Design of DUNE ND Magnet

(Consideration to Aluminum coils)

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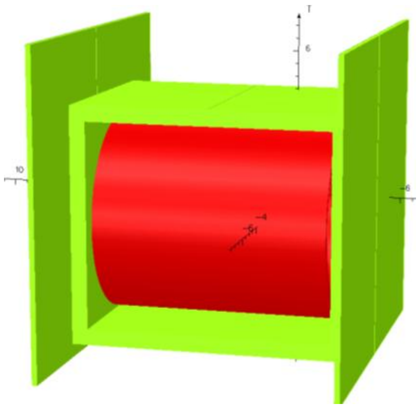
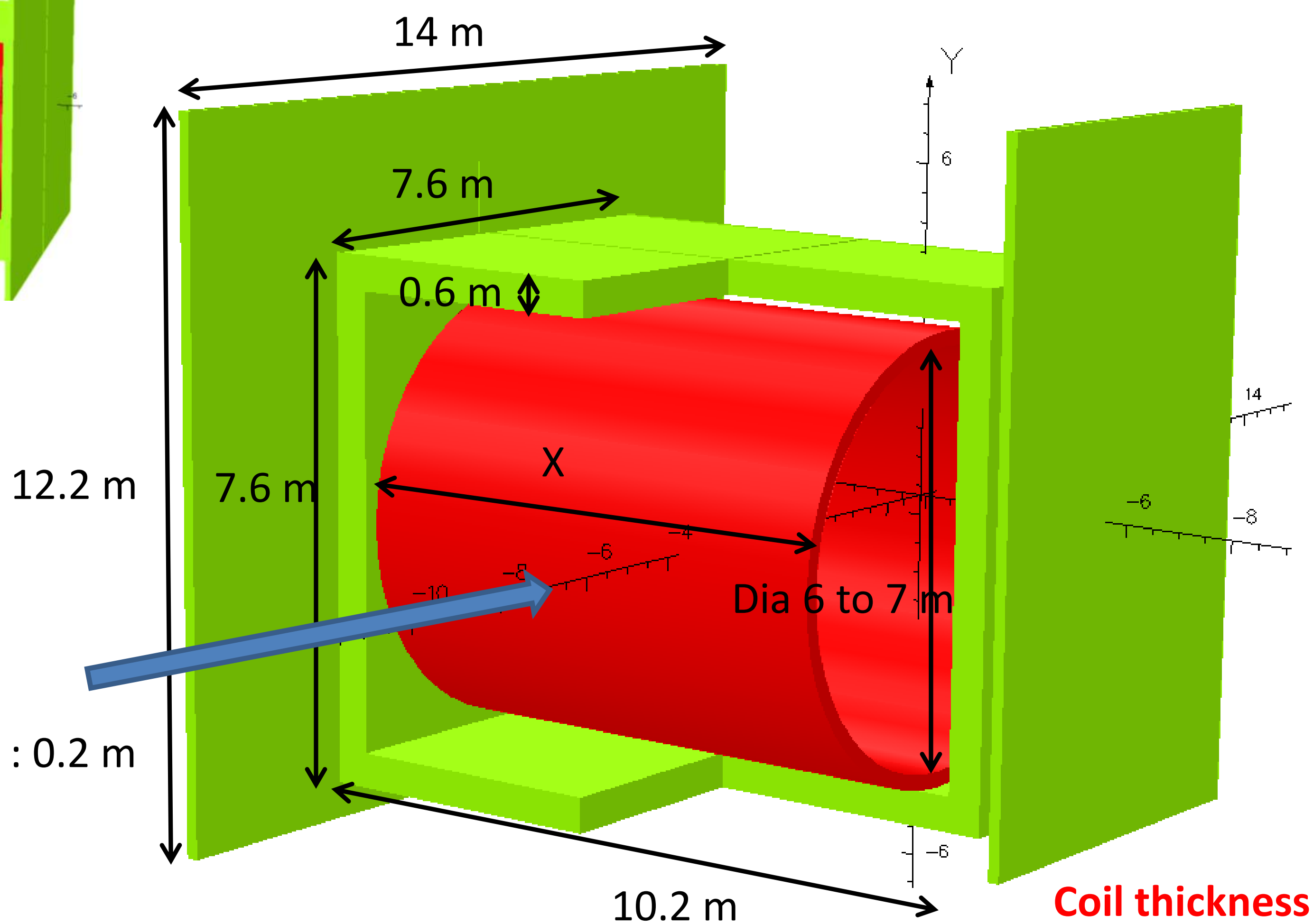
Outline

