

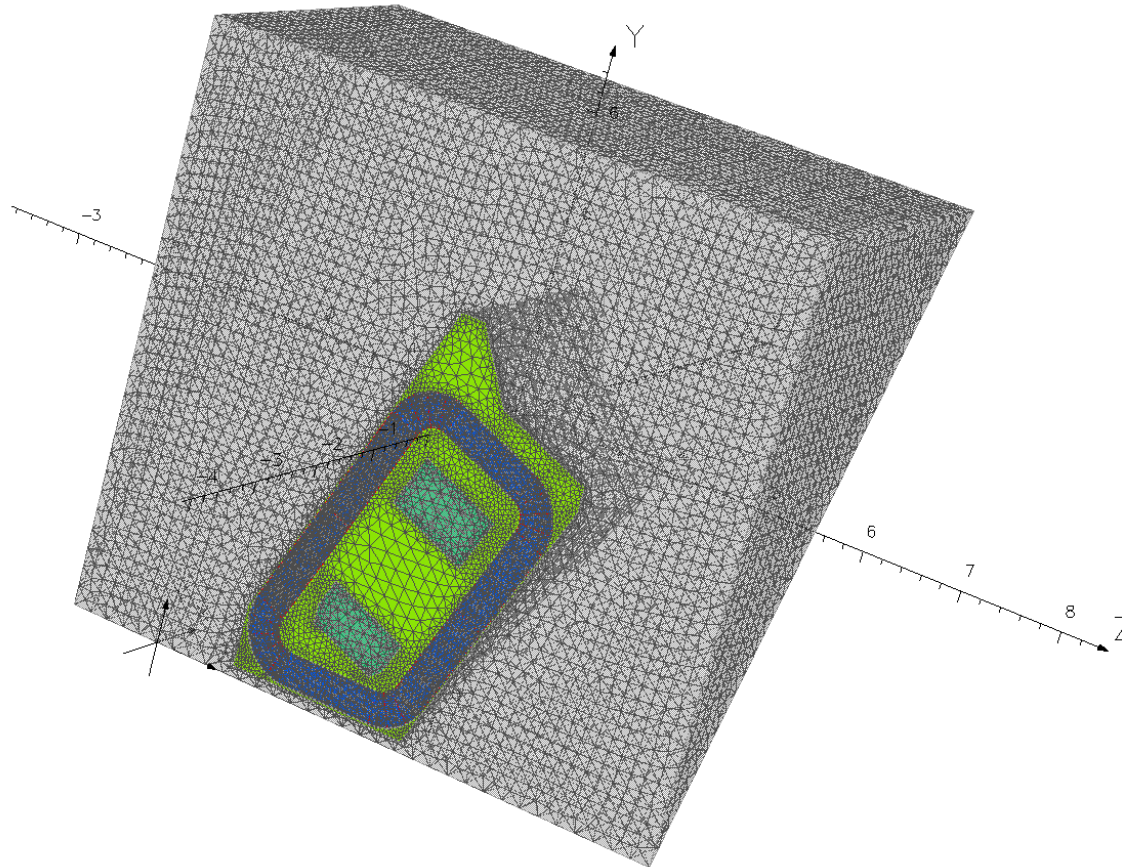
TORUS MAGNET QUENCH ANALYSES

(Status Report)

