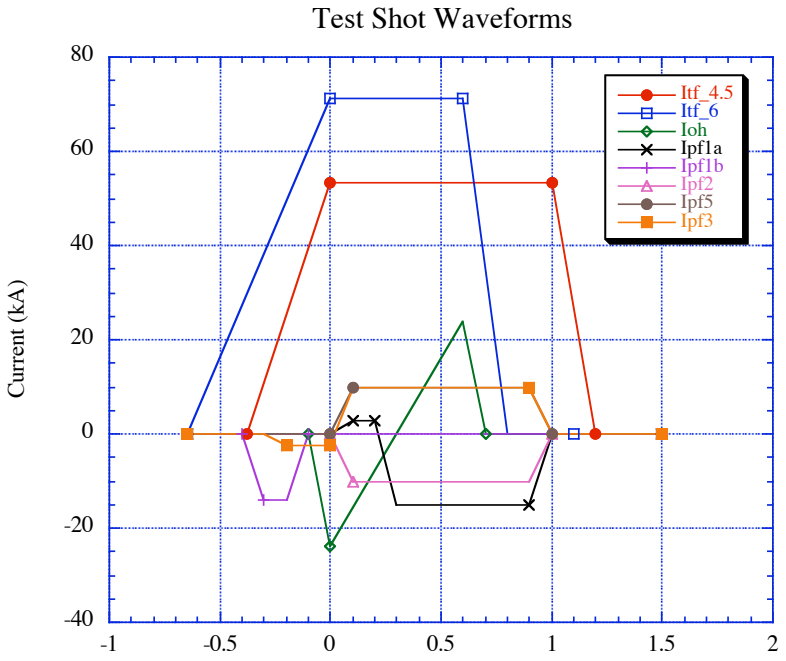
13_030227_CLN_01.doc

***TO: DISTRIBUTION***
***FROM: C NEUMEYER***
***SUBJECT: TF RECOMMISSIONING SEQUENCE***

This memo specifies the sequence of shots associated with the re-commissioning of the TF. The near-term objective is to re-commission to 4.5kG/1.0 second flat top as required to declare the "TF Recovery Project" complete per the "Project Execution Plan" for same. In the longer term, the ultimate capability of 6.0kG/0.6 seconds will be commissioned when required by the research program.

The re-commissioning will be based on the standard test shot procedure which runs the TF, OH, and inner PF coils at 50% and 100% of their approved levels in two steps, with the outer PFs at 100% during both steps. Limits on the time duration of current flow will be based on present "overtime" settings which allow plasma duration up to 1.0 second.

The following idealized figure depicts the 100% test shot waveforms (note that TF and OH rise and fall are shown as linear for simplicity, even though they are actually exponential).



There are three critical time points. At the TF "Start of Flat Top" (SOFT) (t=0), the TF has reached its flat top current and the OH is at the peak of its first swing. PF3 is at its pre-charge current and the other PFs are at zero. This is consistent with the beginning of the plasma pulse (a.k.a. "Start of Pulse" (SOP)). At the "OH Second Swing" (OHSS) time (t=0.6), the OH is at the peak of its second swing, and the TF and PF currents are at their peak flat top values. In the case of 6kG TF the OHSS corresponds to the TF "End of Flat Top" (EOFT), since the 0.6 second flat top is the maximum available. At 4.5kG TF it is possible to extend EOFT out to t=1.0 seconds as shown, but the OH current is already zero, and the PF currents begin to extinguish just prior to this so they reach zero by t=1.0.

Note that PF1b is used only during CHI and for Ip rogowski calibration and is not active while the other PF coils are on.

The following table shows a proposed re-commissioning shot list, along with the TF Bt values, the prospective TF temperature rise, available TF flat top time, and PF currents. Current polarities are based on the engineering convention (positive is CW PF current or TF field, viewed from above).

Shots 1-6 are required for the near-term objective of re-establishing 4.5kG operation. TF values are selected so that the in-plane stress, proportional to $B^2$, is incremented in 4 equal steps. Shots 7-11 would be performed later for the 6kG step. TF values are selected so that the in-plane stress is incremented in equal steps[1] of the same magnitude as the progression to 4.5kG. This requires 3 steps as indicated.

Cases for which instrumentation shall be compared to analytic predictions are indicated with an "X". For these, analytic predictions are required for the strain and displacement at the measurement locations, the peak temperature at the joint, and the joint voltage drop as measured at the probe location.

[1] Nearly equal: the last increment is slightly larger

| | Bt | dT | Tflat | PF | Check Case | Time | ITF | IOH | IPF1A | IPF1B | IPF2 | IPF3 | IPF5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.25 | 11 | 1 | 0% | x | SOFT | 26.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | | EOFT | 26.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 3.18 | 23 | 1 | 0% | x | SOFT | 37.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | | EOFT | 37.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 | 3.90 | 36 | 1 | 0% | x | SOFT | 46.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | x | EOFT | 46.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 4.50 | 50 | 1 | 0% | x | SOFT | 53.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | x | EOFT | 53.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 | 2.25 | 50 | 1 | 50% | x | SOFT | 53.4 | -12.0 | 0.0 | 0.0 | 0.0 | -2.5 | 0.0 |
| | | | | | x | OHSS | 53.4 | 12.0 | -7.5 | 0.0 | -10.0 | 10.0 | 10.0 |
| | | | | | | EOFT | 53.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 | 4.50 | 50 | 1 | 100% | x | SOFT | 53.4 | -24.0 | 0.0 | 0.0 | 0.0 | -2.5 | 0.0 |
| | | | | | x | OHSS | 53.4 | 24.0 | -15.0 | 0.0 | -10.0 | 10.0 | 10.0 |
| | | | | | | EOFT | 53.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 | 5.03 | 48 | 0.6 | 0% | x | SOFT | 59.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | x | EOFT | 59.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 8 | 5.51 | 62 | 0.6 | 0% | x | SOFT | 65.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | x | EOFT | 65.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 | 6.00 | 80 | 0.6 | 0% | x | SOFT | 71.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | x | EOFT | 71.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 | 6.00 | 80 | 0.6 | 50% | x | SOFT | 71.2 | -12.0 | 0.0 | 0.0 | 0.0 | -2.5 | 0.0 |
| | | | | | x | EOFT | 71.2 | 0.0 | -7.5 | 0.0 | -10.0 | 10.0 | 10.0 |
| 11 | 6.00 | 80 | 0.6 | 100% | x | SOFT | 71.2 | -24.0 | 3.5 | 0.0 | 0.0 | -2.5 | 0.0 |
| | | | | | x | EOFT | 71.2 | 0.0 | -15.0 | 0.0 | -10.0 | 10.0 | 10.0 |

Cc:

| | | | | |
|---|---|---|---|---|
| M Bell | A Brooks | T Egebo | D Gates | R Hatcher |
| P Heitzenroeder | R Marsala | D Mueller | M Ono | A Von Halle |
| M Williams | I Zatz | | | |