In last meeting (11 January, 2019), main concerns were as follows

a. **Thickness of copper coils in view of physics requirements, Aluminum having higher radiation length was discussed as an alternative to copper**
b. **Drawings of HPgTPC received**
c. **Design with Aluminum coils having total thickness of 240 mm is considered.**

Magnet Geometry (3/4 view)

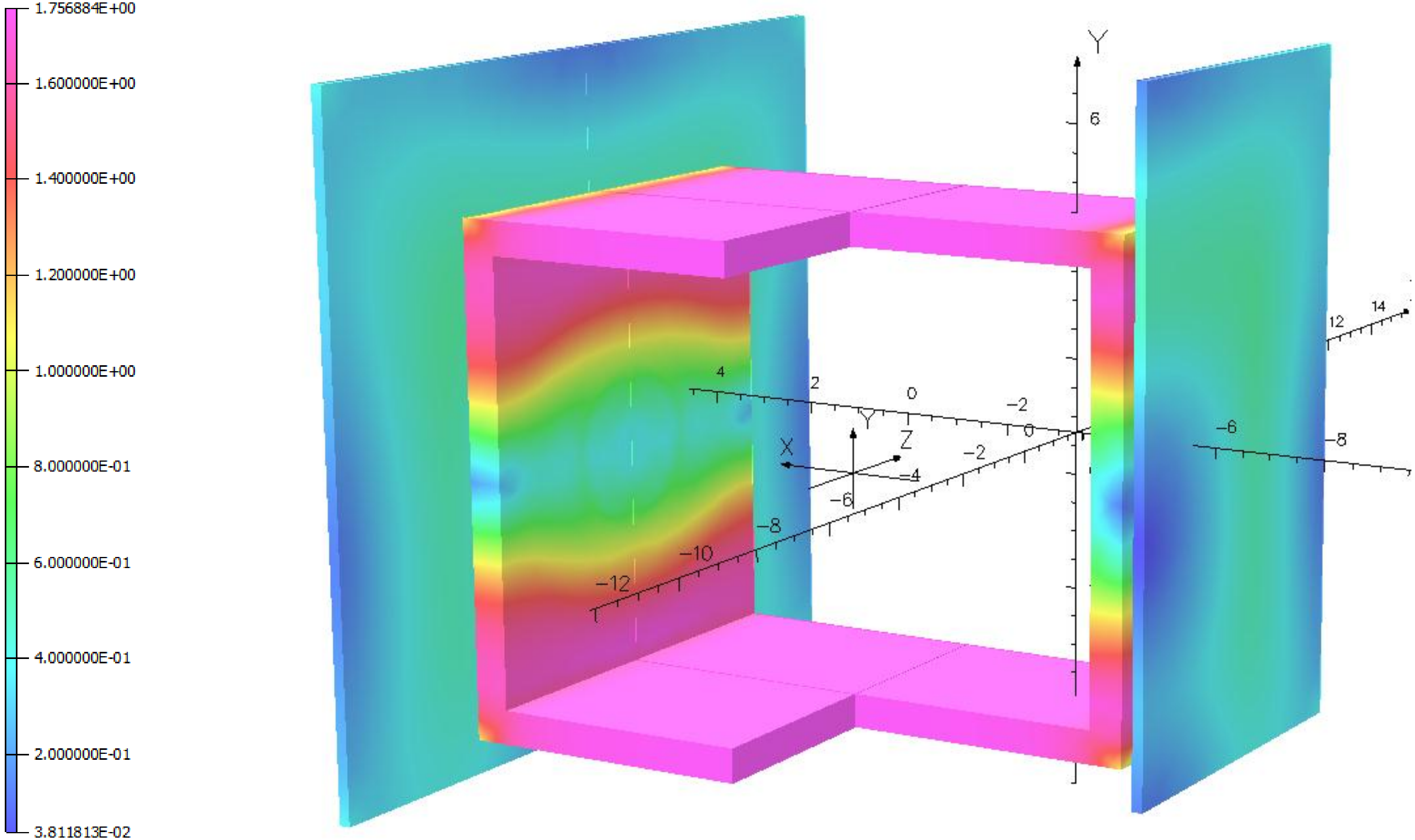




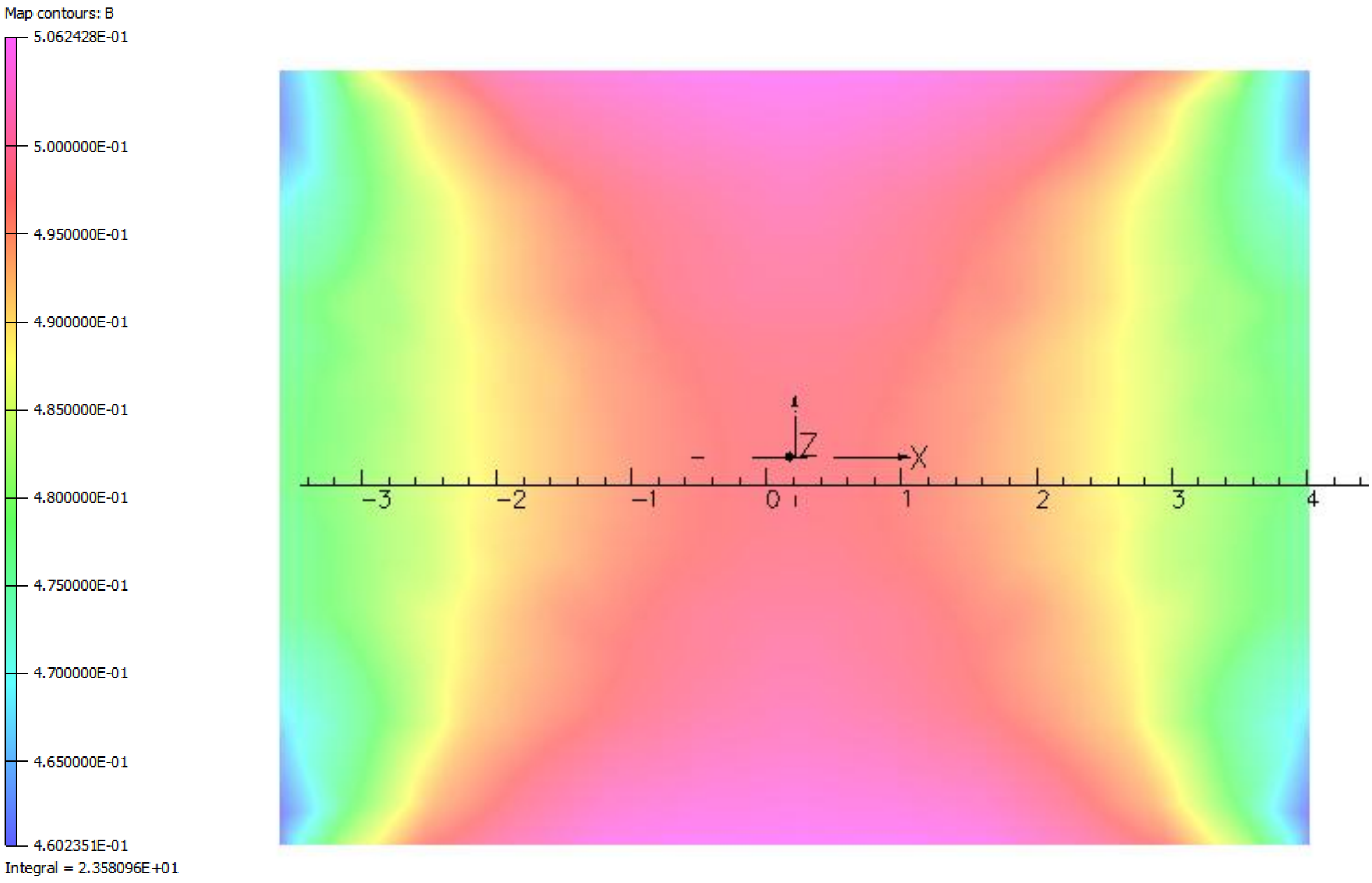
Coil thickness : ~~0.26 m~~

Coil thickness : 0.24 m