V.S. Kashikhin, February 6, 2013

Model Geometry

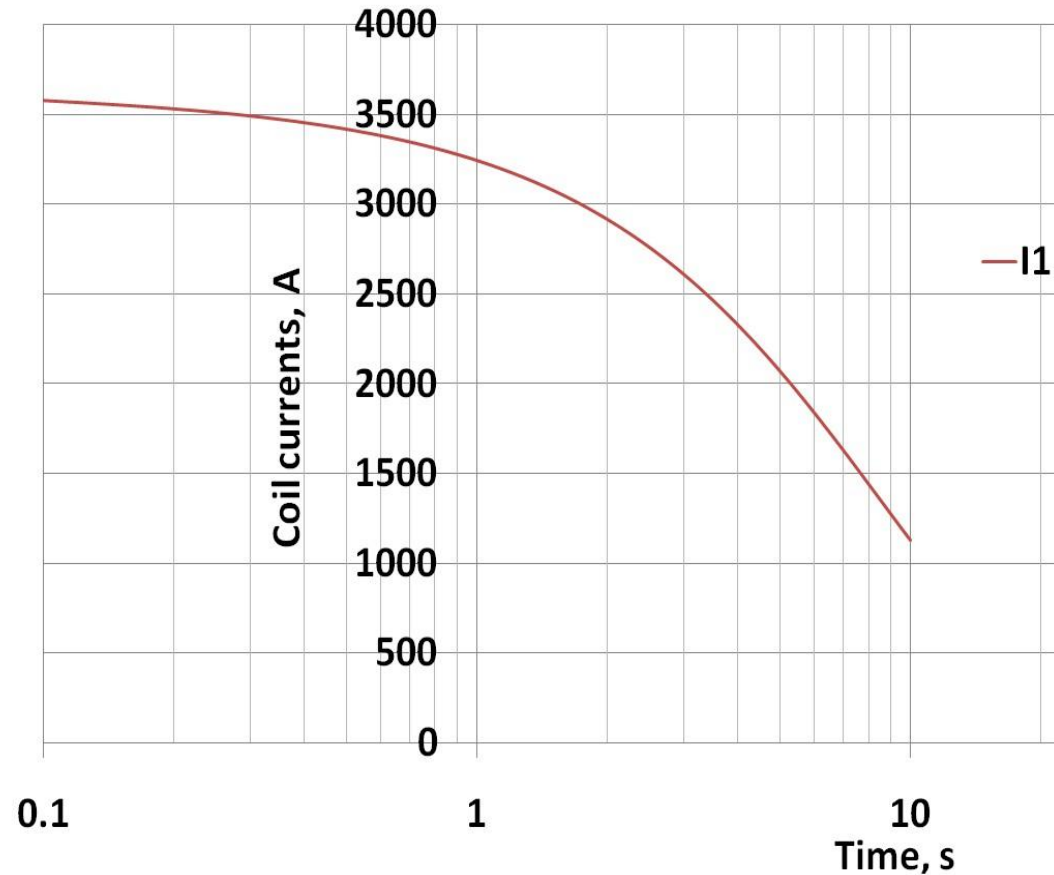
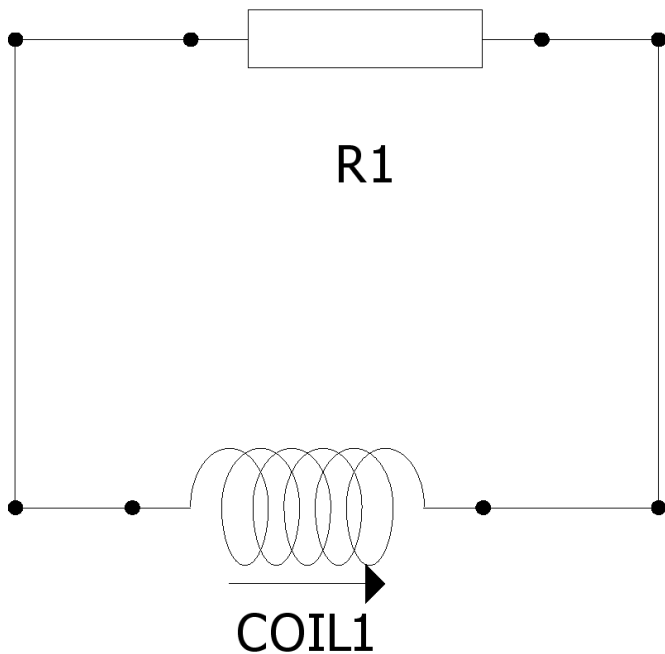
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Opera

