



13-001205-AWB-01

TO: Distribution
FROM: A Brooks
DATE: 5 December 2000
SUBJECT: Impact of Loss of Coolant on Cool down of TF Coil Inner Leg

A recent water leak in one of the outer turns of the TF Coil Inner Leg has forced the shutoff of flow of coolant to that turn. Continued operation will require a longer cool down time since the heat must be removed by conduction to adjacent turns through the 0.064" thick G10 turn insulation and possibly an additional .020" thick segment insulation.

The cool down of adjacent turns will no longer be uniform, producing temperature gradients, which will induce shear stresses in the insulation. Based on preliminary analyses performed by H M Fan and shear tests of the insulation reported by C Neumeyer, the maximum turn to turn temperature difference should be limited to ~20 C.

A general purpose, finite difference, transient Thermal Analyzer Program called T15 (a Grumman code use to analyze the PF coils for the TFTR/OSES program) was used to model the affected turns. Cool down from 100 C by 10 C was simulated representing a 90 C adiabatic heatup. The analysis is linear so the maximum temperature gradients found can be scaled to the appropriate level to set a limit on I2t heating from a pulse.

Figures 1 and 2 show the cool down of the conductors at the water inlet and water outlet. The results show complete cool down in less than 10 minutes. They also show the max temperature gradient which occurs at the water inlet is 70% of the initial I2t heating of the coil. This indicates that the initial I2t heating can be higher than the limit imposed by thermal stresses by $1/.70$ or roughly 40%.

cc P Heitzenroeder
C Neumeyer
M Williams
H M Fan

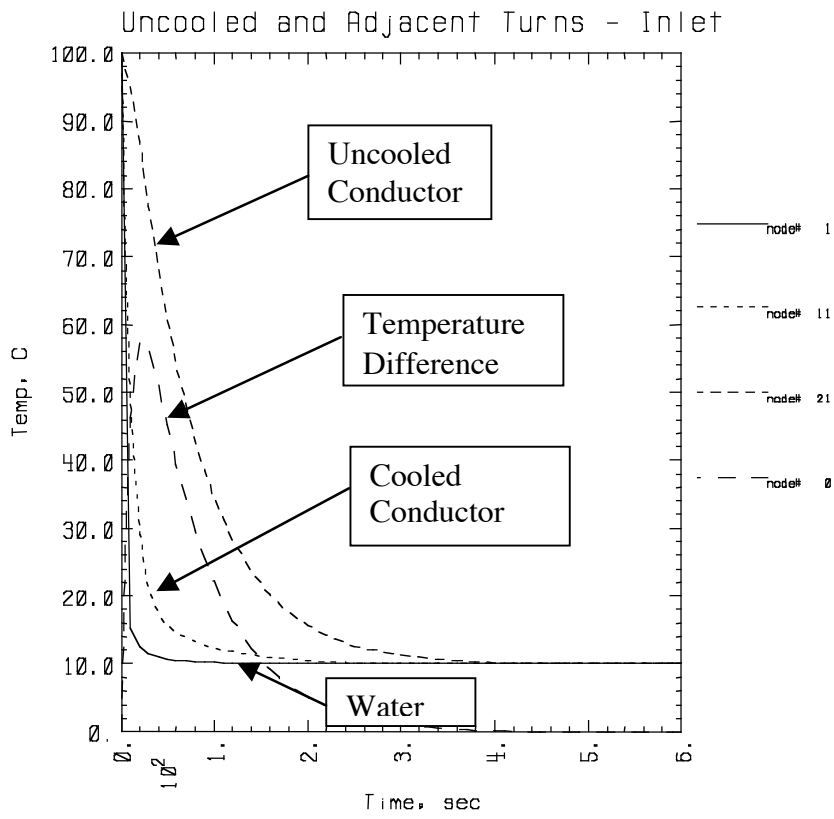


Figure 1 Cool down of uncooled turn and adjacent cooled turn at water inlet.

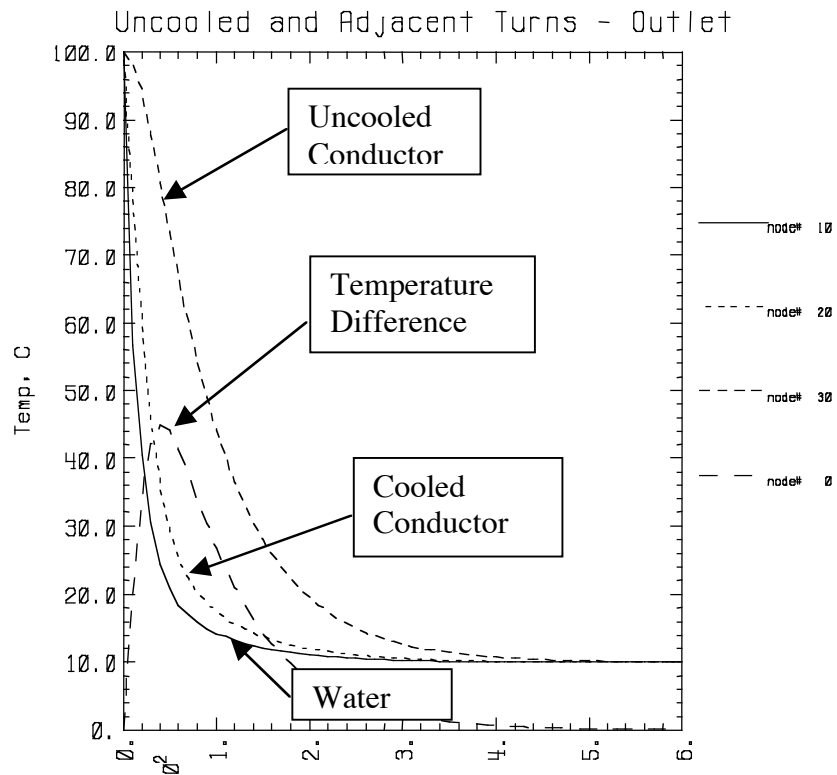


Figure 2 Cool down of uncooled turn and adjacent cooled turn at water outlet