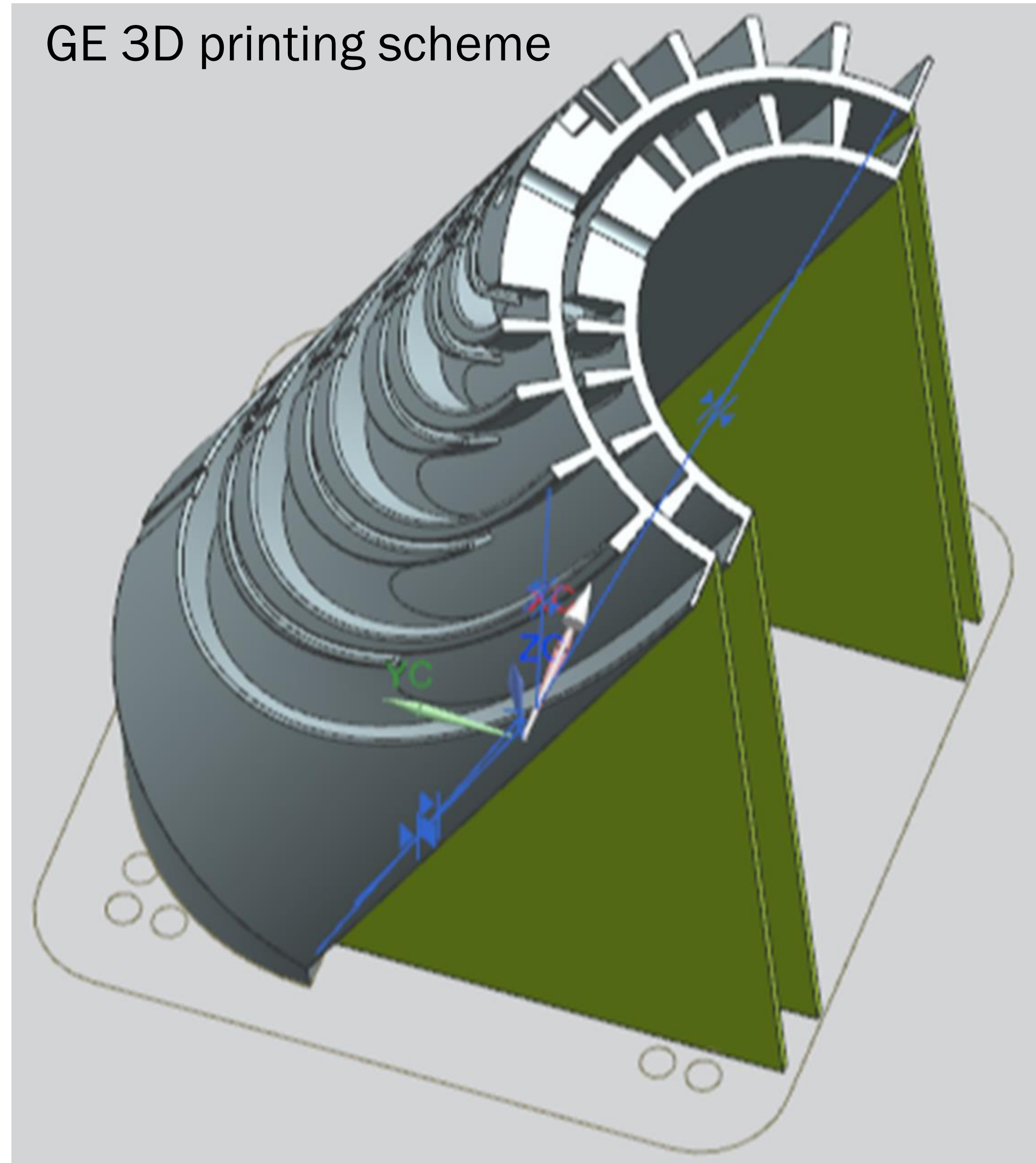




# Coil part design