

TEPCO's Insulation Coordination Technology and its Application to 1000kV Overhead Transmission System and 500kV Underground Transmission System

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Abstract

Recently, the electric power demand has been increasing rapidly in Asian countries. There are several features of the power supply in this area : First, the bulk power transmission system on long-distance transmission lines is required for the realization of the interconnection network, contributing to balancing demand and supply among neighboring countries and the promotion of power sources on remote sites. Second, the power supply system must be highly reliable to meet the demand concentrated in overcrowded metropolitan district. Furthermore, the planning of power systems has to be economically efficient and viable. To meet these various requests, power systems should be planned with a universal design philosophy based on "insulation coordination".

For the pursuit of constructing highly reliable and cost-effective electric power system, system planners have to consider some design principles at the same time. First, overvoltages generated in the system - lightning surge, switching surge, temporary overvoltage .etc - must be suppressed to reasonable levels in terms of insulation design. Second, the increased cost due to the countermeasures suppressing overvoltages as well as the decreased cost due to the adoption of compact, lower insulation leveled equipments must be considered totally in terms of economical design. Finally, the rational insulation coordination must be achieved on the base of these two design principles, consistently over the entire power system - transmission lines and substations.

Sophisticated techniques of insulation coordination can be reached only after the completion of the following three essential studies.

1st study : Suitable models and condition settings in overvoltage analysis based on the profound understandings of the physical phenomena observed in the system.

2nd study : Precise estimations of overvoltage levels and faults frequency based on the vast field tests and measurement.

3rd study : Accurate grasp of equipments' insulation properties.

The Tokyo Electric Power Company (TEPCO) has achieved highly sophisticated insulation coordination with its long-term studies, and its power system is now well-optimized throughout transmission lines and substations from the viewpoint of both insulation and economical design. TEPCO has introduced, as the summarization of its insulation coordination technology, 1000kV overhead transmission system for the bulk power transmission from the remote sites, and 500kV underground transmission system for the metropolitan supply transmission, with its all insulation coordination techniques derived from the experience on lower voltage systems. The methods on these two systems have been applied to the rationalization of insulation coordination on domestic lower voltage systems and

worldwide consultant services.

This paper describes the TEPCO's insulation coordination technology with the practices of 1000kV overhead transmission system and 500kV underground transmission system.