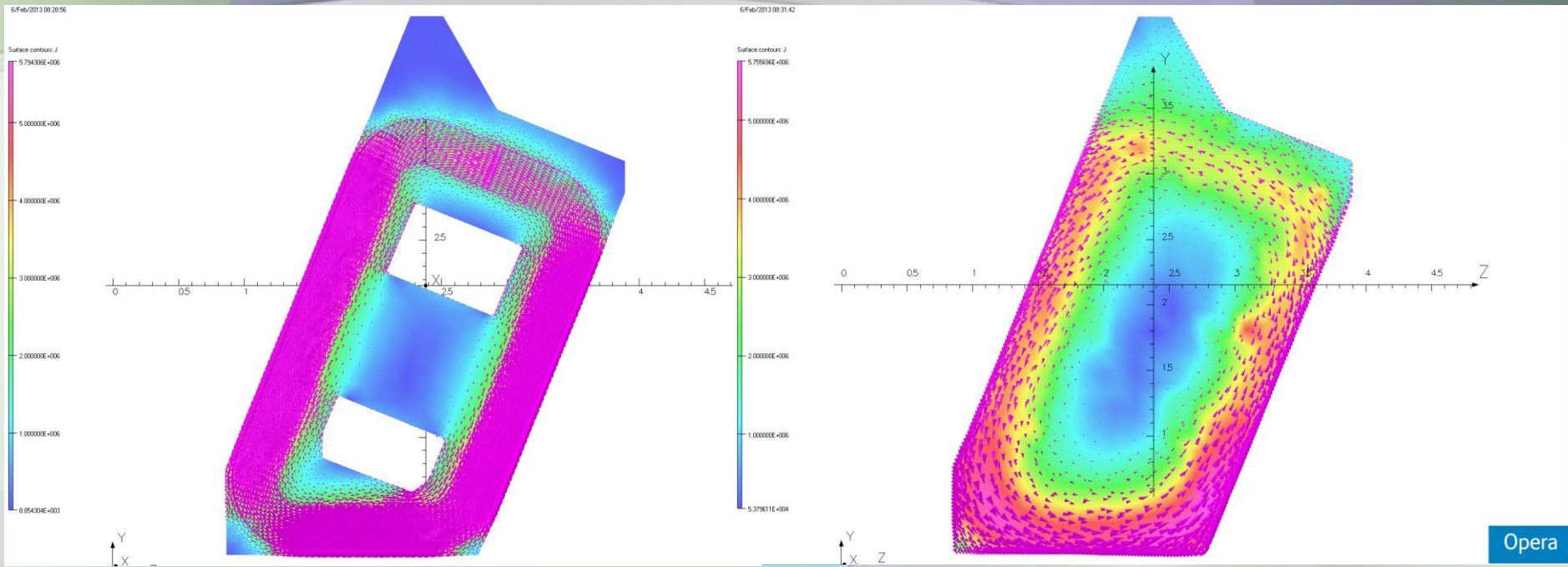
- 30 degrees model with proper boundary conditions reduces 12 times the number of finite elements.
- Issues with the mesh generator in the OPERA3D code
- Large model dimensions with many thin layers.

Circuit Diagram and Current Decay



- It is supposed that the initial nominal current 3770 A flowing through 117 turns of the COIL1 (half coil).
- After the quench initiated by the COIL1 heater the magnet discharges on the external dump resistor of 0.12 Ohm.

