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A Battery-Powered, 60-kJ, 6-RPS Rep-Rate Pulsed Power System

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The US Naval Research Laboratory (NRL) has constructed a pulsed power system designed to operate with batteries as the exclusive source of input electrical energy. Each capacitor bank uses 192 lithium-ion batteries in series with a custom DC-DC converter to charge the capacitor to 5 kV in approximately 10 seconds. For now, the capacitor is being discharged into a resistive load through an inductor. The system is intended to be used as a testbed to expose challenges presented by a high rep-rate pulsed power system on a mobile platform. The system will eventually be made up of sixteen battery-capacitor modules. A single frame within the system encapsulates four complete pulsed forming networks, each of which is comprised of a battery pack, DC-DC converter, capacitor, inductor, and associated pulsed power switches. Each frame is a self-contained system, with the only interfaces being fiber optic networking, 120 VAC for controls, and capacitor discharge cables. In contrast to a typical single shot pulsed power system that is energized by grid-tied electricity, NRL has developed a holistic control scheme devoted to the safe operation and monitoring of the battery packs and pulse forming network (PFN). One frame of PFNs requires more data point monitoring than the entirety of the 12-MJ NRL electromagnetic launcher pulsed power driver, significantly increasing the complexity and computing power necessary for apposite operation. The system will be discussed, the lessons learned will be presented, and preliminary experimental results from a full frame will be presented.

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