1. Purpose of Experiments

Develop an improved discharge shape for combined RF and Divertor work. Use enhanced chopper to probe vertical stability limits.

2. Background

The RF antenna was designed to match a plasma shape we have yet to achieve in a single-null diverted plasma. We have been unable to stabilize a plasma of the required elongation, and, in the absence of appropriate diagnostics, we could not convince ourselves that the forces which develop during a disruption could not damage the machine. Therefore experiments combining both RF heating and divertor research have had to compromise on the plasma shape.

Typical diverted plasmas are centered 2 cm below the midplane. This can lead to non-optimal RF loading under some conditions. If we plan (as we do) to devote serious amounts of run time to RF + Divertor experiments, it would seem appropriate to at least attempt to develop a more appropriate target plasma.

Prior to the last campaign, the chopper was modified to current limit instead of trip out. This modification has been extensively tested and I consider it reliable. Prior to the current campaign, another modification was done which has improved the dynamic response of the chopper. This has also proved to be successful. Finally, we experimented with the reduction of the series resistor which (together with the wavegen) establishes the chopper bias current. The last modification has been tested into a dummy load but not during plasma operation.

We have also installed diagnostics to estimate the toroidal distribution of the potentially damaging currents which flow in various structures during a disruption. It should be possible, by examining data from the current campaign, to identify operating conditions which will not violate engineering constraints.
3. Approach

The idea would be to hold the lower x-point at a position appropriate to a good divertor configuration, and to raise the plasma Z-position shot by shot. When the stability boundary is approached we tend to see a vertical oscillation set in; using this as a diagnostic we would then vary the chopper gain and/or decrease the series resistor to optimize the stability.

4. Resources

4.1 Machine and Plasma Parameters

This run probably requires $I_p > 400 \text{ kA}$ to be interesting. The maximum plasma current for the run should be established by engineering analysis based on recent data, and by assuming that any given shot might disrupt at the maximally damaging time. If we can’t calculate ourselves up past about 400 kA under these constraints we shouldn’t attempt the run.

4.3 Diagnostics

As usual, including RF diagnostics and divertor diagnostics.

4.4 Neutron Budget

Nominal to minimal.

5. Experimental Plan

See approach, above.

5.1 Run sequence plan

1. Establish a normal diverted discharge with outer gap appropriate for RF to make loading measurements, with IP about 400 kA. (3 shots)

2. Program plasma from $z=-.02 \text{ M}$ to $z=0.$, in .005 M steps. Note changes in RF loading. We’re unlikely to reach $z_{cur}=0$. When the vertical stability limit is reached (probably at $z_{cur}=-.01?$) move on. (4 shots)

3. Reload the normal diverted plasma, and run 1 shot. (1 shot)
4. Change the EFC series resistor. (It should be reduced to about half its current setting.) Then repeat step 2 above. (4 shots)

5. If we’re able to hold the higher elongation plasma under these conditions, we should induce a VDE deliberately (remember IP is only 400 kA), and evaluate disruption currents as a fraction of IP, and their toroidal distribution. If it appears safe to do so, proceed with item 6. (1 shot)

6. Raise IP in 4 steps to our nominal 800 kA. Then use the rest of the run (if any) to optimize plasma shape, RF loading, and X-point location. (4 shots. Total so far 17 shots, not counting surprises.)

6. Anticipated Results

Improved vertical stability, exploiting the modifications to the chopper. A plasma optimized for combined RF and Divertor experiments.

7. References