Eddy currents analysis @ quench
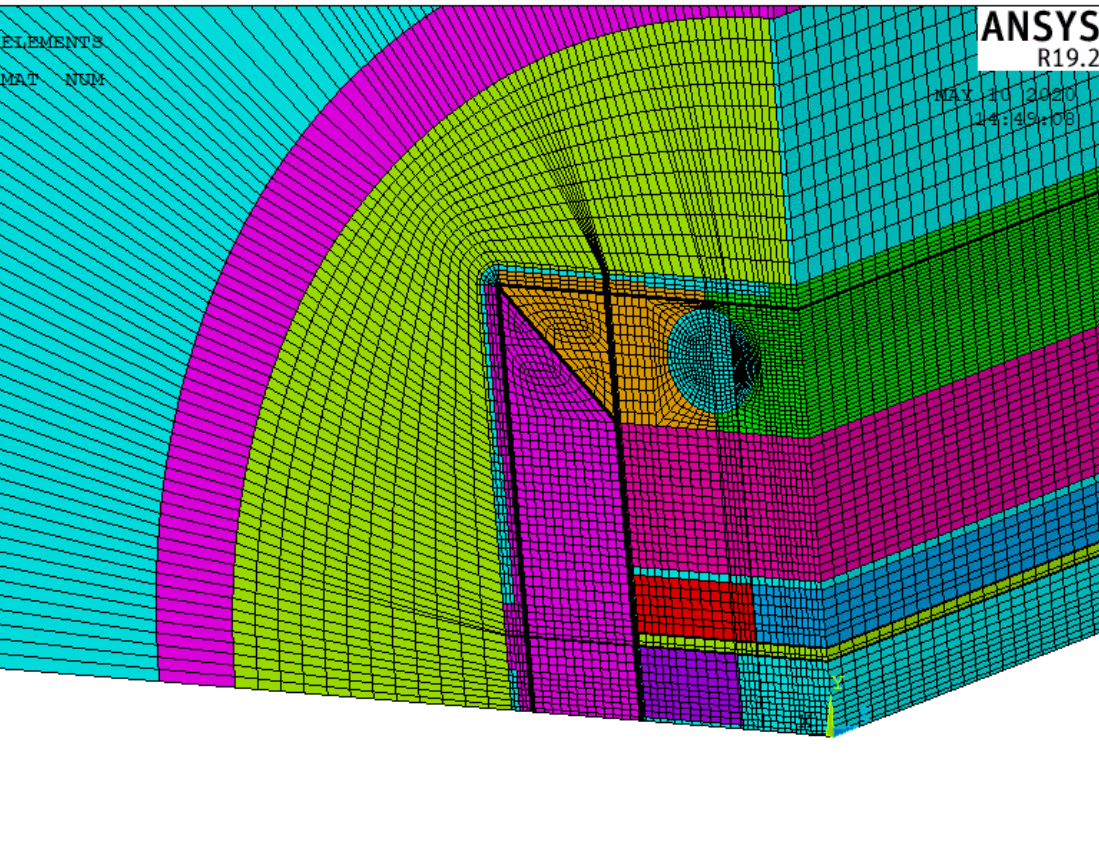# 3rd version

P. Testoni

04 June 2020

Three analyses performed

1. 3D analysis: current in the coils is varied with an exponential law and 0.2s time constant

2. 3D analysis: current in the coil obtained closing the coil ends in a dump resistor R=0.136 Ohm

3. 2D analyses to assess the eddy currents in the cryostat (also by changing the thickness of the Al shell from 7 to 3 cm)
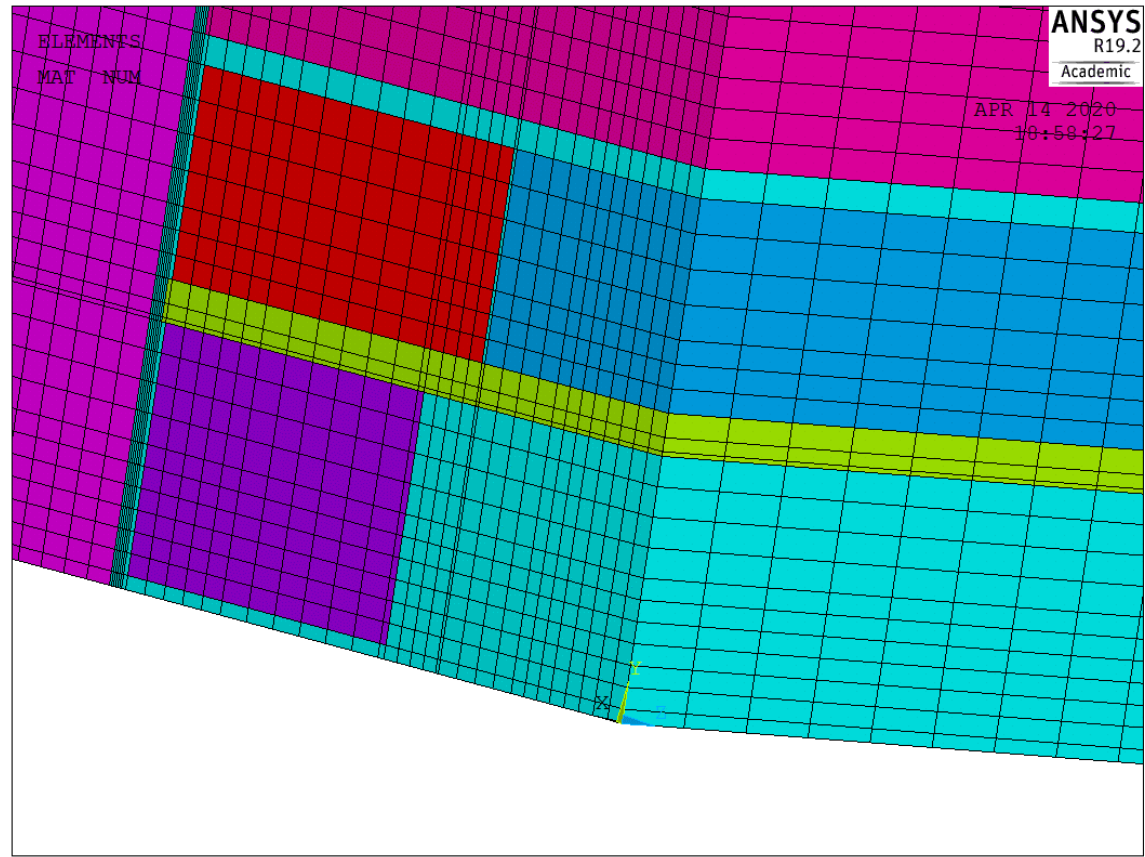
3D analyses

