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TO: DISTRIBUTION
FROM: C NEUMEYER
SUBJECT: RATED TF PULSE

This memo describes the rated pulse waveform for the NSTX TF system. Data is attached in an Excel file.

Data was taken from a 6kG, 71.2kA shot (#108712). Therefore the waveform for the rise time reflects the actual performance of the power supplies, etc..

Current rise to lower field levels would follow the same shape except to lower current (3kG at 35.6kA, 4.5kG at 53.4kA).

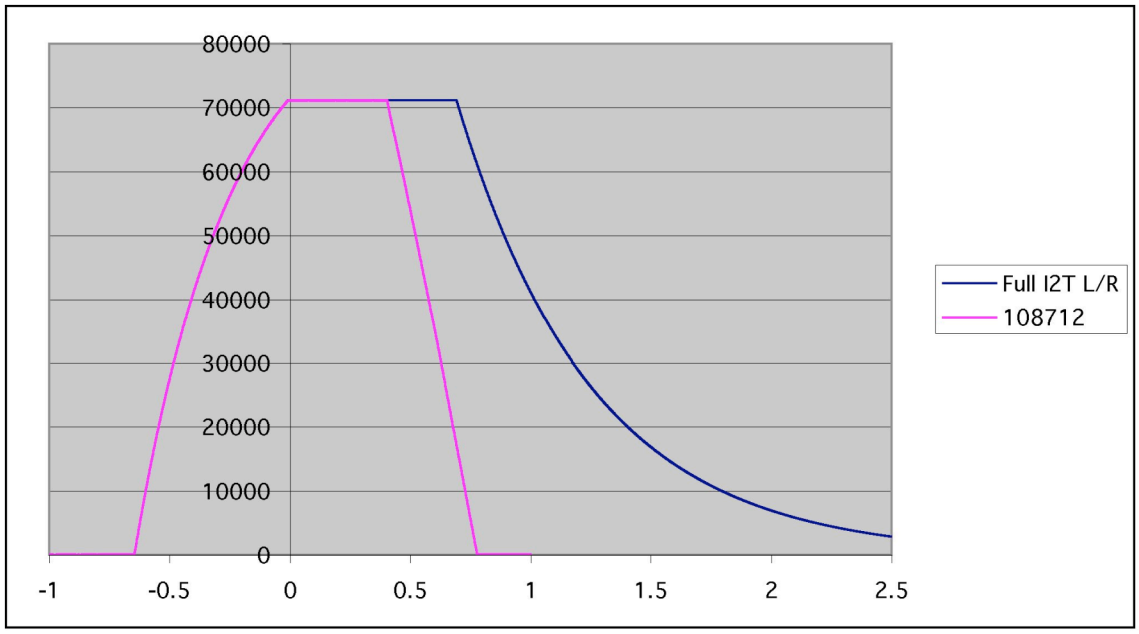
The I2T value of shot 108172 was 4.27e9 A^2-sec. This was based on an operating envelope established at the time which would limit the maximum possible adiabatic temperature rise in the inner leg conductor, starting from 12C, to 70C (Tmax=82C). In order to ensure this, in anticipation of the possibility of L/R decay, the protective device setpoint was set to 4.3e9. So the maximum I2T of a trip-free shot is 4.3e9, as reflected by 108712. This corresponds to an actual temperature rise of 51C (Tmax=63C), and is typical of 6kG operations which have taken place thus far on NSTX.

At full I2T rating, we intend to allow 6.5e9, corresponding to an 80C rise (Tmax=92C) in the inner leg conductor. In order to ensure this, our protection systems would limit the I2T at End of Flat Top (EOFT) to 5e9 for a trip-free pulse, allowing for the possibility of L/R decay.

To simulate the maximum condition a second case was created which extends the flat top from 108712 and then adds on a simulated L/R decay with an ultimate I2T of 6.5e9. For the resistance, a value of 8mΩ was assumed. In actuality, the resistance varies with temperature. Larger values (8.5mΩ) or higher show the best curve fit with measured data. But a slightly lower assumption errs on the conservative side, and allows for imprecision in the protective device settings, etc.

Flat top time at 6kG for the rated pulse is 0.7 sec. If TF joint redesign so dictates, the I2T limits mentioned above, which are derived based on the inner leg conductor temperature rise, may have to be reconsidered.

These results are shown on the following figure and the data (time step = 1mS) in the accompanying Excel file.



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