Politechnika Śląska

Wydział Górnictwa, Inżynierii Bezpieczeństwa i Automatyki Przemysłowej

Dyscyplina: Inżynieria Środowiska, Górnictwo i Energetyka

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WPŁYW CHARAKTERU DOZIEMIENIA ORAZ KONFIGURACJI KOPALNIANEJ SIECI ROZDZIELCZEJ NA SELEKTYWNOŚĆ DZIAŁANIA ZABEZPIECZEŃ ZIEMNOZWARCIOWYCH

Rozprawa doktorska

przygotowana pod kierunkiem:

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Gliwice, 2024

Abstract

The subject of the dissertation focuses on the analysis of the influence of network layout on the operating conditions of earth fault protection relays in medium voltage (6 kV) networks with an isolated neutral point used in Polish coal mines. The aim of the dissertation was to develop a simulation model of a mine MV distribution network enabling the analysis of complex ground-fault phenomena and the coordination of characteristics of the applied ground-fault protection relay. Ground faults are the most common disturbances in mine distribution networks operating under harsh environmental conditions, in situations of high fire and explosion hazard.

In the study, the ATP-EMTP software environment for power network simulation was selected, taking into account its many years of development and verification, extensive literature, comprehensive functionality and active user community. An analysis of the suitability of this environment for modelling extended distribution power networks was carried out, considering numerous technical requirements.

Six cases of ground faults recorded in coal-mine medium voltage networks were subsequently described and analysed in detail. An attempt was made to reproduce these cases in ATP-EMTP using the Π cable line model. The scope of the analysis included both low-resistance and high-resistance short circuits. For each case, the relevant model was presented and its parameters were identified. The analysis demonstrated the feasibility of zero-sequence admittance protection in mine MV distribution networks, both in terms of reliability and transversal selectivity.

The application of different protection criteria, including traditional zero-sequence voltage and zero-sequence current protection and modern zero-sequence admittance protection, is presented in the next stage. The optimum values of the integration time used in protection relays for the calculation of the rms values of the criterion values, ensuring both rapid detection of ground faults and robustness against waveform distortion, were determined. Particular emphasis was placed on the distortion of the recorded waveforms associated with transients and the operation of high-power loads generating higher harmonics. The conclusions highlight the

importance of using different protection criteria in medium-voltage isolated neutral point networks to ensure operating selectivity and avoid unwanted tripping. It suggests supplementing the current standards with the possibility of using zero-sequence admittance protections and proposes specific principles for the selection of settings for these protection devices. The need for further research into the influence of integration time value on the detection of intermittent ground faults was also pointed out.