Finite element model

Resistivity Ohm m

|		
iron	RSVX	0.5000000E-06
SS	RSVX	0.4960000E-06
Al	RSVX	0.5760000E-08

Formulation

ANSYS element SOLID236 is used. It is an edge element and it allows to appropriately manage eddy current analyses with non linear materials. Analysis 2 is performed with the "stranded coil" option.
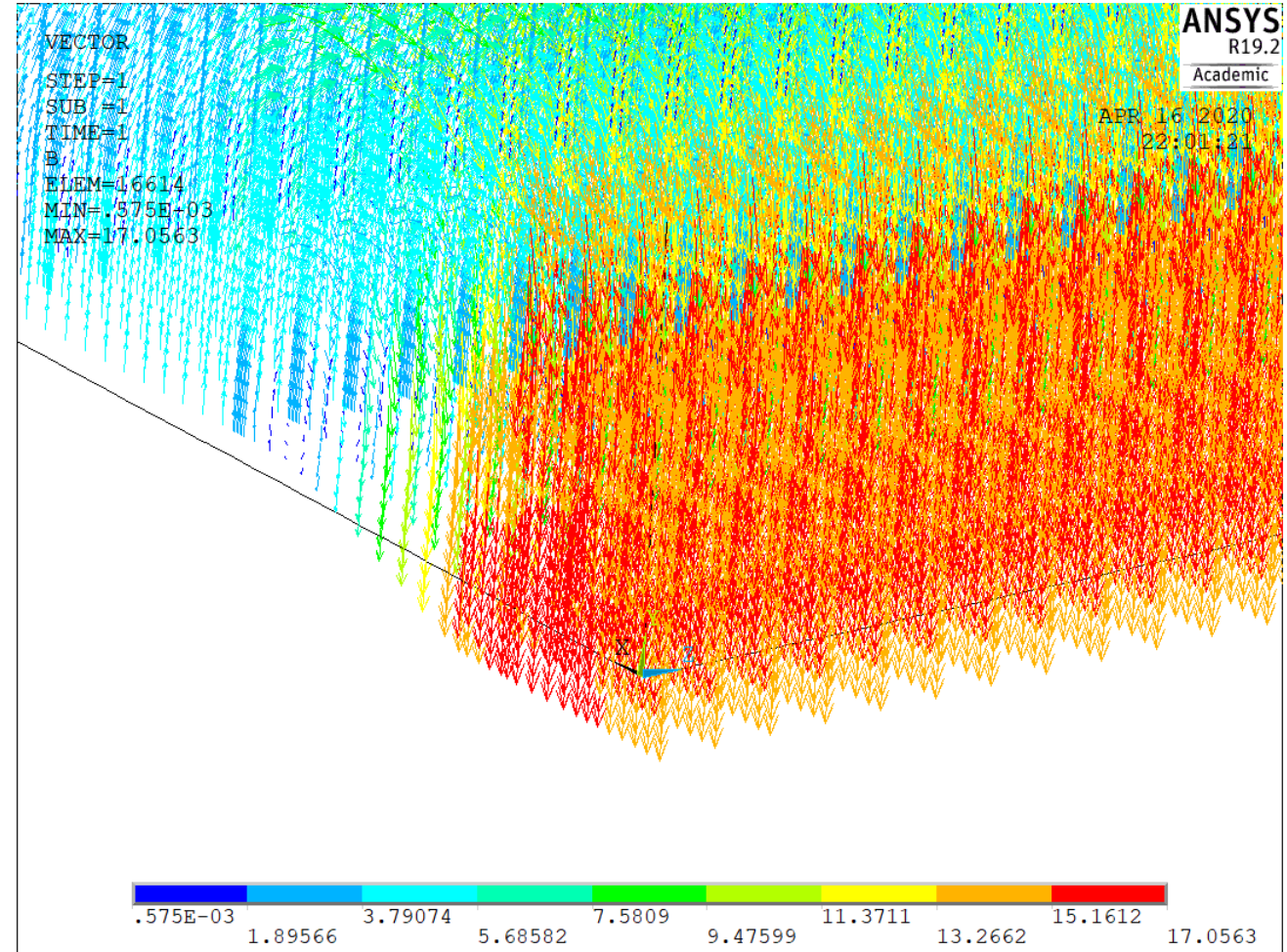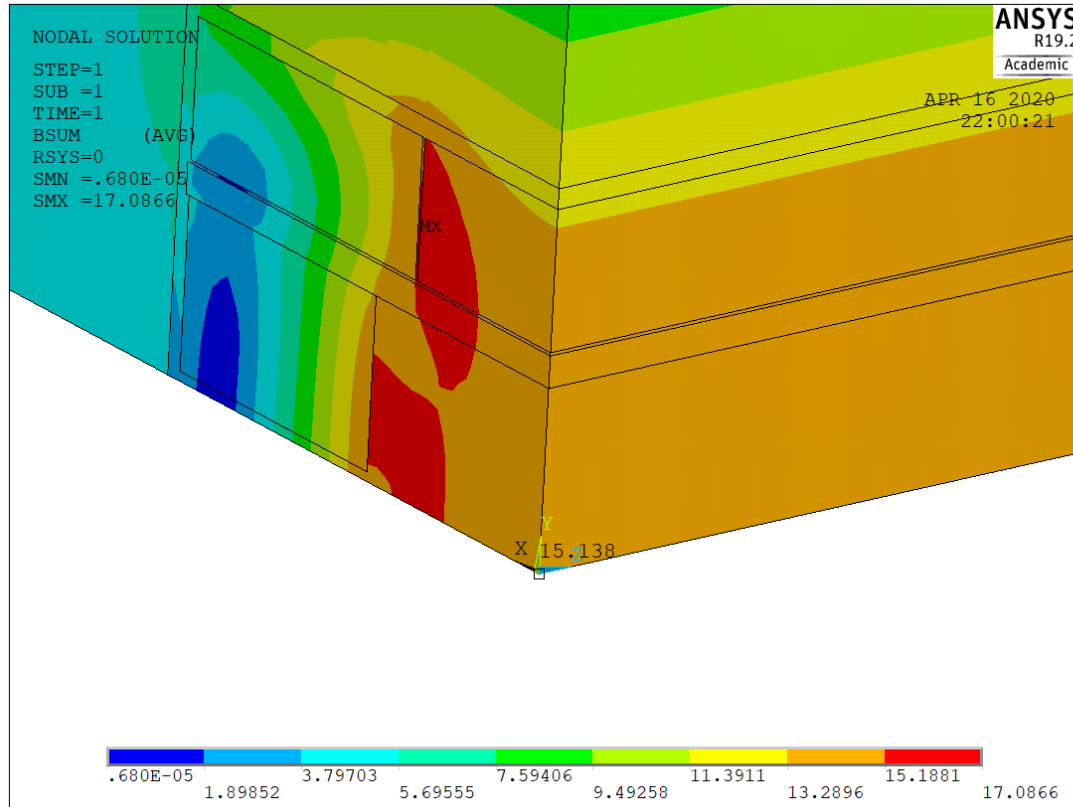
First analysis

- Current in the coils is varied with an exponential law and 0.2s time constant
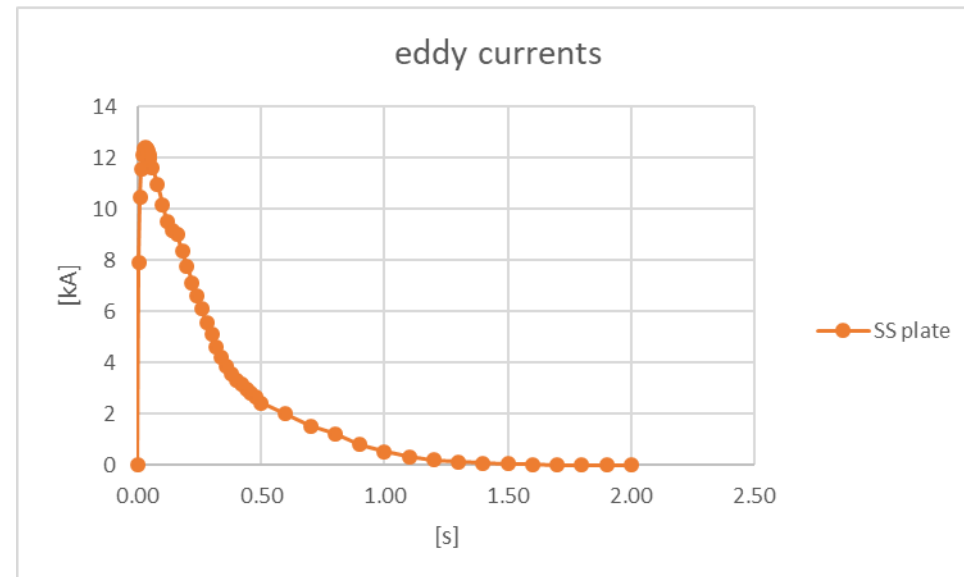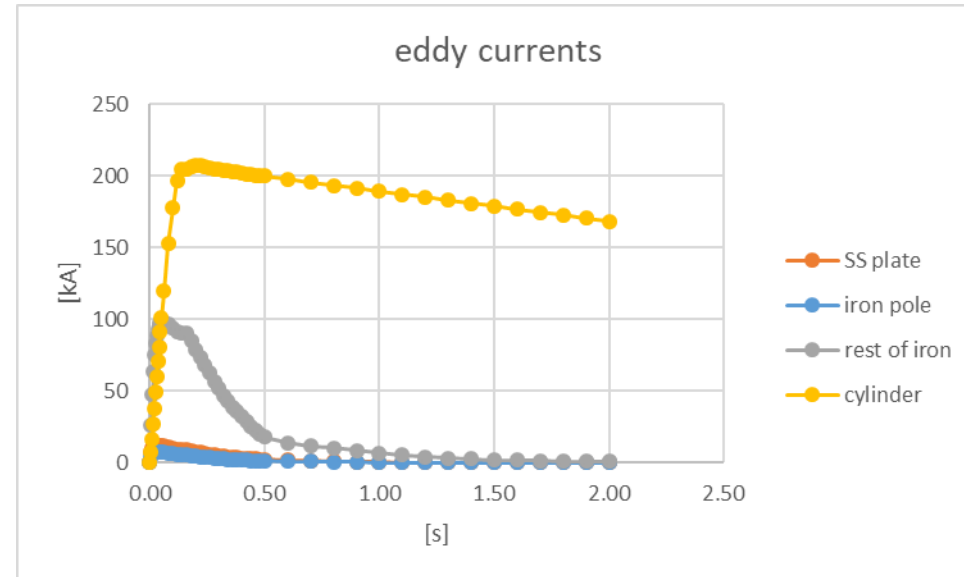
Loading

