Doctoral Thesis

Investigation of Lightning Trip-out on 150 kV Transmission Line in West Sumatra in Indonesia

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インドネシア西スマトラの150kV送電線雷トリップアウトに関する研究

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Abstract

The lightning performance on the 150 kV transmission line in West Sumatra in Indonesia is presented. It is shown that main cause of the trip-outs is lightning, 66% of all trip-outs. Main conclusions are as follow:

The trip-out rates calculated by taking account of the reduction of the tower-footing resistance due to the ionizing effect agree well with the observed ones. This indicates the importance of the impulse resistance in the analysis of the lightning performance of the line.

The trip-out rate at the lower arm is high for the cases of the average grounding resistance of 33.3 ohms, and the rates at the upper arm are high for the cases of the average grounding resistance of 5.6 ohms. Such trend can be simulated by the IEEE method using the impulse resistance.

The trend that trip-out ratio becomes high with the increase of the span length is significant after improvement of the tower-footing resistance. However, the trend is weak before improvement of the tower-footing resistance. This is because in the case of the high tower-footing resistance the flashover occurs before the arrival of the wave reflected from the adjacent towers due to the high potential rise of the tower. Therefore, the degree of the influence of the span length on the trip-out ratio is dependent on the tower-footing resistance.

The local lightning activity significantly affects the trip-out rate. The high rate of lightning trip-out before and after the improvement of the tower-footing

resistance is seen in circuit I. This is due to the placement of circuit I on the north side from No. 1 to 37 towers and on the east side from No. 38 to No. 140 towers. In this area, the thunderstorm often approaches the line from the northeast.

The trip-out rate of the line under study can be reduced to less than half of the present rate, 22 flashover/100 km–year, if the tower-footing resistance at all towers is set to less than 10 Ω and the length of an arcing horn gap is set to longer than 1.2 m.