PRE-BREAKDOWN CURRENT BEHAVIOR IN DC VOLUME
BREAKDOWN IN TRANSFORMER OIL

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The phenomenology of pre-breakdown events in transformer oil is investigated using high-speed electrical and optical diagnostics. Data collection using a coaxial test setup terminating into a 50Ω load line to simulate a matched impedance system allows very fast risetimes. Transmission line type current sensors and capacitive voltage dividers with temporal resolution of 300 ps provide information about the discharge voltage and current. Steady, DC currents ranging from a few nA with less than 10 kV of applied voltage, to a few µA prior to full breakdown are measured using an electrometer. Pre-breakdown events are measured with positive and negative charging voltages with respect to ground. Light emission from the discharge is measured using a series of fast photomultiplier tubes, (risetimes 800 ps), that observe positive and negative electrode tips and center of the channel. Preliminary results on self-breakdown (breakdown voltage +44kV) with a 2.35 mm gap show a DC (seed) current of several hundred nA with pre-breakdown spikes of a few mA immediately before final breakdown. Periodicity of the current spikes combined with a general increase in magnitude prior to full breakdown has been observed. Data collection using a negative charging line, with respect to ground with enhanced field at the cathode, indicates current spikes that are typically 25 to 50% faster than spikes using a positive charging line with enhanced field at the anode. Detailed optical diagnostics along with high-speed electrical diagnostics of the pre-breakdown phase will address the physical mechanisms initiating volume breakdown.

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