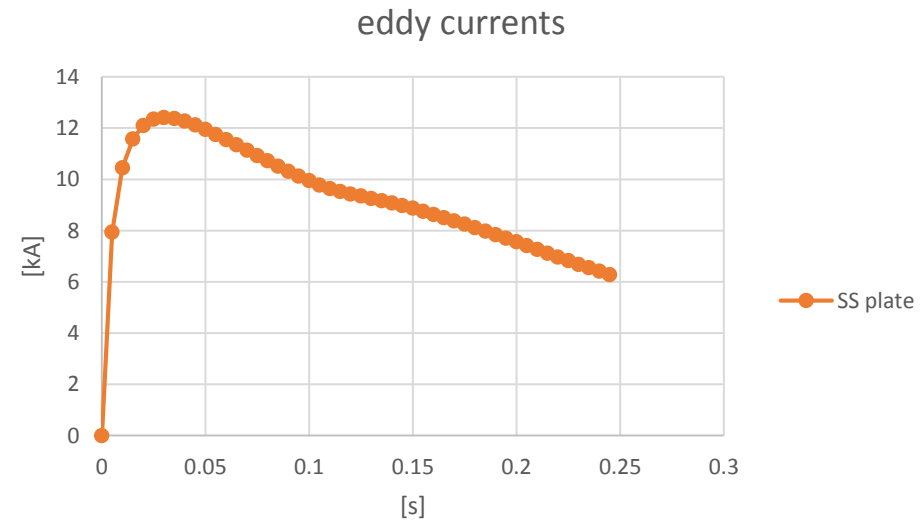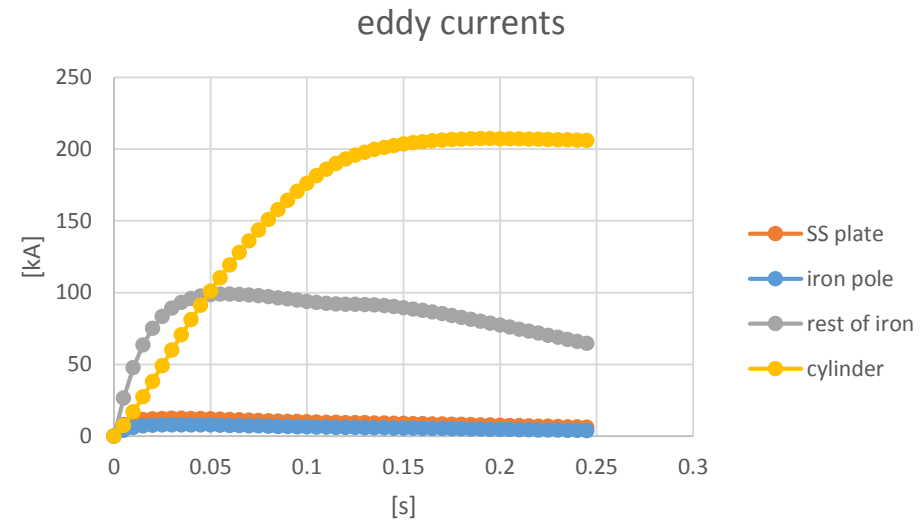## Current in the coils is varied with an exponential law and 0.2s time constant

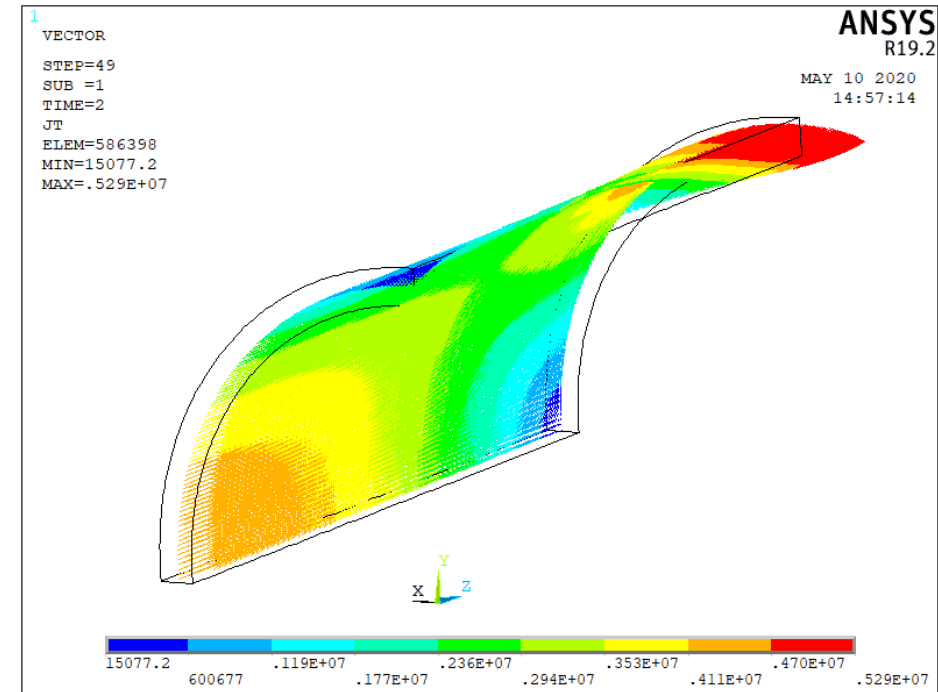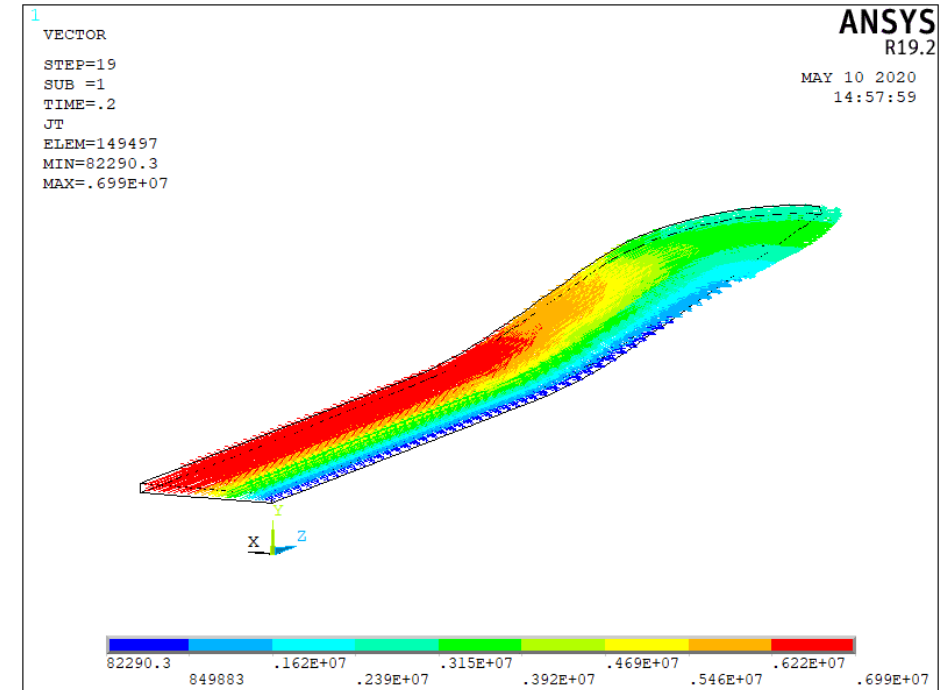current in the coils
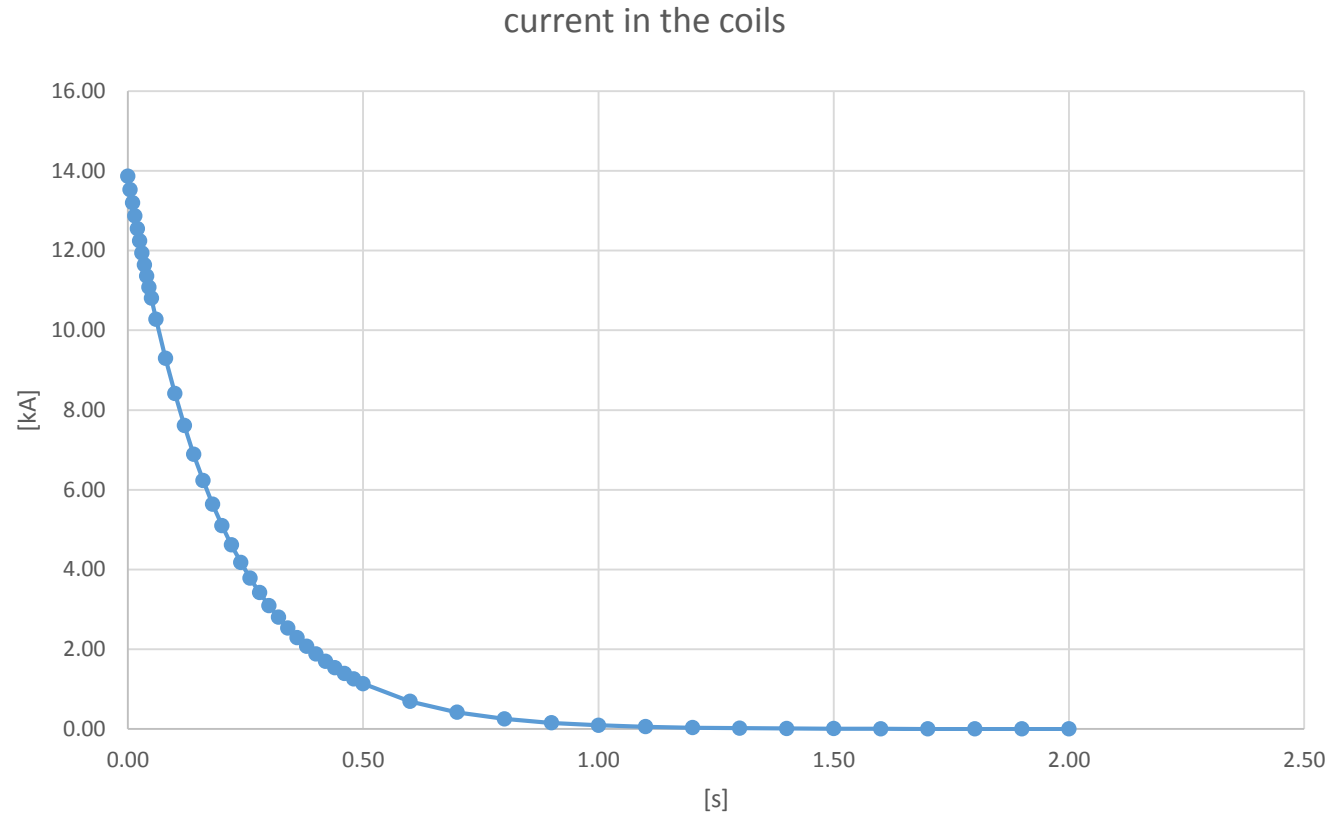
Initial conditions

