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PARTICLE-IN-CELL SIMULATIONS OF THE MAGNETICALLY INSULATED TRANSMISSION LINES AND POST-HOLE CONVOLUTE OF ZR*

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The refurbishment of the Z accelerator at Sandia National Laboratories, the "ZR project"[1], is scheduled for completion in June 2007. The vacuum section will be topologically similar to Z, but with new hardware for the four magnetically insulated transmission lines (MITLs), and the double post-hole convolute. It must operate reliably at ~40% higher voltage and ~30% higher current than on Z.

On Z, there are late-time current losses (5 – 10%) in the post-hole convolute. Earlier 3-D particle-in-cell (PIC) simulations of the Z convolute[2] show that electrons flowing into the convolute from the MITLs are lost to a very small area of the anode at magnetic null regions. We believe that gap closure effects of dense plasmas formed in these regions are responsible for the observed current loss. The ZR vacuum section is designed to limit the electron flow into the convolute from the MITLs, and the resulting anode heating, to be no worse than on Z today.

It is currently not possible to simulate the entire vacuum section of Z with a single 3-D PIC simulation. Instead, we iterate between two related setups. First, we model the four MITLs with very high resolution 2-D simulations from the convolute radius out to large radius (r = 60 cm). In this system, the 2-D MITLs are coupled at their inner radius with a transmission line model of the convolute. Second, we model the convolute in 3-D. In this system, the MITLs are necessarily zoned much more coarsely than the 2-D simulations, and only extend out to a more limited radius.

The 2-D MITL simulations provide reliable values for the electron flow current into the convolute. The new simulations presented here improve on earlier results[3] by modeling all four levels with 2-D PIC simulations simultaneously. The new 3-D simulations are a significant advance beyond previous work[2]. We will present the first comparison of the anode heating in the convolute between Z and ZR.

1. E. A. Weinbrecht, D. D. Bloomquist, D. H. McDaniel, *et al.*, 15th International Pulsed Power Conference, Monterey CA, 2005 (to be published).
2. T. D. Pointon and W. A. Stygar, 13th International Pulsed Power conference, Las Vegas NV, June 17-22, 2001, pp. 1696 - 1699.
3. T. D. Pointon and M. E. Savage, 15th International Pulsed Power Conference, Monterey CA, 2005 (to be published).

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