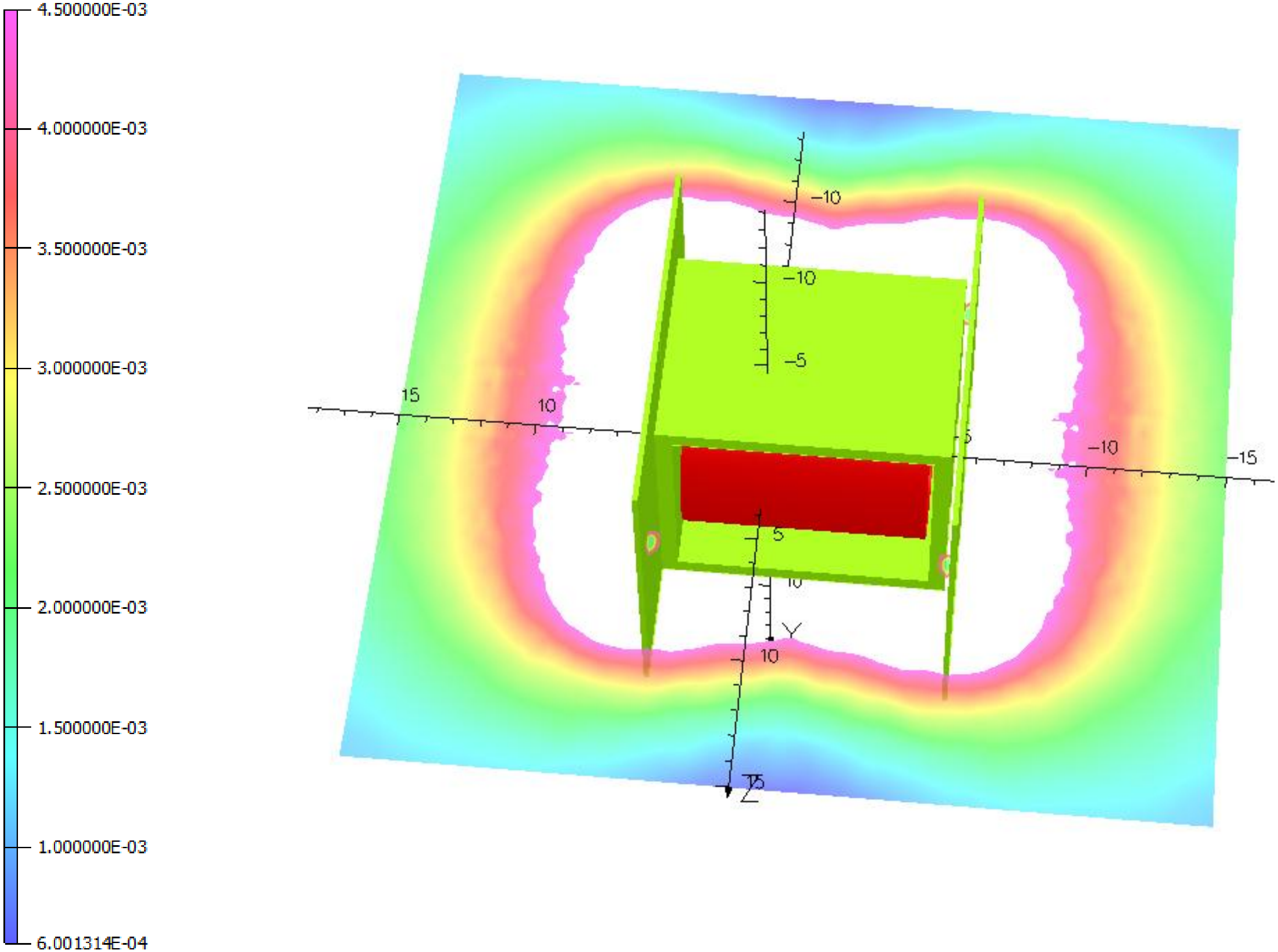
Electromagnetic simulation



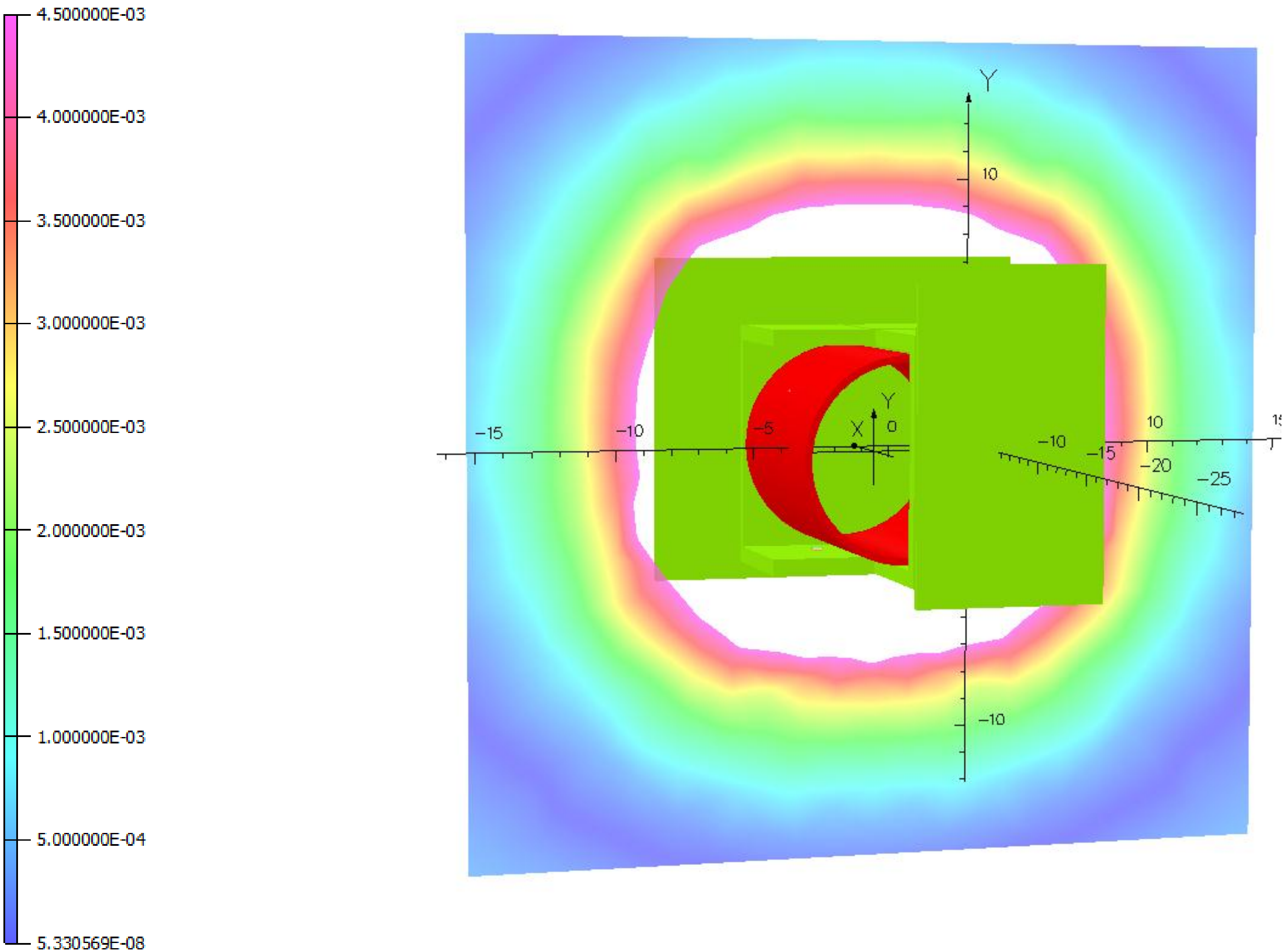
Magnetic Field profile (Longitudinal plane)



