Title:
INITIAL OPERATION OF THE UPGRADED PEGASUS ST EXPERIMENT

Authors: R. Fonck, D. Battaglia, M. Bongard, S. Burke, N. Eidietis, B. Ford, G. Garstka, M. Kozar, B. Lewicki, E. Unterberg, and G. Winz

Insitution: University of Wisconsin, USA

Subject Area: A. Experiments in, A.2 Equilibrium and stability

ABSTRACT

The PEGASUS Toroidal Experiment is exploring current and pressure limits in the high β_t, low-q operating space at near-unity aspect ratio. The first limit of interest is the external kink boundary that will define the accessible low-q, high I_N space. Initial operations were characterized by high β_t at very low toroidal field ($B_t \leq 0.07$ T) but were limited in operational space due to both 2/1 tearing modes in the resistive, low-shear interior and current control capability. The experiment has been modified to avoid these limits with increased, time-variable TF, increased V-s, and improved position and shape control. The modifications allow for greater flexibility in q(r,t) tailoring and should provide access to the external kink boundary. Equilibrium and stability (DCON) modeling projects stable equilibria approaching $I_p/I_{tf} \sim 3$ ($I_N \sim 20$). The initial campaign with the upgraded facility is focused on first suppressing the internal MHD activity and then challenging kink limits by achieving the modeled parameters. Plasma operations restarted in Summer 2004, after a two-year shutdown. Operations to date, with limited ohmic solenoid power (about 1/2 design V_{loop} and 1/5 design V-sec), have produced transient plasmas with $I_p \sim 0.14$ MA, and steady discharges on the order of 0.09 MA. As was seen in the first Pegasus campaign, simple OH startup at low TF results in strong n=1 MHD activity that eventually degrades plasma evolution. The present campaign is focused on using the new flexible coil power supplies to control plasma evolution to suppress these instabilities and increasing the field utilization factor, I_p/I_{tf}. A single low impurity, high current (~ 1kA) plasma gun has been installed in Pegasus to test auxiliary plasma injection and current drive parallel to the symmetry axis of the machine during plasma startup. The gun is located in the lower divertor region. Plasma injection reduces ionization losses during startup, and for a Pegasus windup factor of ~5-15, the gun can provide significant target plasma current (~ 10 kA) at the beginning of an ohmic discharge. Initial operation with a single gun (300-600A) have produced toroidal currents > 6 kA, with clear visual indication of magnetic relaxation or reconnection. Above a threshold in injected power and/or helicity, the current amplification factor, I_p/I_{gun}, increases during a discharge to roughly twice the geometric stacking factor. Tests with this gun are centered on developing an understanding of current evolution and coupling with OH operation to ease startup requirements. They also provide critical tests for a future multiple-gun array.

**Work Supported by U.S. DoE grant No. DE-FG02-96ER54375*