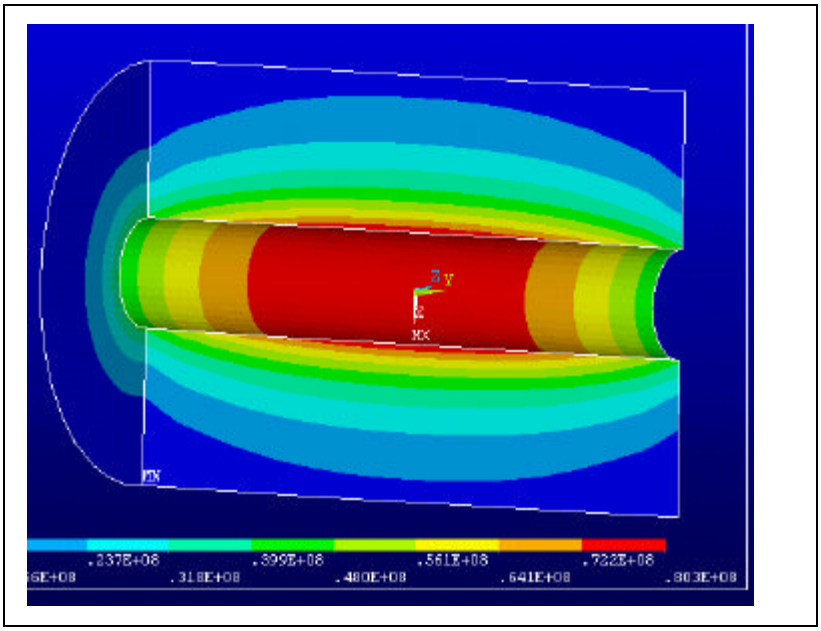
Memo to Rui Vieira; Joe Minervini; Jim Irby
From: Peter Titus, MIT - PSFC
Subject: 1.8 MVA LN2 Pulse Magnet
Date: October 10 2001



I haven't attempted Bob's graded coil, or the addition of the small correction coils. Stress calculations and Resistance/Impedance Matching attempts were based on a single coil:

r	z	dr	dz
.20425	0	.2415	.97

Stresses for this coil, MPa:

Field	Smeared Hoop	Smeared VM
10T	80.3	82.6
15T	180.7	186

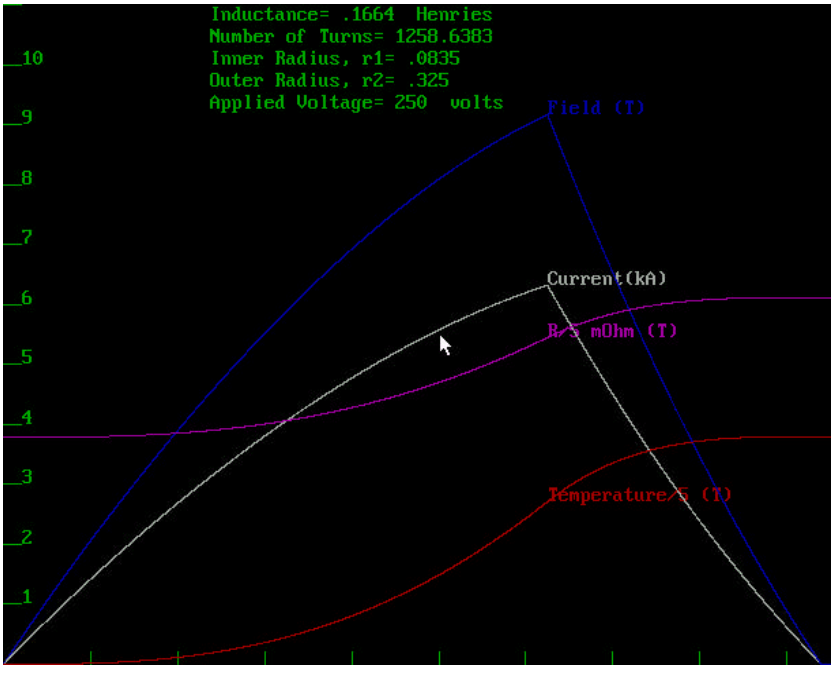
Stresses for this coil with .85 packing fraction, MPa:

Field	Smeared Hoop	Smeared VM
10T	94.5	97.2
15T	212.8	218.8

Interpolated values:, Work hardened copper-, OFHC c10100 60% red

temp deg k	77	90	100	125	150	200	250	275	292
yield	374	369.	365.	356.	347.	328.	317.	312.	308.
ultimate	476.	466.	458.	439.	420.	383.	365.	356.	350.