for 3D printing at GE



GE 3D printing scheme

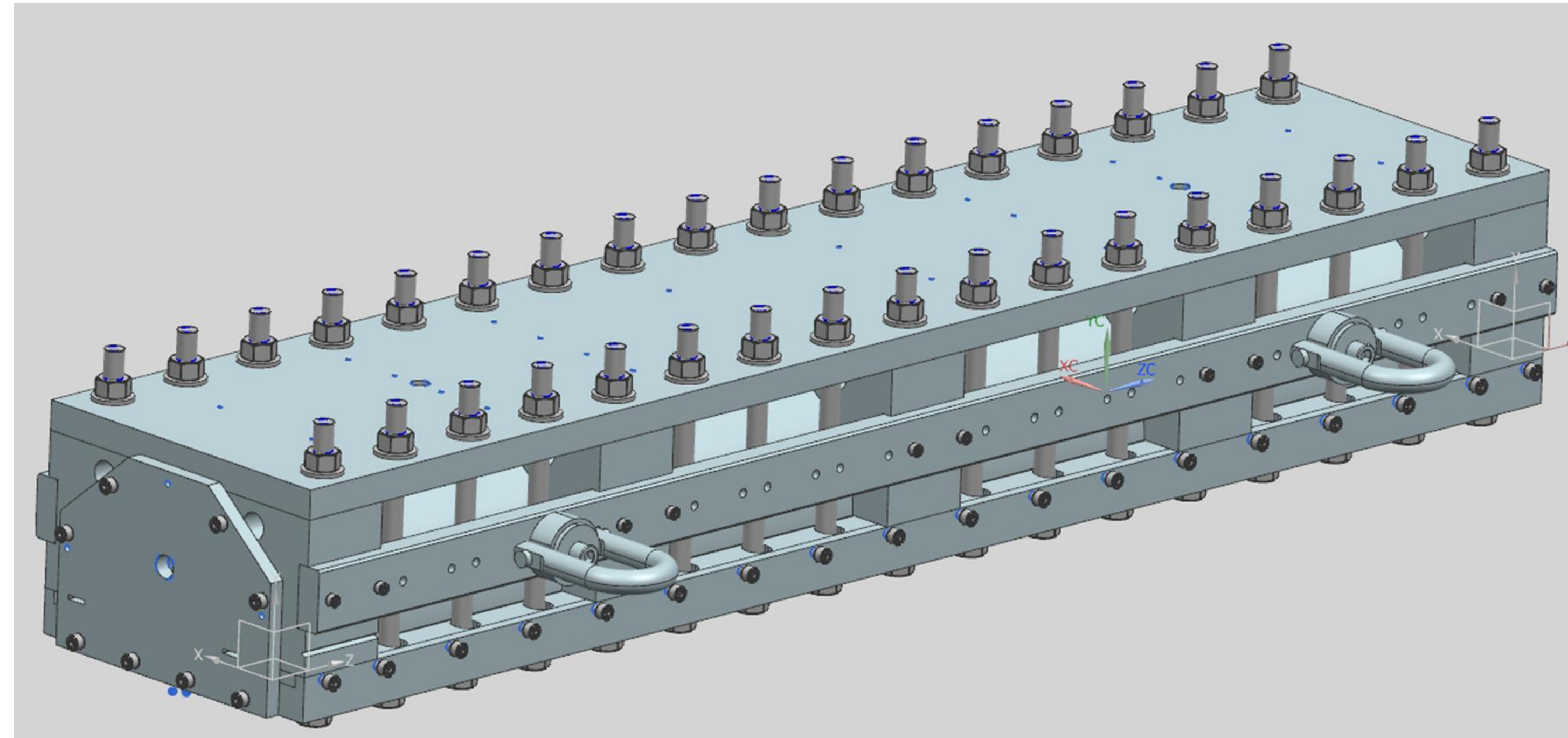
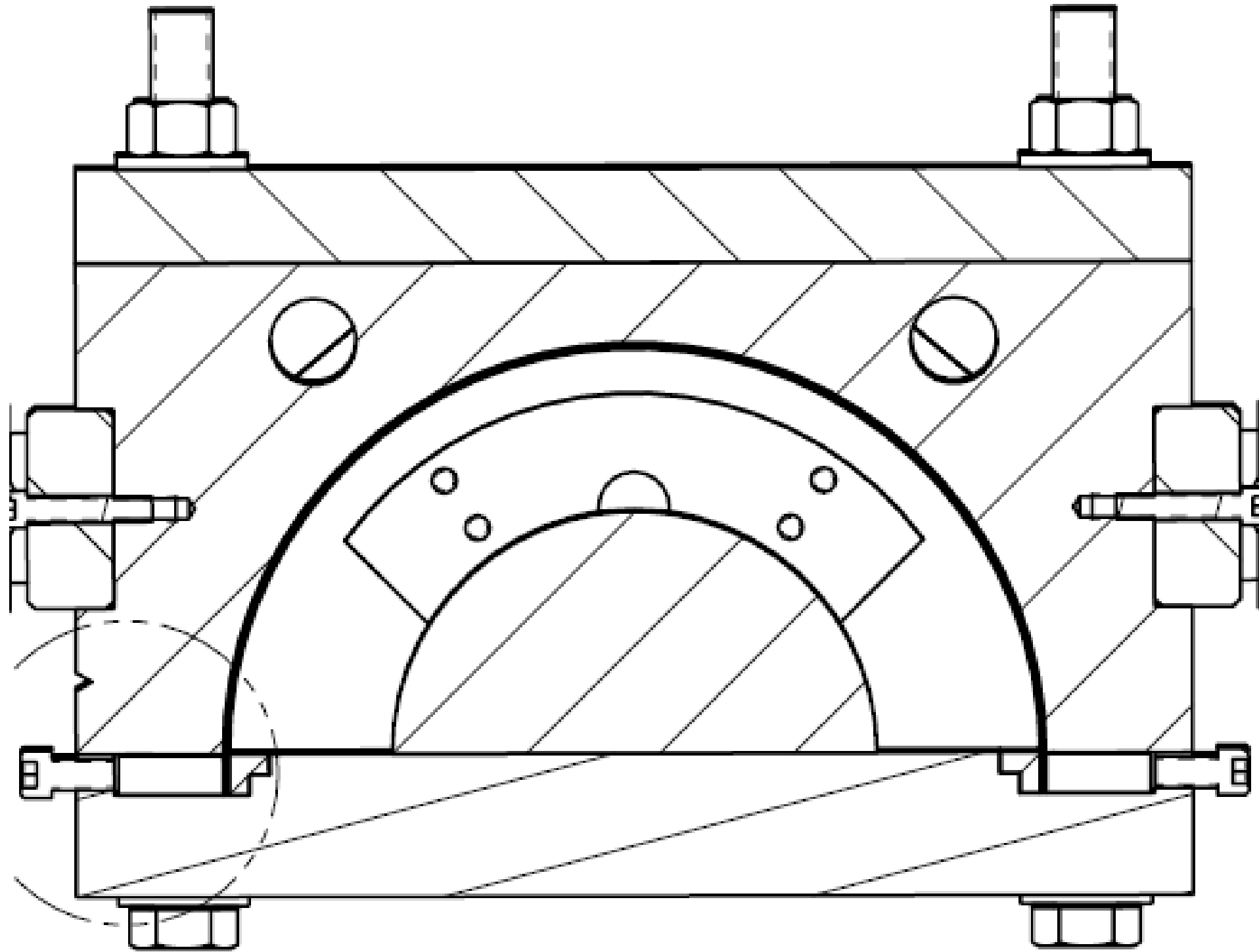