Evolution of eddy currents in 2 s

Evolution of eddy currents in the first 0.25 s
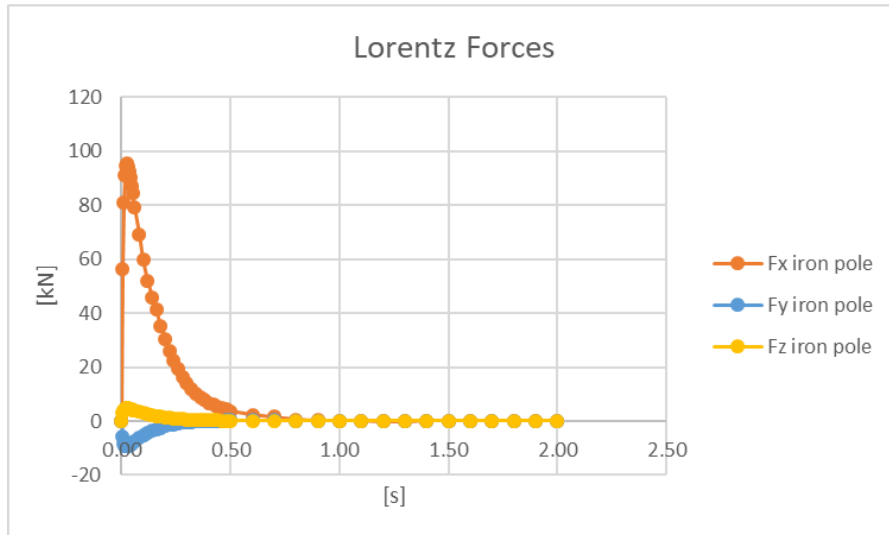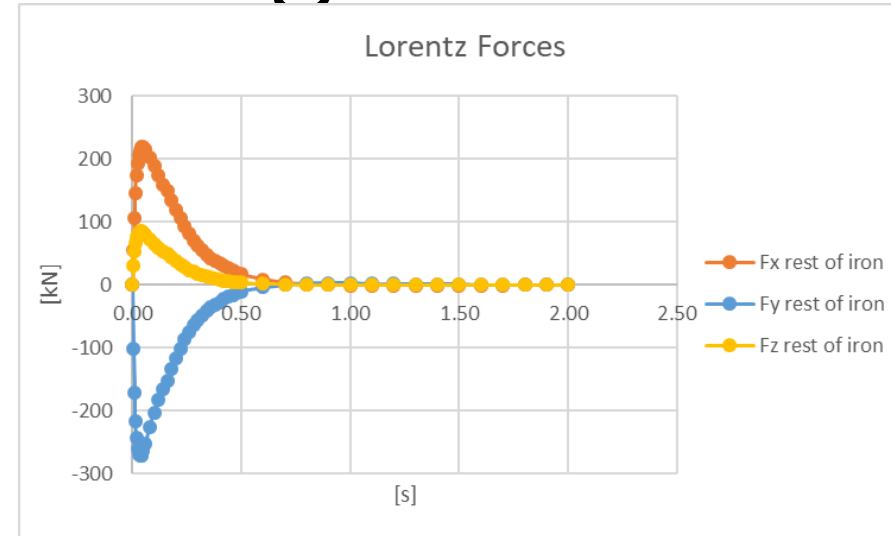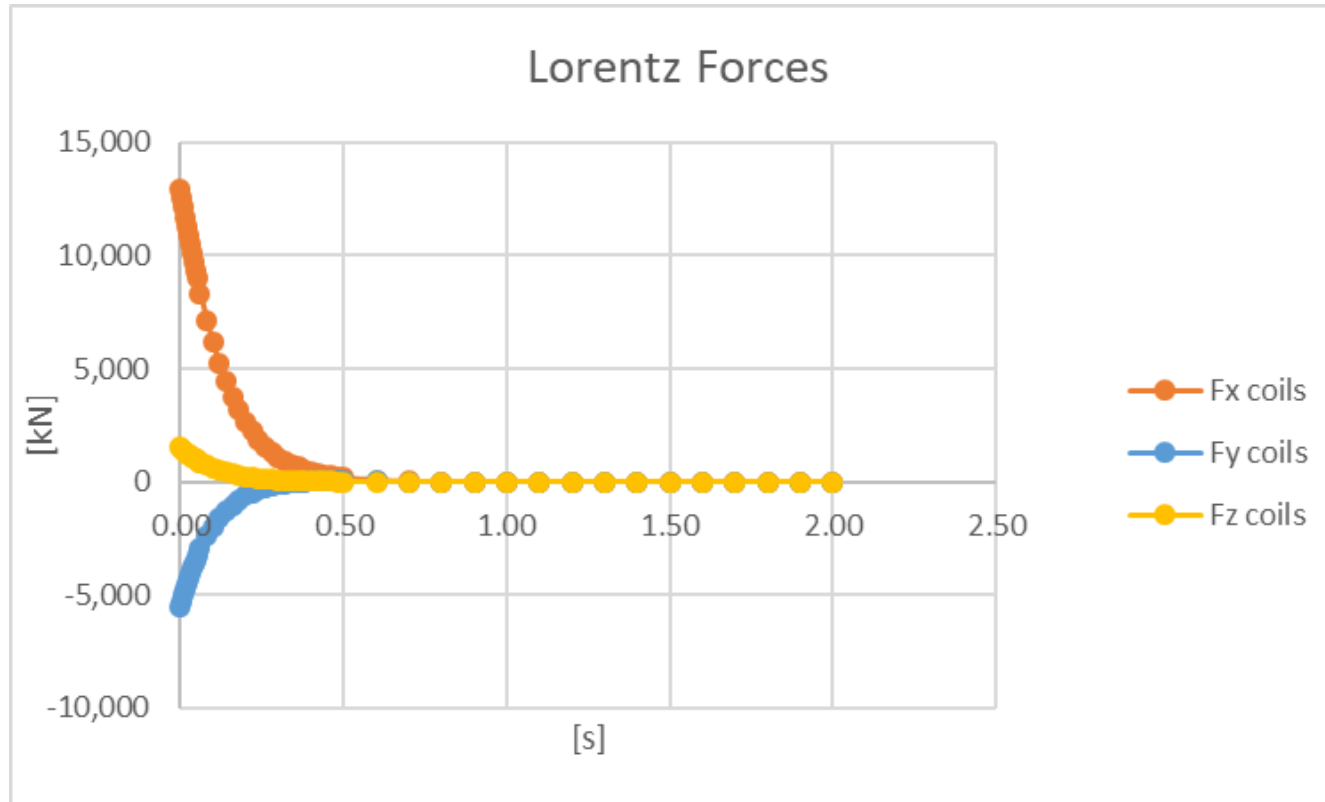
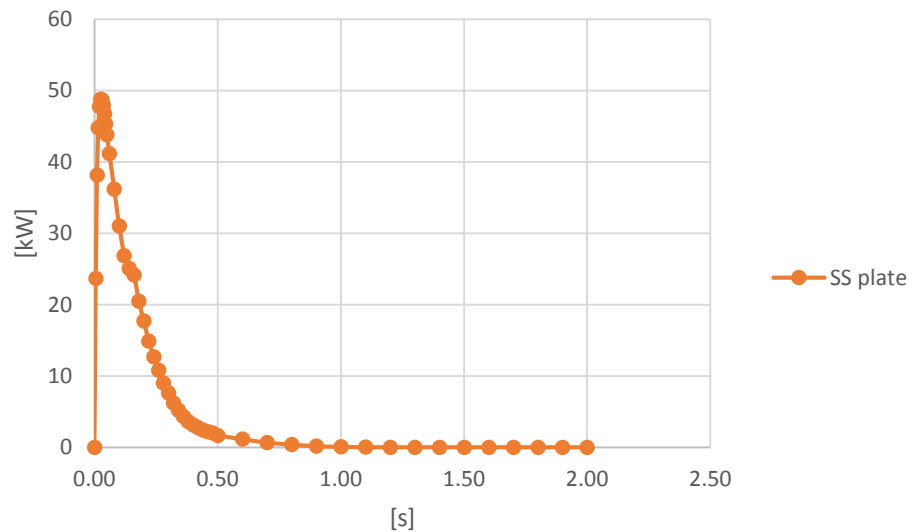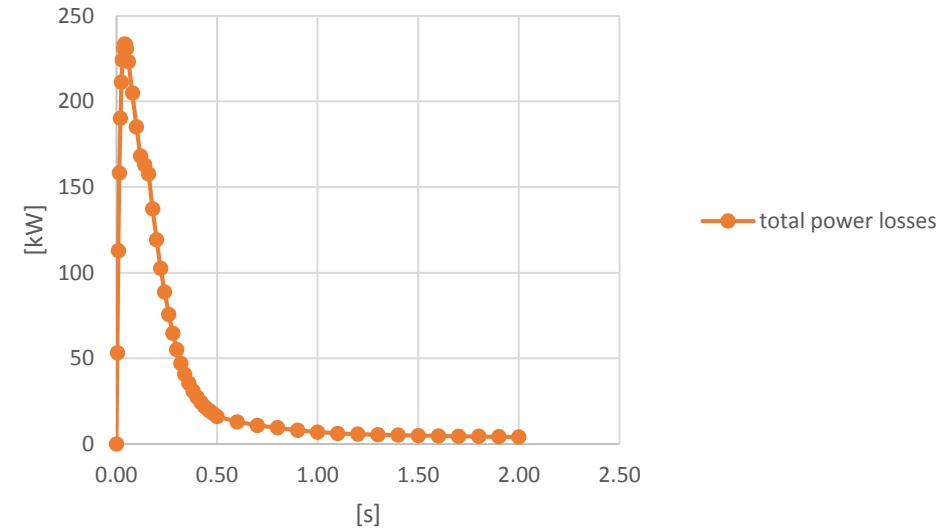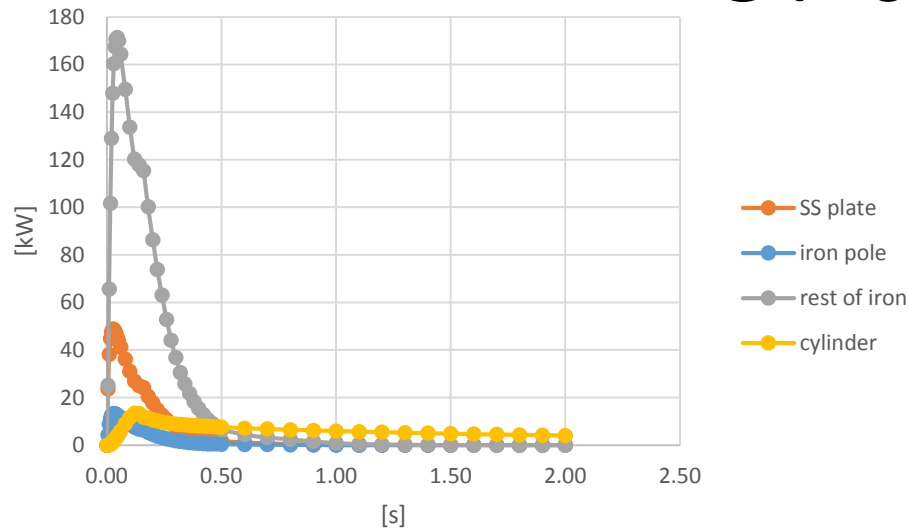# Eddy currents

