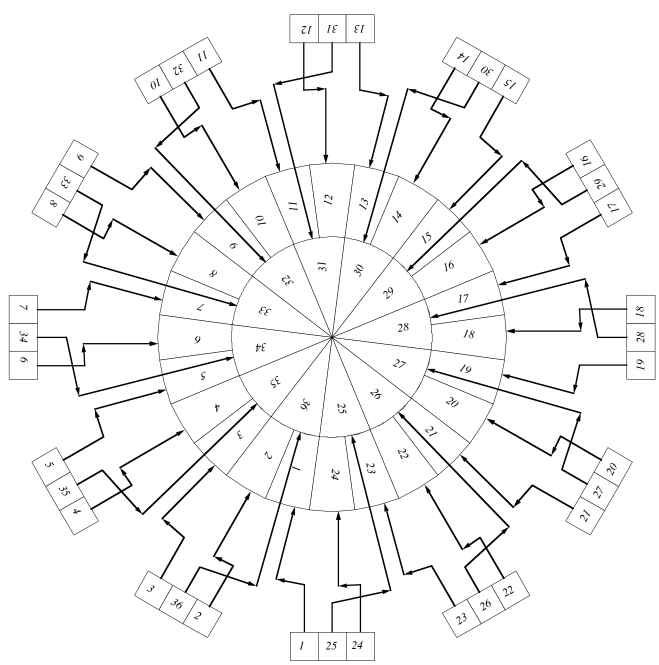
13_040106_CLN_01.doc

TO: DISTRIBUTION
FROM: C NEUMEYER
SUBJECT: TF AS-BUILT CLOCKING AND WINDING PATTERN

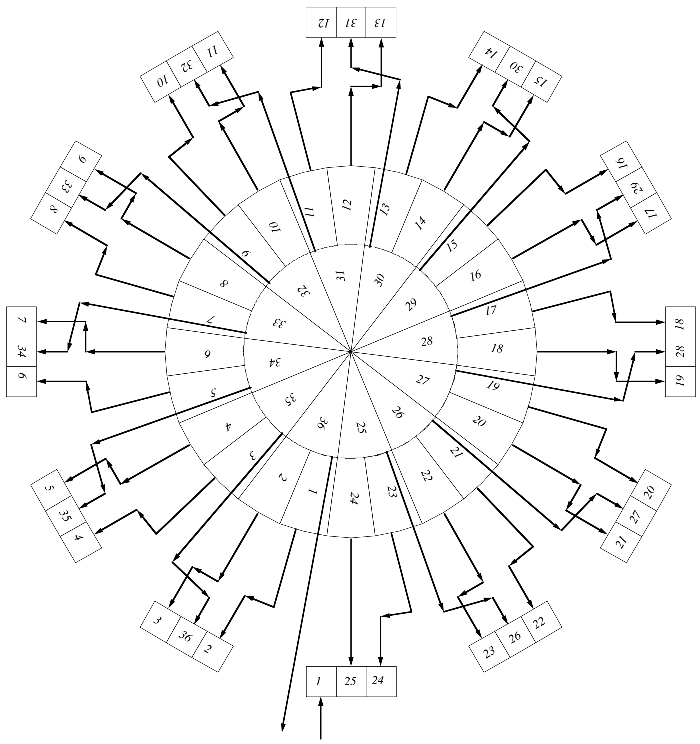
References:

[1] "TF Flag Connections", 13_030630_CLN_01
[2] "Optimization of Clocking of TF Bundle", 13_031106_CLN_01.doc

The following diagrams show the as-built positioning of the TF bundle, based on observations made in the field today by the writer. This configuration is different than described for the original design in the reference [1] memo, in that the inner leg bundle is rotated 15° clockwise. However, with the change to the bus input feed as to the configuration shown, where the input lead connects to the left hand side of the outer leg bundle (viewed from above), rather than the right as was the case in the original installation, the series sequence of the turns is preserved. This means that the customization of the test voltages as described in reference [2] is maintained, and the connections being made to the joint voltage drop instrumentation system, are not effected. Although different than the original installation, the difference in clocking is accommodated by different usage of the flex and connecting links.



Top of Machine, Viewed from Above



Bottom of Machine, Viewed from Above

As far as cancellation of toroidal current is concerned, just as was the case with the original installation, the new clocking does not provide ideal cancellation.

On the top of the machine, outer layer, there are 12 clockwise (CW) toroidal progressions of 0+Δ degrees and 12 CW toroidal progressions of 15-Δ degrees, where Δ is the angle between the center line of the center conductor in the outer leg bundle and the centerline of the conductors on either side. On the inner layer there are 12 CCW progressions of 7.5 degrees. So, there is a net CW progression equal to 12(0+Δ+15−Δ)−12(7.5)=90 degrees.

Similarly, on the bottom of the machine, outer layer, there are 12 clockwise (CW) toroidal progressions of 0+Δ degrees and 12 CW toroidal progressions of 15-Δ degrees. On the inner layer there are 12 CCW progressions of 22.5 degrees. So, there is a net CW progression equal to 12(0+Δ+15−Δ)−12(22.5)=-90 degrees.

Roughly speaking, the magnetic effect seen at the plasma is similar to that from a toroidal loop carrying 71.2kA*90/360=17.8kA CW on top, and CCW on the bottom. The result is a stray radial field at the plasma.

An additional factor, not measured, arises from the fact that, different than shown in the diagrams above, the centers of the outer layer turns do not align exactly with the centers of the outer legs. This appears to have resulted from the placement of the bundle not being exactly aligned with the outer legs. With the flexibility of the flex links and the oversized bolt holes, this error is accommodated by the parts.

While the imperfect cancellation may be correctable by suitable control of the other PF coils, it is in any case noted to exist. Furthermore, it differs from that on the original installation, where there were net progressions of –90 degrees CW on top and bottom. The result, for the original, would therefore produce a stray vertical field at the plasma.

With the original scheme, and per the original design intent, the cancellation could have been made ideal by rotating the bundle 2.5º CW. Although the writer has not examined this issue in detail, it would appear that with the new scheme the cancellation cannot be improved by rotating the bundle.