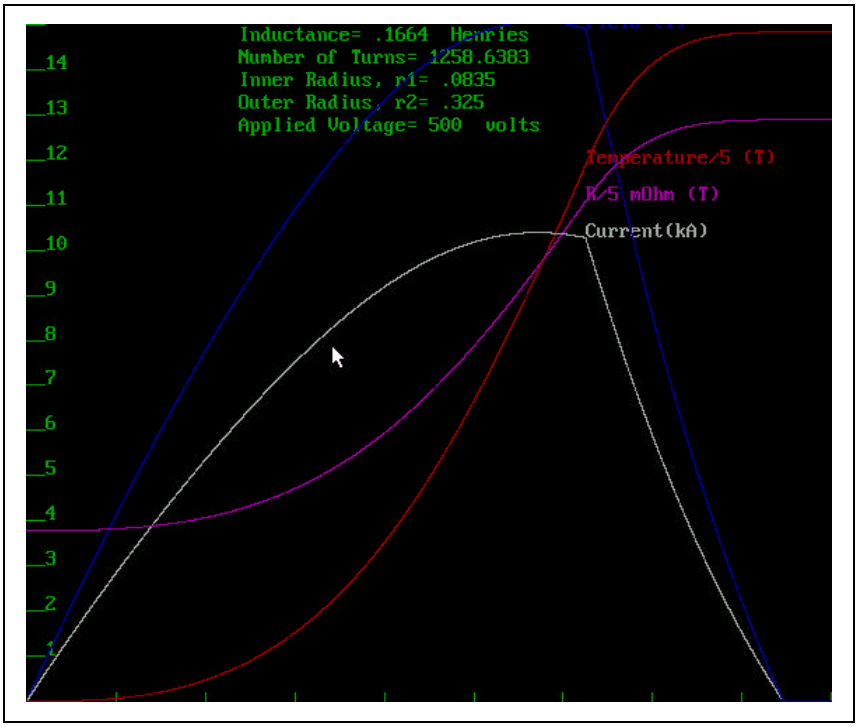
For Fusion magnets we allow the inner skin of the solenoid to reach the yield - Treating this stress as a bending stress with a 1.5*Sm allowable with Sm based on 2/3 Yield. There appears to be some margin in the design with 15T stresses around 220 MPa and a conductor yield of 350 MPa for a 125 K temperature. But if we want to use hollow conductor for cooling we may need external support. For Costing we should include a 1 inch thick shell or pipe.



Resistance/ Impedance Matching to the 300 V power supply.

My results don't include the graded coils. To get the 10T I need a slightly thinner build to lower the Inductance. The thinner build produces a higher temp. The graded coil is evidently intended to accomplish the same thing. In my

simulation, 500V produces the 15T. with the same coil. For the cost estimate we should be able to assume the baseline coil configuration



Cooling Options:

1) Wind 2, 3 or 4 layers of cold worked solid conductor, then a plate/layer with axial channels. The number of layers and the channel material would be chosen after cooldown and structural calculations.

2) Hollow conductor backed by a SST Shell. This would probably be a heavy wall pipe section. Bob tells me the reason they didn't consider hollow conductor was that they couldn't get the strength they needed. Coil heat-up is small by tokamak standards, and I don't believe the thermal differential between coil and case or shell will be enough to cause a thermal stress problem. Active cooling might be considered.

3) Co-Wound options i.e in option 1 replace the axial channel layer with a layer of co-wound solid copper and SST tubing.

The above options require pressurized flow, rather than some kind of percolation as Bob describes. To get natural circulation through this magnet you would need vertical slots - difficult with a layer wound concept. For Costing purposes I would suggest a design like that below. Bob uses a graded conductor, with a smaller cross section in the inner half of the build. You might cost two types of conductor, along with a hollow conductor layer for cooling. Heat transfer calculations are "in process" -The coinfiguration below is a guess.