t=2s

t=0.2s

Evolution of Lorentz forces for 1/8 of the magnet
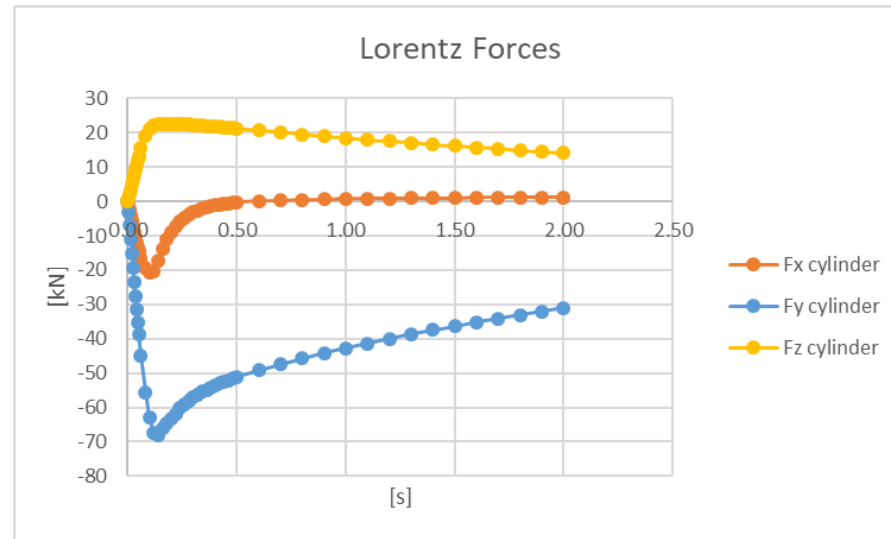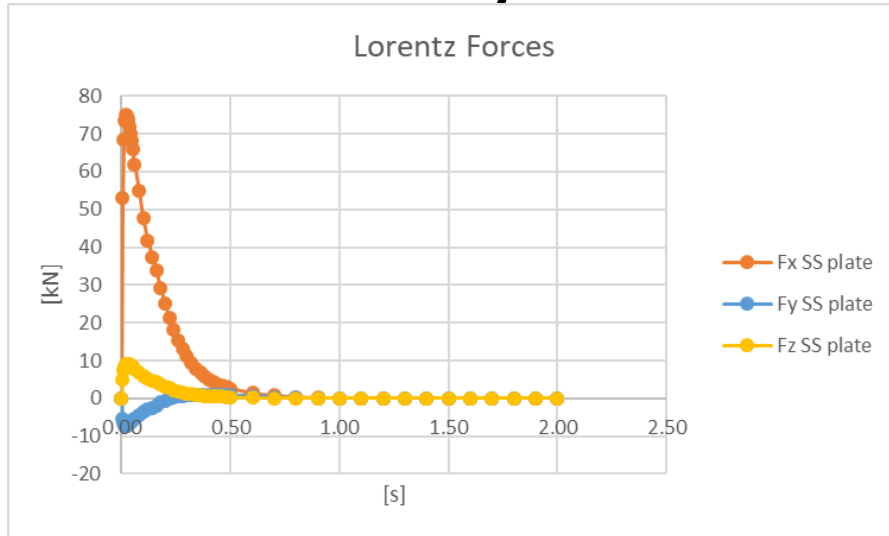
Evolution of Lorentz forces for 1/8 of the magnet
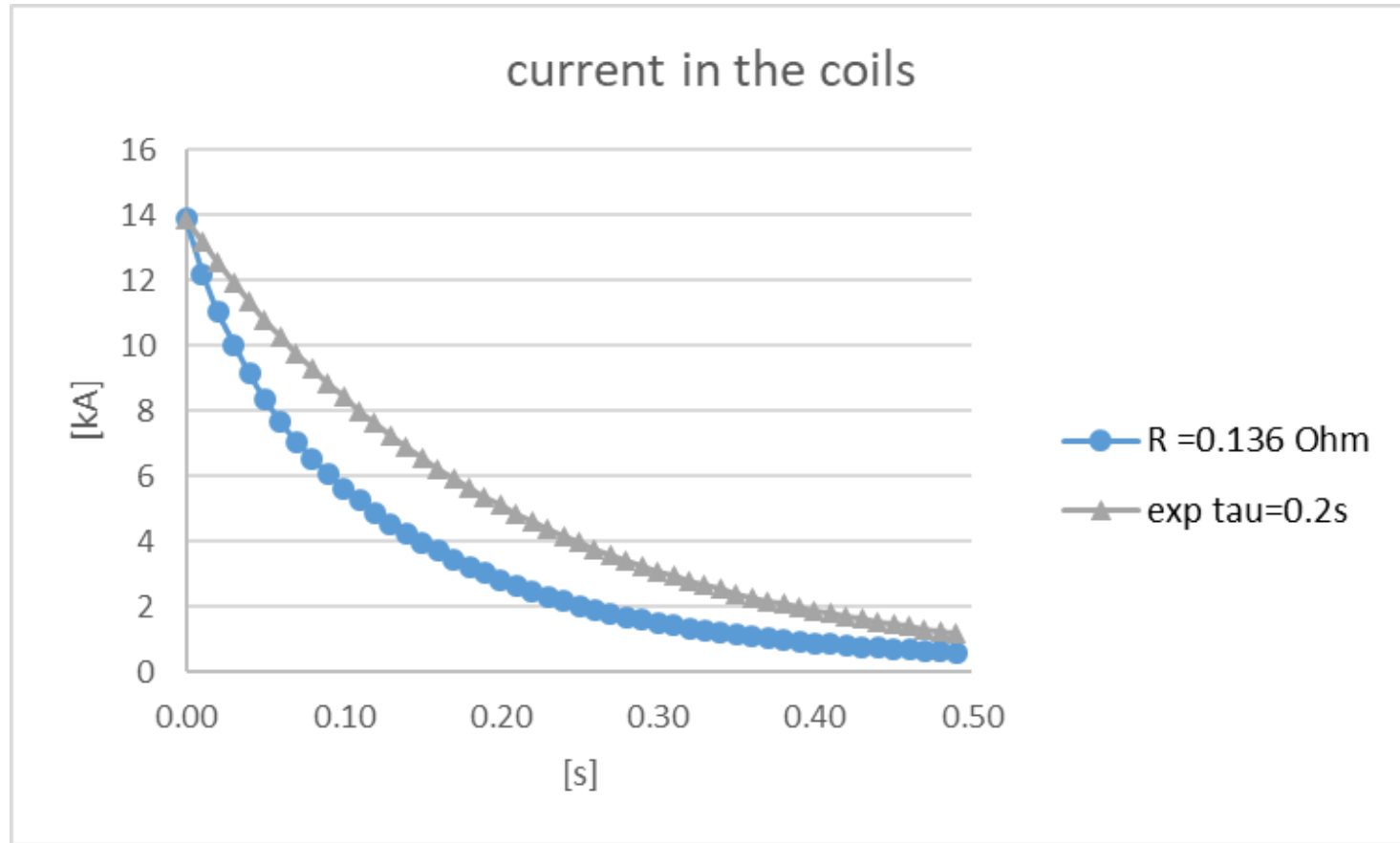
Evolution of power loss for 1/8 of the magnet
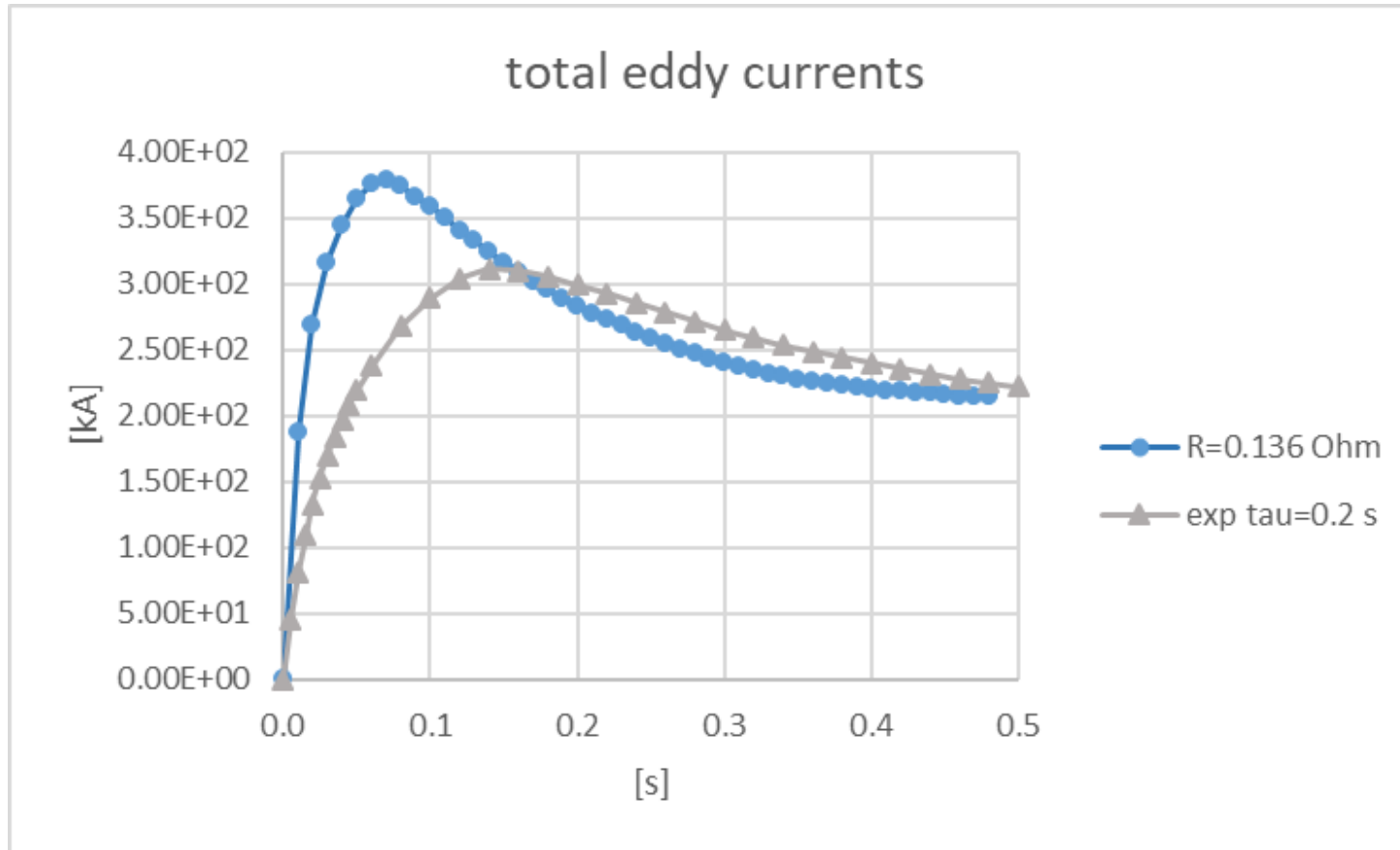

