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NUMERICAL ANALYSIS OF PARTIAL DISCHARGE BEHAVIOUR UNDER DC STRESS WITH VOLTAGE DISTURBANCE AT DIFFERENT VOID SIZES

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Abstract Partial discharge (PD) is commonly related to electrical insulator degradation. It occurs in a high electric field environment, especially in high-voltage systems. It can lead to the electrical breakdown of insulators. Knowledge of the characteristics of PD allows for testing and monitoring of insulation properties in power system equipment. PD can be observed in both AC and DC power. However, research on AC-PD is much more mature than DC-PD due to the established pattern of AC's changing magnitude and polarity

characteristics. This work uses finite element analysis to study PD activity under DC stress with voltage disturbance at different void sizes, with AC harmonic as the focused disturbance. The characteristics are evaluated based on the electric potential distribution, electric field distribution, electrical charges, and repetition rate. As the void radius increases from 1 mm to 4 mm, the inception voltage decreases by approximately 65%, while the PD repetition rate increases by 58%. In addition, a comparison between DC-PD and AC harmonic disturbance and AC-PD is performed to analyze their differences. The simulation result shows that the repetition rate for DC-PD with AC harmonics is approximately 75% lower than that of AC-PD, indicating fewer PD events in the case of DC-PD with AC harmonics. The conducted simulation provides valuable insights and guidance for the formation of DC-PD testing, and consequently, a validated method can be approved to monitor insulating material condition under DC power.

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