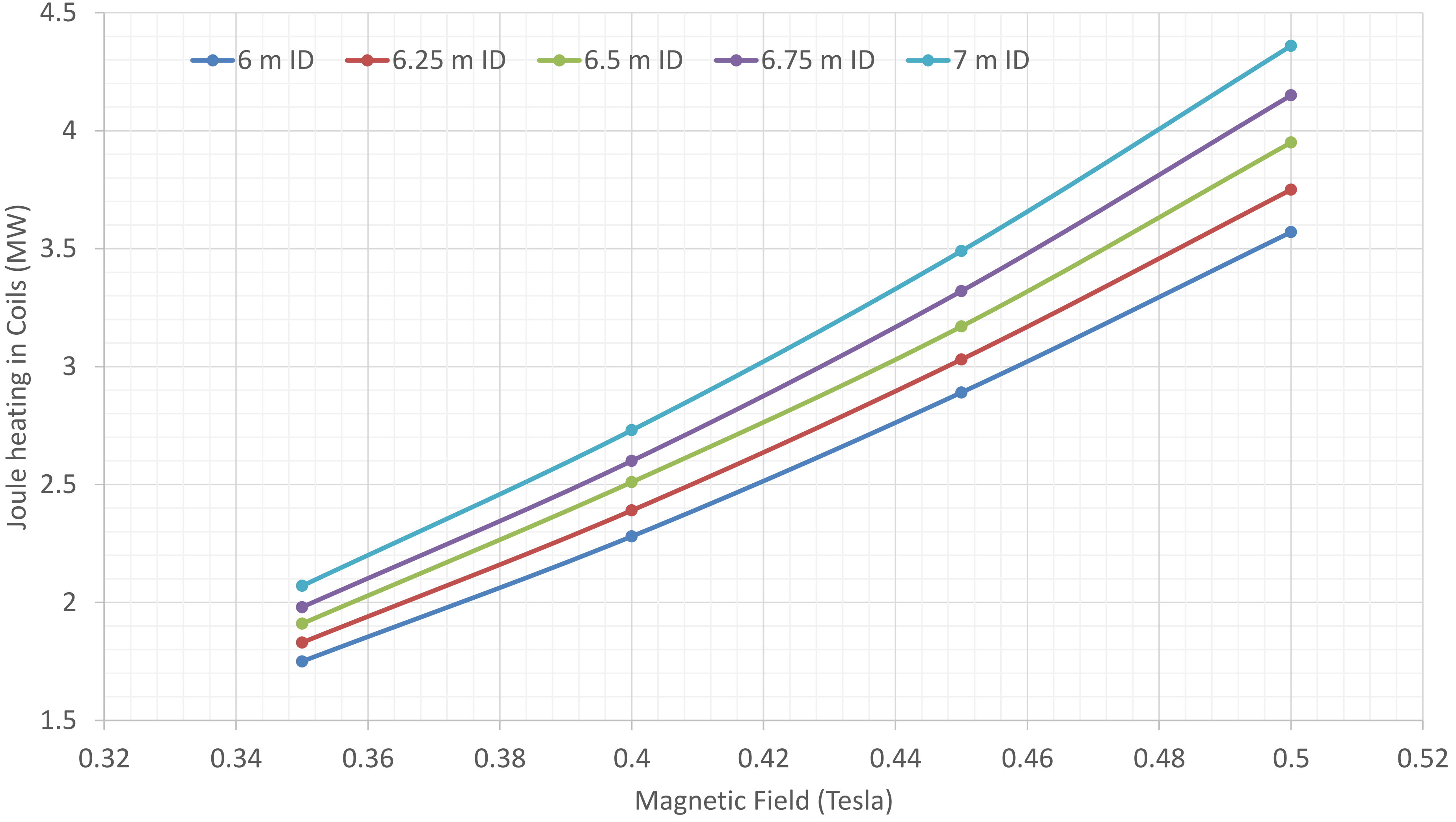
Fringe Fields in Horizontal Plane



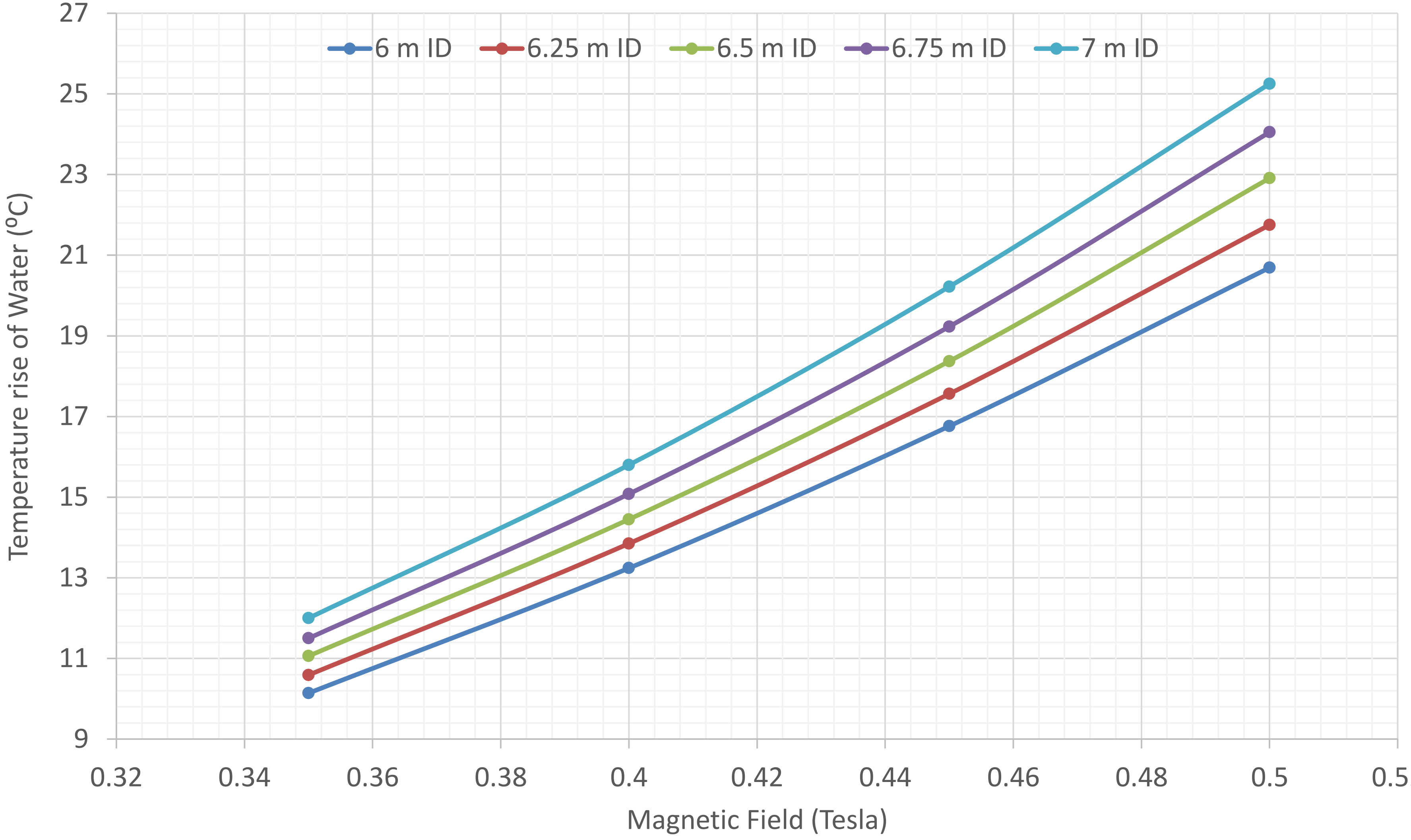
Fringe Fields in Vertical Plane



Power Consumption in coil as function of Coil ID and magnetic Field

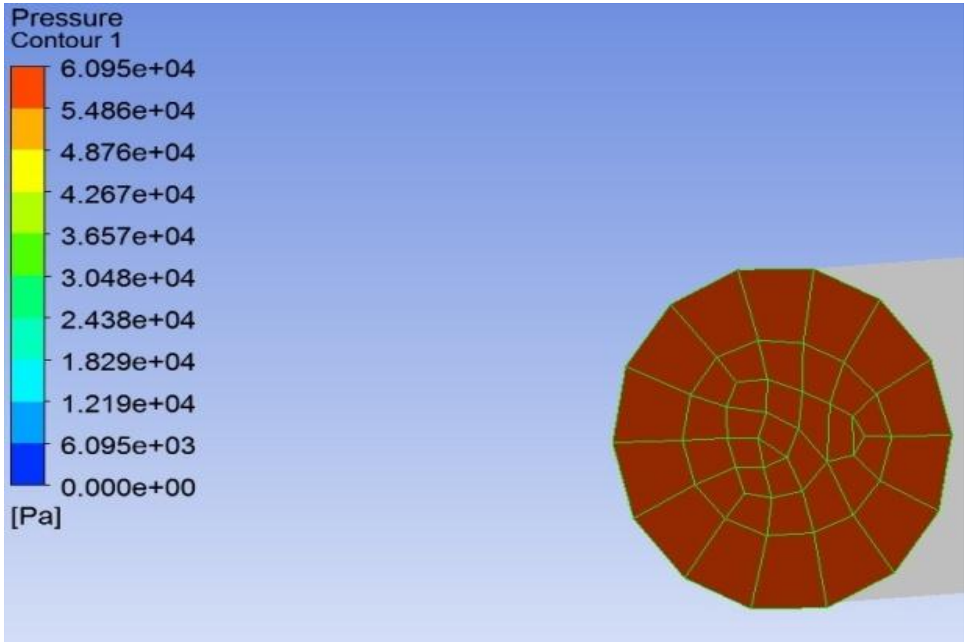


Temperature rise of water as function of Coil ID and magnetic Field



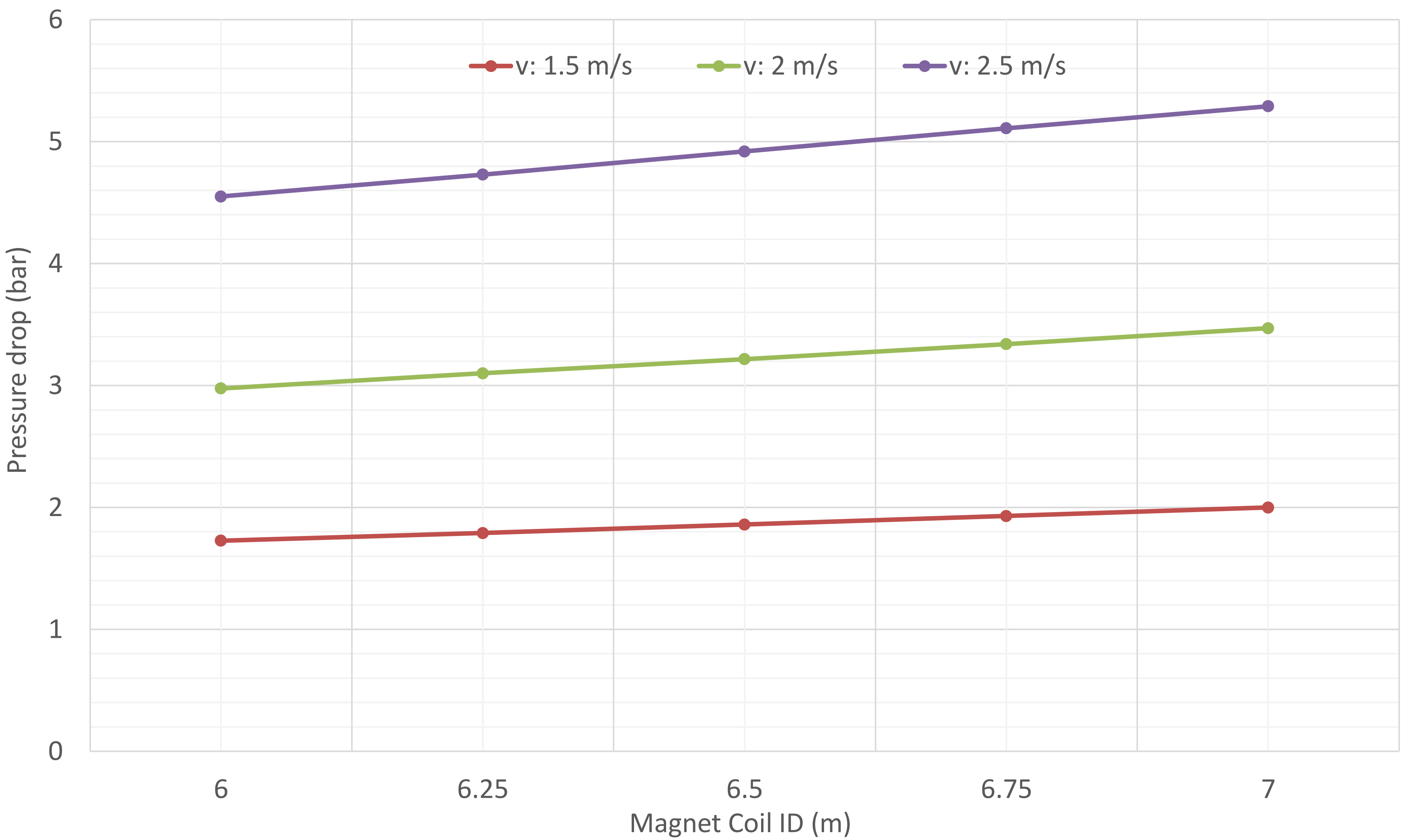
Pressure drop as a function of magnet coil ID and water velocity

S.N	Coil Diameter	Water Flow Dia	Pressure Drop @V=1.5 m/s	Pressure Drop @V=2 m/s	Pressure Drop @V=2.5 m/s
1	6 meter	20 mm	1.476	2.46	3.654
3	6 meter	18 mm	1.674	2.778	4.134
4	6 meter	16 mm	1.956	3.258	4.842



Pressure Drop is 3.654 bar @ velocity 2.5 m/s , diameter of coil is 6 meter, dia is 20mm

Pressure drop as a function of magnet coil ID and water velocity



Summary

1. A Modified magnet design with iron yoke and shield is used.
2. The MMF required and temperature rise as function of magnetic field and ID of solenoid are evaluated.
3. The shields on either side have reduced to fringe fields.
4. With about 200 mm thick Aluminum coils, power dissipation will be about 20% larger than reported in this presentation.
5. For reducing the power dissipation ***minimum workable magnetic*** field and ***minimum OD of HPgTPC*** shall be fixed.

Thanks!