Total Energy loss (for the entire magnet)= 460 kJ

Second analysis

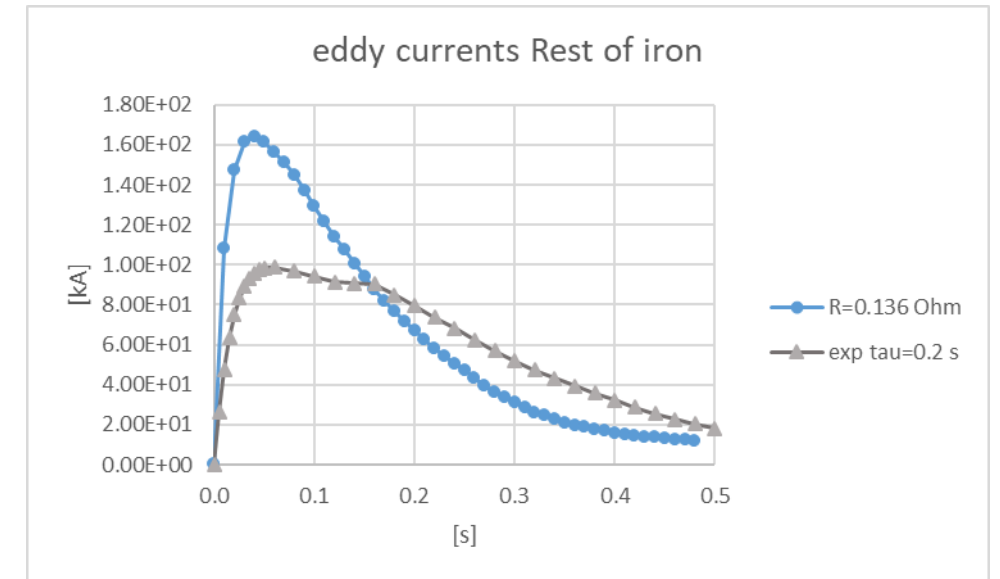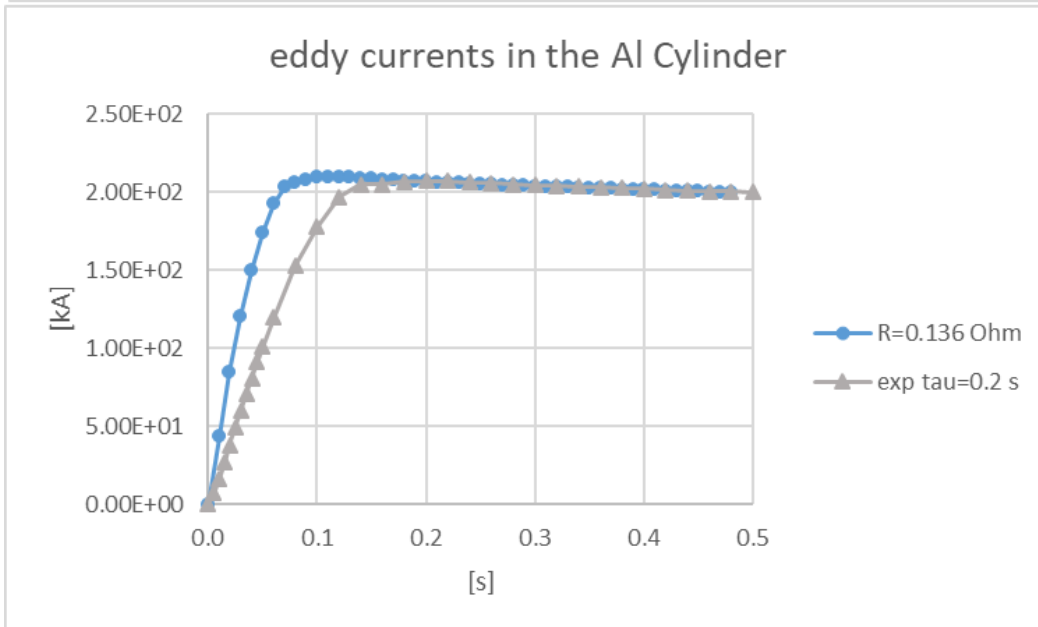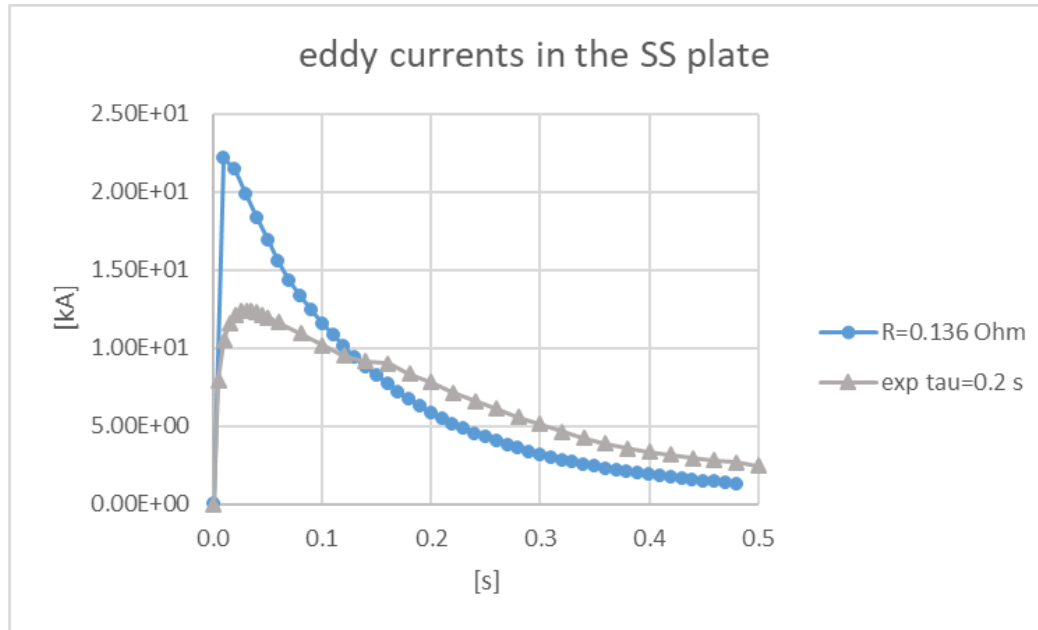Current in