

Public Abstract

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Title: Development of a Gigawatt Repetitive Pulse Modulator and High-Pressure Switch Test Stand and Results from High-Pressure Switch Tests

An increasing demand exists today for higher performance, repetitively pulsed, high-voltage switching technology, particularly in the realm of very high energy discharge technologies. The current state of the art relies heavily upon outdated or delicate technologies such as gas switches and semiconductors, respectively. It is foreseen that the demands of future pulsed power applications will not be met with these technologies and therefore a major study was undertaken to characterize a new class of repetitively pulsed, liquid dielectric switches based on high-pressure, flowing oil. A pulsed power modulator operating in a resonant charge mode generates ~ 250 kV across the high-pressure concept switch. The high-pressure switch self-breaks into a matched-impedance load, generating a pulse that is ~ 125 kV and 25 kA in amplitude, and 70 ns in duration, delivering a peak power of 3.25 GW. The pulse modulator is capable of sustained operation at 22 pulses per second.

Experimental results were collected for both single-shot and repetitive test conditions. The switch operates at breakdown electric field strengths of $1.8 \text{ MV}\cdot\text{cm}^{-1}$ on average, with typical deviations on the order of $\pm 10\%$ of the average value. The tests were conducted over a wide range of oil pressures and oil flow rates, from 500 psig to 2,500 psig and from 4 gpm to 11.3 gpm. The tests were conducted to over 1,000,000 shots and the switch continued to demonstrate consistent performance.