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Enhancing dI/dt via current switching using parallel targets on the Z facility

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Pulsed-power-driven inertial confinement fusion experiments benefit from short current pulses, which allow for higher velocities and temperatures to be reached with greater power delivered to the target. The driving voltage and the inductance of the system set the rate of current rise, and the Z Pulsed Power Facility [1] is operated today at the voltage limit of what the vacuum insulator stack can support without incurring electrical breakdown. We propose a mechanism for obtaining a shorter current pulse on a science target by placing it in parallel with an initially low-inductance switch target that becomes inductively unfavorable during the current rise. As the switch target undergoes a steep increase in inductance or breaks its current path entirely, the majority of the current diverts rapidly from the switch target into the science target, achieving a faster rise than what the driver can natively produce without increasing the electrical stress on the vacuum insulator stack. We present initial experiments on Cornell University's COBRA pulsed-power driver [2] in which we study inductive current split between static targets and switching of current from a wire array into a static target. We also discuss preliminary results from a wire array switching study on the Z Pulsed Power Facility.

References (if any)

[1] Savage, M. E., Bennett, L. F., Bliss, D. E., Clark, W. T., Coats, R. S., Elizondo, J. M., ... & Wakeland, P. E. (2008, June). An overview of pulse compression and power flow in the upgraded Z pulsed power driver. In 2007 16th *ieee international pulsed power conference* (Vol. 2, pp. 979-984). IEEE.

[2] Greenly, J. B., Douglas, J. D., Hammer, D. A., Kusse, B. R., Glidden, S. C., & Sanders, H. D. (2008). A 1MA, variable risetime pulse generator for high energy density plasma research. Review of Scientific Instruments, 79(7).

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