the coil obtained closing the coil ends in a dump resistor R=0.136Ohm
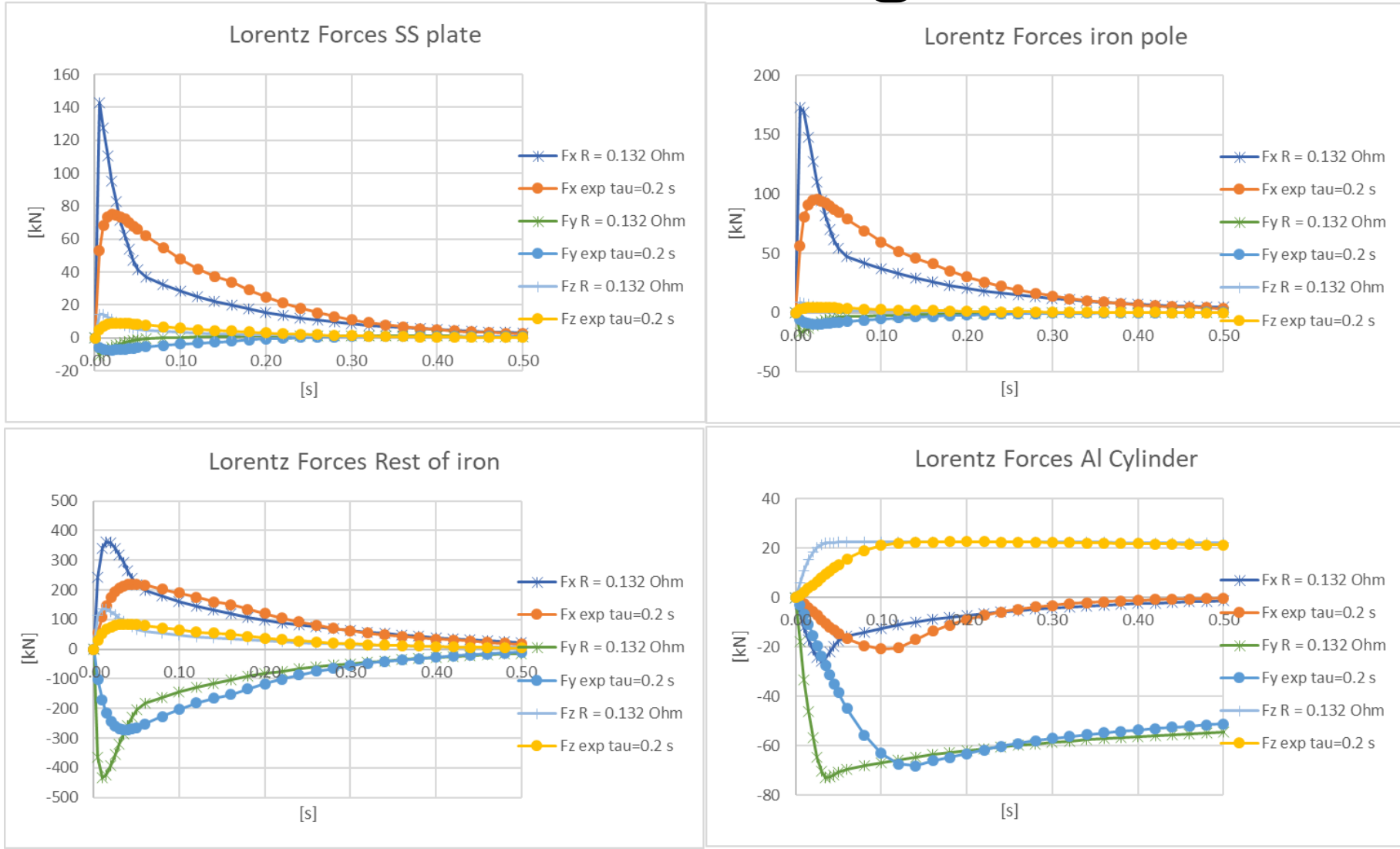
Current in the coil
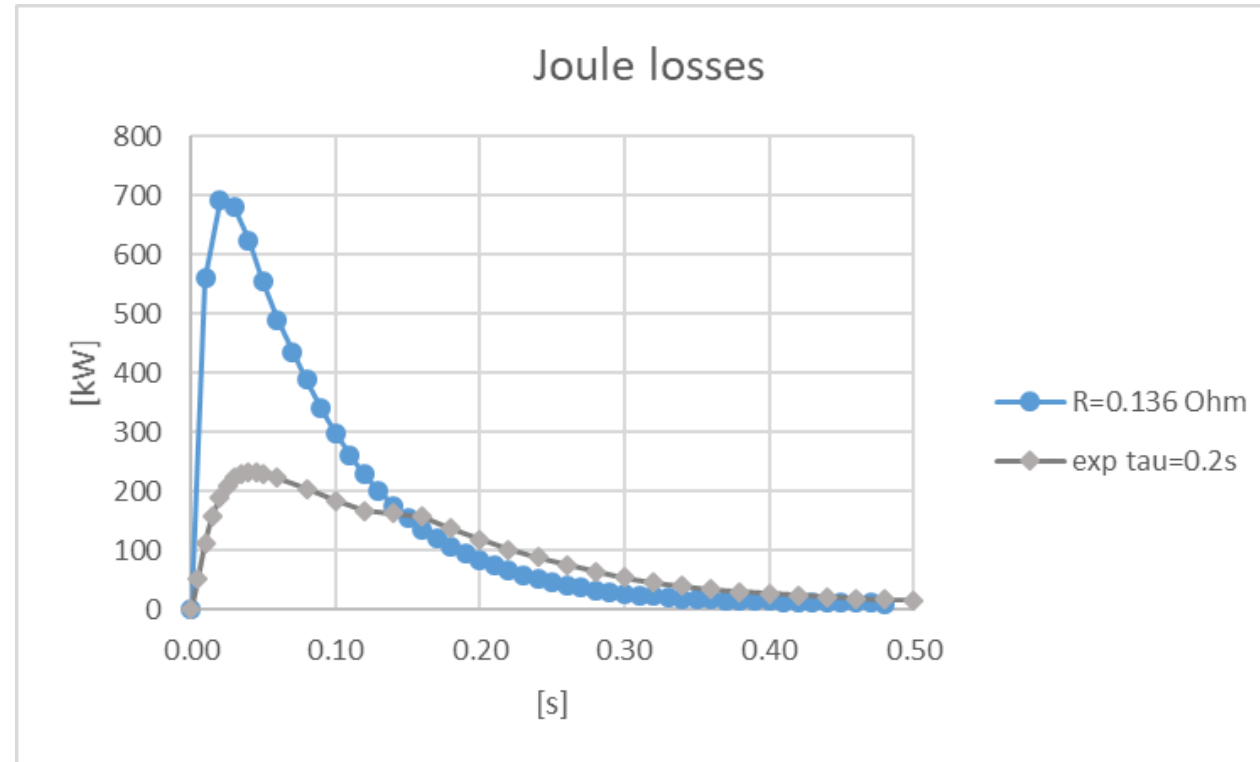
Evolution of eddy currents

