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Review and Recent Developments in DC Arc Fault Detection

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With the development and implementation of dc based power systems, dc arc fault protection becomes an inevitable challenge for the safe operation in various applications. This paper presents a brief review of dc arc fault modeling and detection methods. The goal is to examine state-of-the-art technologies and to identify future research and development needs of dc arc fault protection in modern dc networks. For dc arc modeling, the focus is given to external characteristic equation which models the arc with electrical parameters. This type of model, normally in the form of V-I equations, can be used to simulate and analyze the impact of an arc fault to the dc network. Moreover, models of the random high frequency components in arc current and their applications will be reviewed and discussed. Then, selected dc arc fault detection techniques based on time, frequency, and time-frequency domain analysis are reviewed and compared.

It is crucial to differentiate high-impedance, series dc arc faults from normal operating conditions such as load changes or switching-related noise. Thus, preliminary results from a robustness study of a wavelet based detection algorithm under noisy environments is presented. The noises studied include wideband noise, impulse noise from system transients, and frequency specific noises such as harmonics and switching-related noise, all of which are commonly seen in dc power systems. Current industry standards on dc arc detection are more focused on photovoltaic systems for terrestrial applications. The status of a draft SAE standard being developed on 270 Vdc arc fault detection and validation tests for aircraft is briefly discussed.

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