- Part design is complete
- Part fabrication at GE



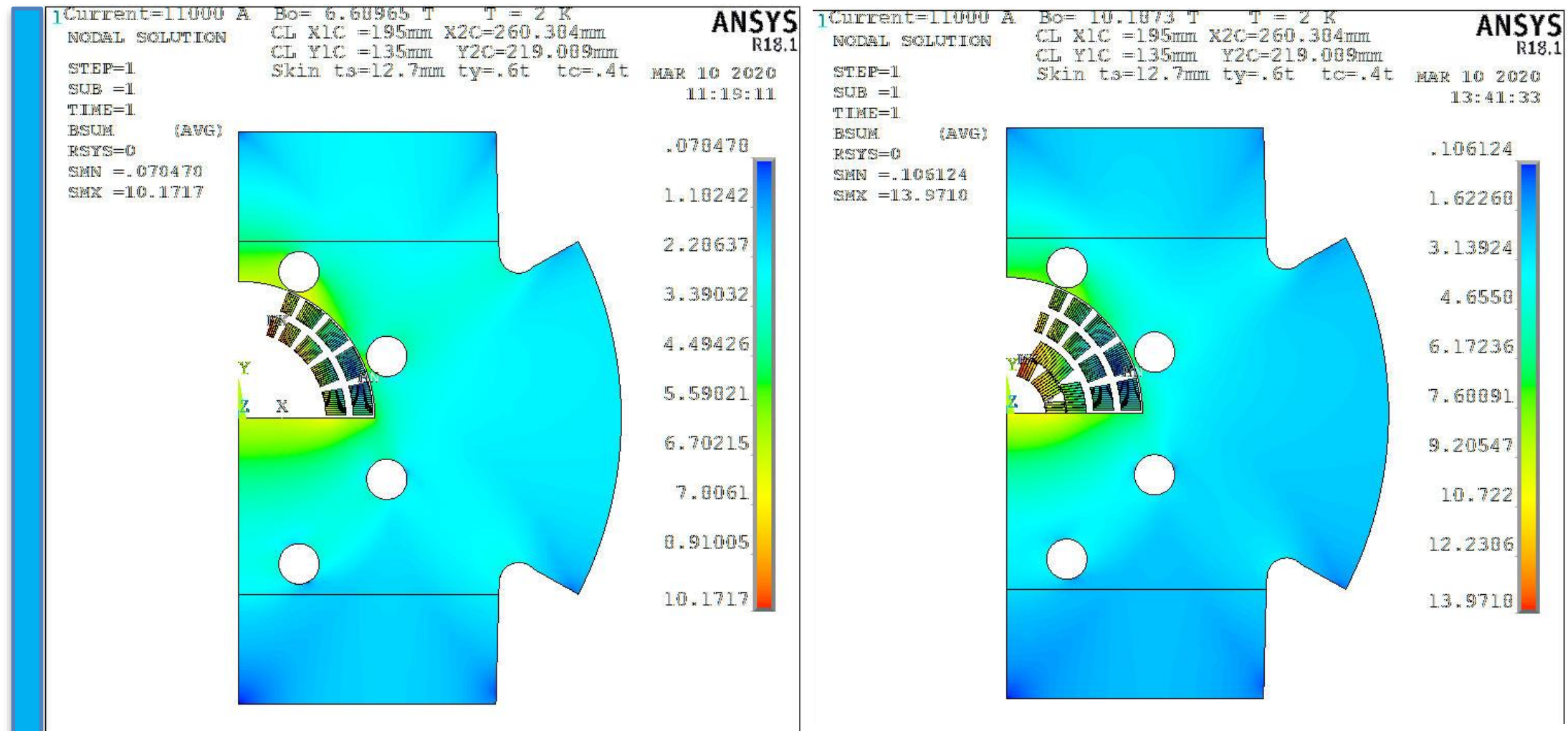
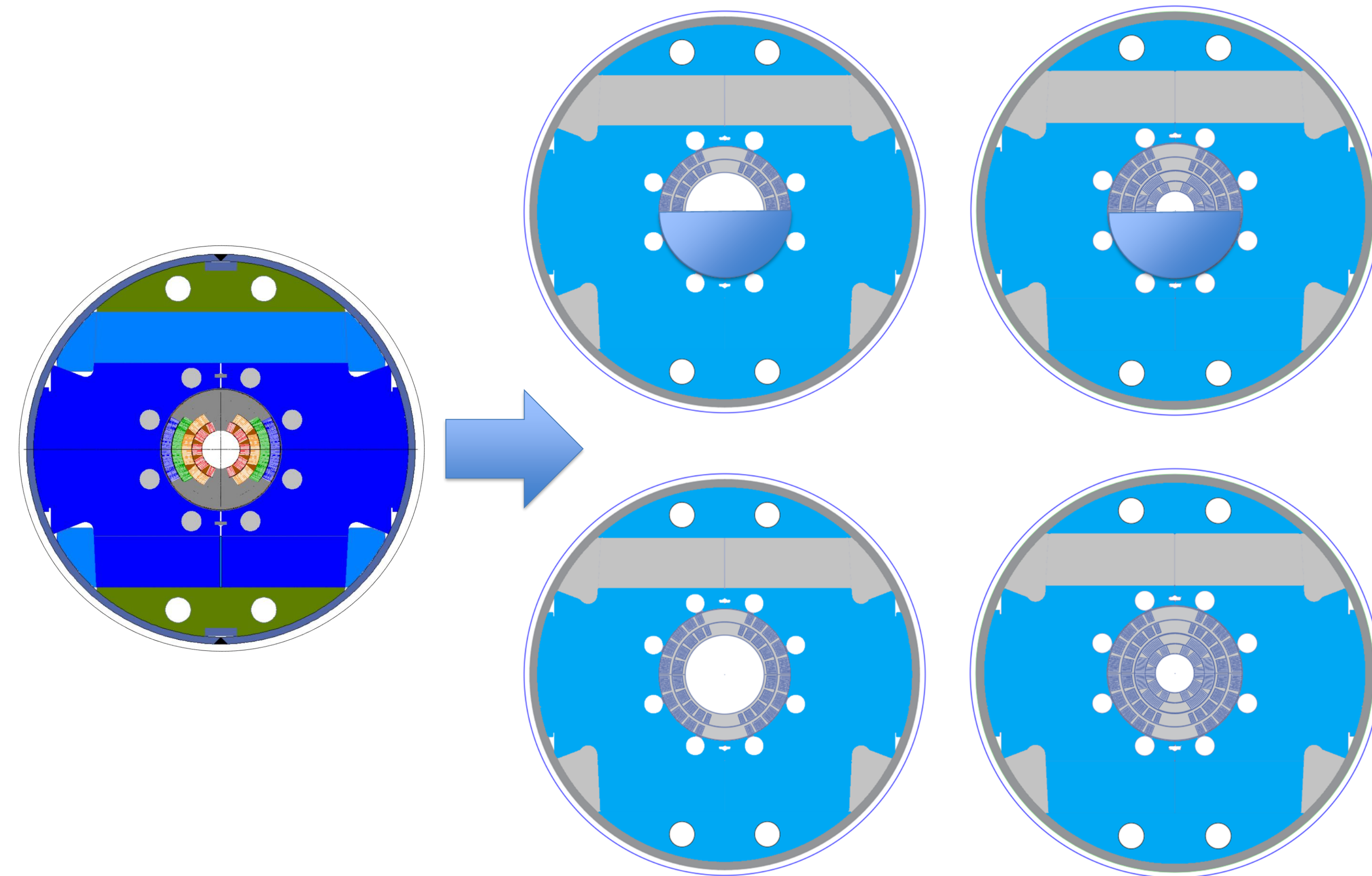


# Reaction-Impregnation tooling



- **Modification of the MDPCT1 L3-L4 coil tooling**
  - **block modification** – increase inner radius by ~10 mm
  - **bottom plate modification** – optimize shell-plate interface
- **The number of blocks and modifications were optimized to reduce cost**





- **Structure modification**
  - Increase iron inner radius by ~10 mm
  - Design and fabricate mirror blocks
- **Structure analysis**
  - Magnetic analysis
  - Mechanical analysis
    - skin thickness optimization

**Modified MDPCT1 structure – program cost reduction**





- **Cable fabrication**
  - 40-strand cable is available
- **Coil design and procurement**
  - Coil design is complete
  - Part procurement has started, delivery in June-July 2020
- **Coil tooling design and procurement**
  - Design is complete
  - Procurement req is waiting for Velev's signature (needs to be signed asap!)
- **Structure design modification**
  - Structure has been selected
  - Magnetic and mechanical analysis is in progress
  - Structure design modification will be done in Q3
  - Procurement will start in Q4 (or in October FY21 if budget is not available)