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Experimental Observations of the Transient Characteristics of Series dc Arcs with Capacitive Loads

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Series arcs can occur in dc power systems whenever an energized wire supplying power to a load is interrupted. This can happen when a wire snaps abruptly or when a load connection becomes loose. Rather than ending in a simple open circuit, the inductance in series with the load establishes an arc, which inserts an additional impedance in between the source and load. The arc impedance decreases load current and complicates detection while still posing a severe hazard. For this reason, the interaction between series arcs and load power converters is of interest. Load converters act as a dynamic input impedance to the arc thus complicating efforts to accurately decouple the interface of arc and load. This paper performs an empirical study of the fundamental interaction between a series arc and fixed impedance, RC load. Both transient and steady state arc behavior are experimentally studied for a fixed series inductance while varying dc supply voltages, load currents, load capacitances as well as terminal gap distances for a spring based separation mechanism. Tests are repeated multiple times at each parameter set to account for the random nature of the arc. It is found that load current and load capacitance dominantly affect the occurrence of sustained series arcs. Results have contributed to formation of a generic arc transient waveform that can be used for further study of the complex interactions between series arcs and power-converter loads.

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