Evolution of eddy currents

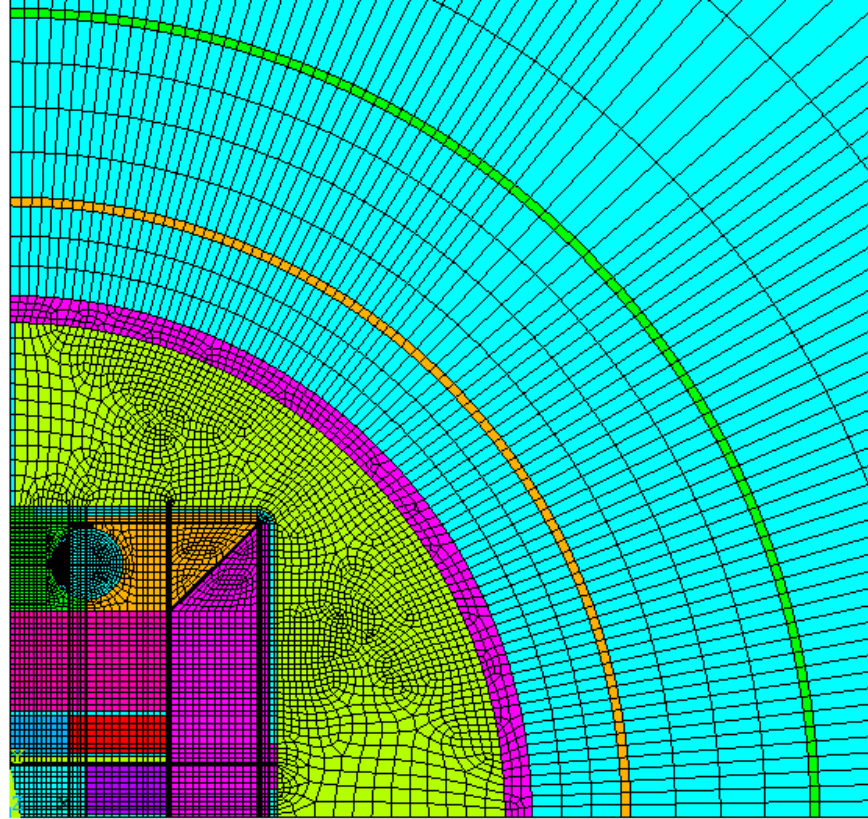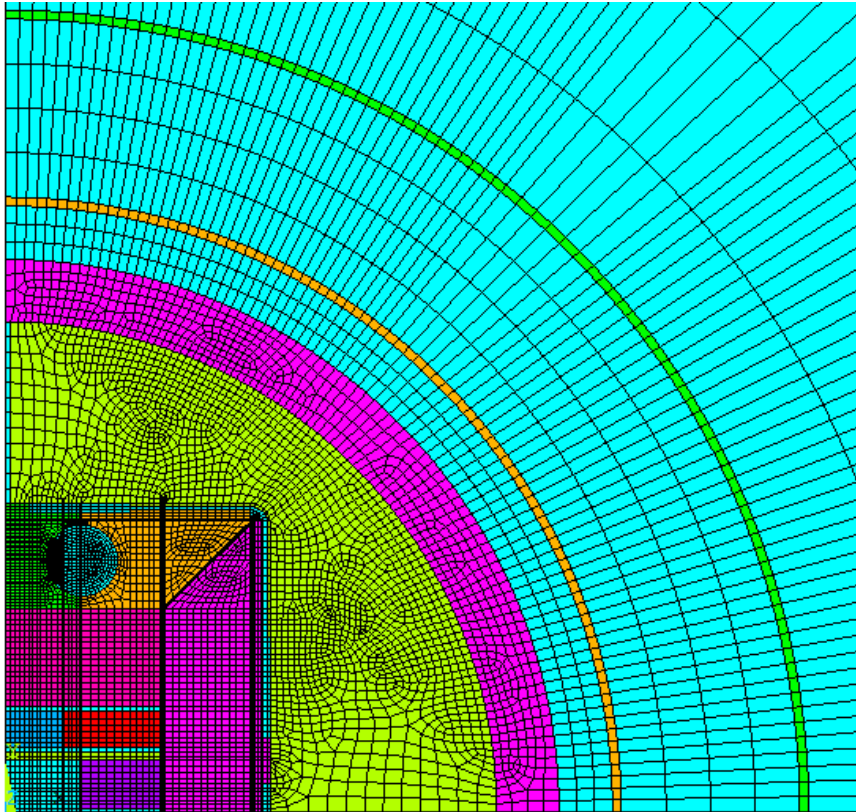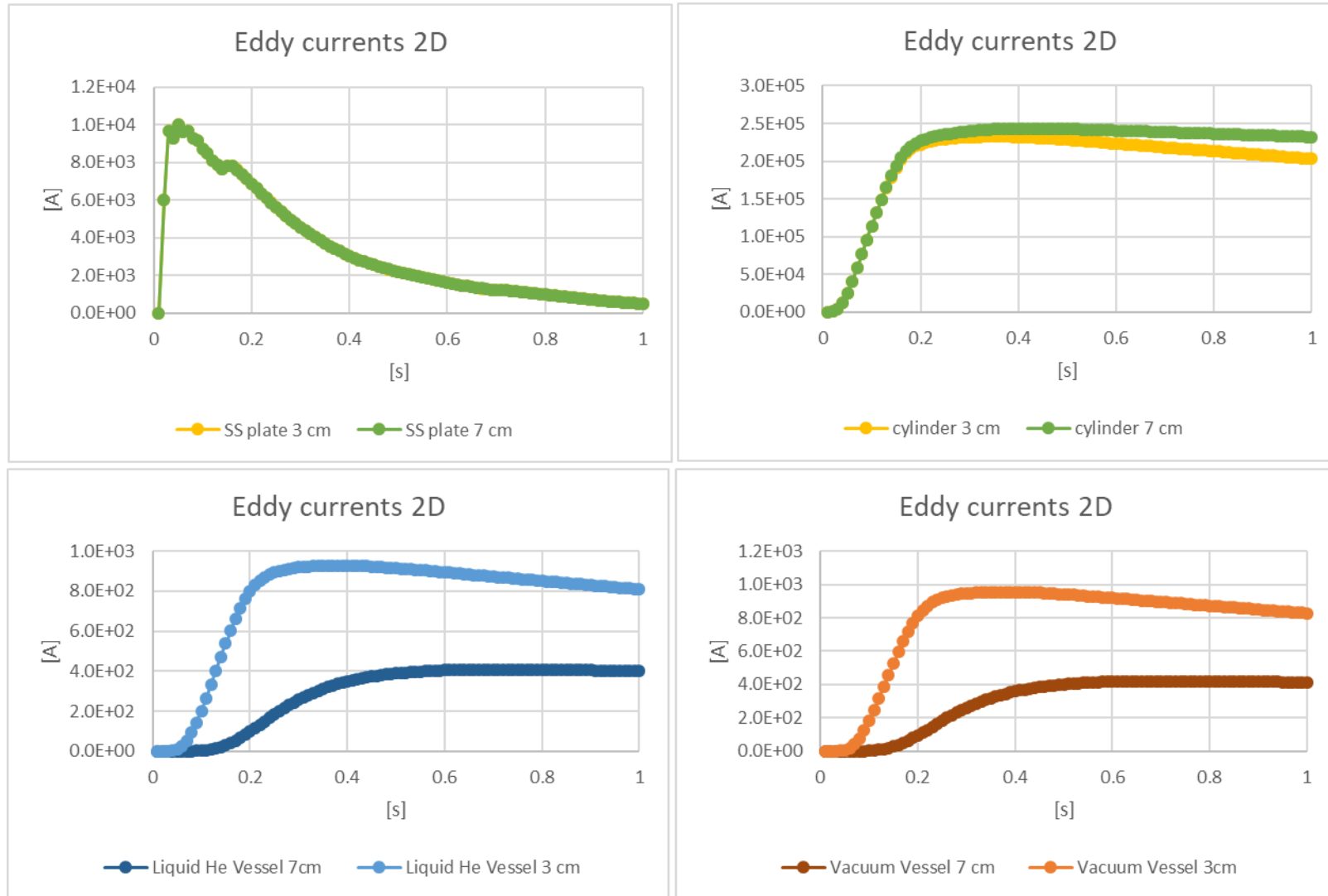# Evolution of Lorentz forces for 1/8 of the magnet

Power loss

Conclusions

- The real evolution of the current in the coil during the quench is faster then the exponential trend with t=0.2 s

- This produces more eddy currents and highest forces in almost all components of the dipole.

Third analysis

2D analyses to assess the eddy currents in the cryostat (also by changing the thickness of the Al shell)

Evolution of eddy currents

Evolution of Lorentz forces (p.u.l.) for 1/4 of the magnet