Transient Magnetic Field Analysis

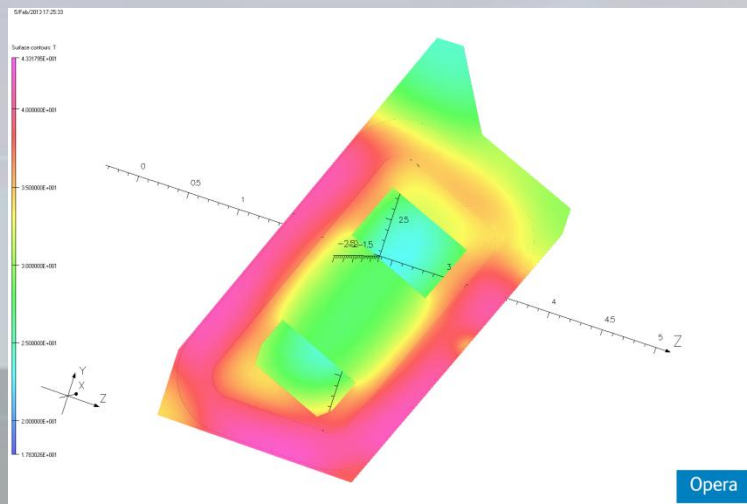
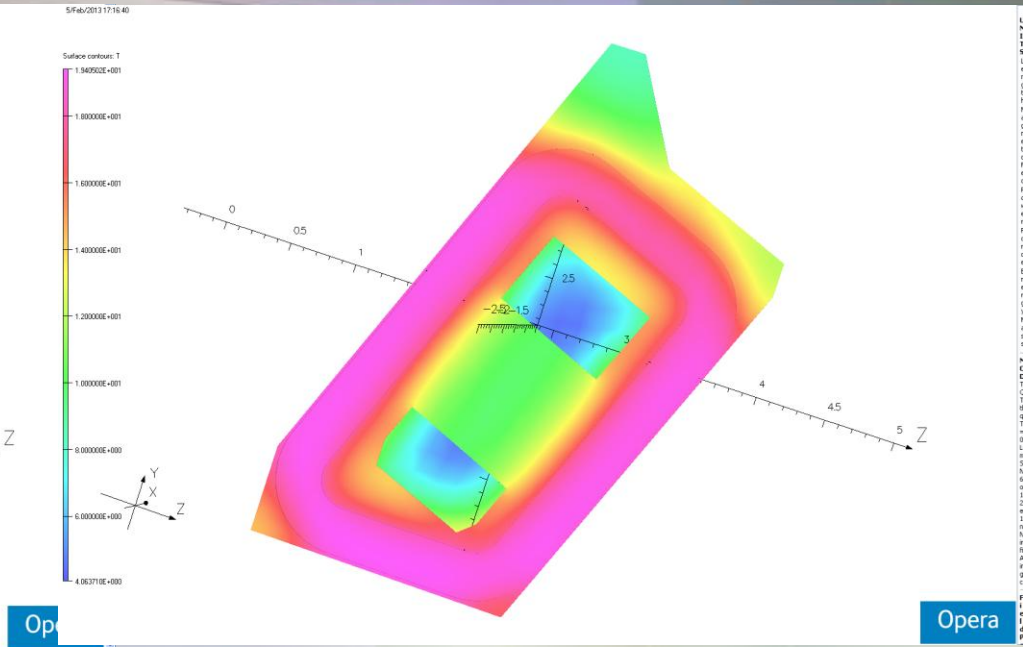
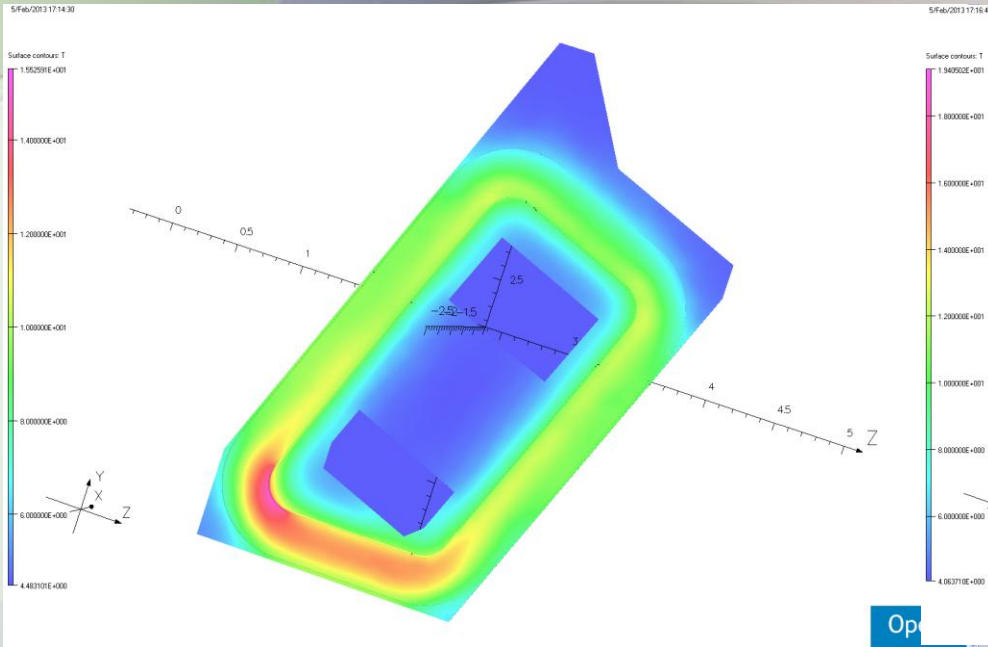


Eddy currents induced in the Al case (left) and in the nitrogen shield (right) at time 0.25 s. Current density in A/m².

The peak forces on the shield after 0.25 s magnet quench are:

$F_x = -48.1$ kN, $F_y = -13.2$ kN. The shield area is 7.5 m², the shield pressure is 6.5 kPa.

Thermal Analysis



Status

- The 1/12th model for the QUENCH code simulations are built.
- The test runs showed reasonable results.
- What should be done:
 - Include in the model thermal conductance on the coil-case boundary surfaces;
 - Include the coil anisotropic thermal conductivity in the transverse to the current flow direction;
 - Investigate the nitrogen shield slots influence on the eddy currents and forces;
 - Built the whole 360 degrees model;
 - Investigate the asymmetrical quenches and corresponding parameters.
 - Investigate various coils fault scenarios by increasing the circuit resistance which will cause the faster magnet discharge.
 - Proposed during the meeting to simulate the externally short-circuited magnet system discharge to estimate coil peak voltages.