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"Lightning Protection Design of Power Stations in Japan"

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Abstract

Lightning protection design of power station is essential to establish highly reliable electric power transmission with less supply troubles. In Japan, as a basic reference of the lightning protection design of power stations, "Guide to Lightning Protection Design of Power Stations, Substations and Underground Transmission Lines" has been widely used. The newest revised guide (CRIEPI report H06) was published in 2012. The contents of the guide includes lightning protection of main circuits, air-insulated bus, low voltage control circuits, generators, AC-DC converter stations, underground transmission lines and etc. Out of the guide, this document describes lightning protection design of main circuits.

In lightning protection design of main circuits, lightning impulse withstand voltage (LIWV) of power equipment and lightning protection measures such as arrangement of metal oxide surge arresters are determined considering lightning overvoltage in power stations. If extremely high lightning overvoltage levels are assumed, it is possible to perfectly prevent lightning accidents. However, the costs of lightning protection measures becomes too high. So, it is important to determine appropriate lightning overvoltage levels to achieve economical and reliable lightning protection design.

The lightning overvoltage levels are determined by lightning overvoltage analysis using numerical simulations of lightning surge and depend on lightning stroke conditions assumed in the simulations. In Japan, single phase back flashovers due to lightning strokes to a top of transmission tower close to power stations are generally assumed. This condition is very severe because lightning surges which have arcing horn flashover voltage invade to power stations with less attenuation during traveling on transmission lines. So, the lightning overvoltage levels determined by above analysis exceed lightning overvoltage caused by almost all lightning. Furthermore, lightning overvoltage levels can be reduced by evaluating the simulated lightning overvoltage waveform in terms of the equivalent standard lightning impulse test waveform based on the V-t characteristics of the equipment.

As a result of lightning protection design based on the concept mentioned above, actual lightning accidents in main circuits of power stations are limited to several times per year in Japan.

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