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Initial Evaluation of the Load Current Multiplier Concept on the Sandia Z Accelerator

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Load current multipliers (LCMs) are specialized impedance transformers used in pulsed power generators to improve generator-to-load coupling at high power densities. These devices were recently demonstrated to increase load current by 70% on a 1 MA / 100 ns generator [1], but the concept has not been evaluated experimentally on higher current (>10 MA) generators. For example, plasma formation in vacuum magnetically insulated transmission lines [2], which was not observed in the previous 1 MA experiments, is expected to be a significant loss mechanism in these LCM devices at higher currents. We have developed a conservative LCM design compatible with the 80 TW Z accelerator at Sandia National Laboratories, utilizing a large double post-hole vacuum convolute architecture. The design consists of a combination of analytic, electromagnetic, and particle-in-cell calculations. Initial performance estimates predict a 30% increase of peak current from a 15 MA / 250 ns pulse into low-inductance, non-imploding solid targets. In this paper, we will discuss both our design methodology as well as initial perspectives for upcoming experiments to evaluate the potential usefulness of the LCM concept in high energy density physics research.

[1] A. Chuvatin et al., "Operation of a Load Current Multiplier on a Nanosecond Mega-Ampere Pulse Forming Line Generator,"Phys. Rev. ST Accel. Beams, Vol. 13, 010401, (2010).

[2] W. Stygar et al., "55-TW Magnetically Insulated Transmission-Line System: Designs, Simulations, and Performance,"Phys. Rev. ST Accel. Beams, Vol. 12, 120401, (2009).

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