Electric Power Engineering Research Laboratory

Brief Overview

The Electric Power Engineering Research Laboratory is engaged in the advancement of fundamental technologies, including electrical insulation, lightning protection, fault current control and high power testing technologies for power transmission and distribution equipment. It is also developing next generation power equipment and new electric power technologies.

Achievements by Research Theme

High-voltage and Insulation

【Objectives】

We aim to clarify the deterioration mechanism for various aged insulation materials, advance external insulating technology for transmission lines, improve accuracy of high-voltage measurements, and evaluate and develop insulation materials for the next generation equipment.

【Principal Results】

・For the purpose of clarification of deterioration mechanism and development of diagnosis for 20 to 60kV class XLPE cables, we proposed a method to grow water-trees artificially to simulate the last stage of XLPE cable [H10013].

・Uncertainty of peak voltage measurement and virtual-front-time and time-to-half-value measurement for several hundred kV lightning impulse voltage were evaluated quantitatively for the measuring system with a voltage divider constructed as the Japanese national standard. The accuracy of the measuring system was confirmed as the top-level of the world [H10005].

Lightning and Electromagnetic Environment

【Objectives】

We aim at establishing reasonable measures to deal with lightning damage and developing insulation coordination technology for power systems in the information-communication technology (ICT) society, as well as establishing the technology for electromagnetic compatibility (EMC) in power system equipment and consumer equipment.

【Principal Results】

・We experimentally clarified the two major mechanisms of failures by lightning in low-voltage electronic watt-hour meters: (a) magnetic field generated by lightning current passing through the inside of a watt-hour meter damages the arithmetic processing part, and (b) lightning current melts and ruptures the electric power supplying line installed in the arithmetic processing part [H10001].

・We proposed a lightning surge calculation model for high-voltage distribution lines juxtaposed with communication lines. This model made it possible to estimate accurately overvoltage behavior generated by lightning strikes to power distribution lines [H10008].

・We clarified significant difference between new and old guidelines relating to the electromagnetic field exposure on human body and its safety issued by the International Commission of Non-ionizing Radiation Protection (ICNIRP). Furthermore, we developed a new method for calculating the evaluation index of induced quantity inside the body stipulated in the new guideline [H10010].

Applied High Energy Physics

【Objectives】

We will present rational installation strategies of the Fault Current Interrupting Arcing Horns to contribute to lightning protection measures of power transmission systems. Also, we will develop innovative measurement technologies using laser and optical technologies and work on their application to diagnosis of power delivery apparatus.

【Principal Results】

- We proposed the effective installation strategies of the Fault Current Interrupting Arcing Horns in power transmission systems in terms of coordination with line protection relays aimed at their redundant operations [H10009].
- Terahertz waves were shown to be applicable to noncontact, nondestructive measurement of topcoat thickness (several hundreds μm) of thermal barrier coatings for gas turbine blades used in thermal power plants with an accuracy of $\pm 10\,\mu$m [H10003].
- We succeeded in generation of quasi-mono energetic electrons from a pressure-controlled gas jet target irradiated by ultra-intense laser pulses. Moreover, by applying the gamma rays generated from these quasi-mono energy electrons to radiographic imaging for steel, such as pipes, the contrast ratio was improved [H10004].

Electric Power Application

【Objectives】

To promote electrification of transportation sector, etc., we aim to develop application technologies of power electronics related to next generation charging system for electric vehicles (EVs) and so on. We also aim to develop an electromagnetic transient analysis program for power systems, and super conductive electrical power equipment.

【Principal Results】

- We proposed a new method for compensating distribution-line voltage drops due to nighttime simultaneous charging of EVs utilizing reactive power injection from battery chargers [H10006].
- We developed a bi-directional magnetic-resonant power transfer device, which can deliver electric power with longer distance than conventional induction type wireless power transferring system for next generation EV charging system [H10012].

High Current Technology

【Objectives】

To estimate performance of electric equipment at a short-circuit fault, we aim to improve short-circuit test techniques and establish measuring techniques for power frequency currents.

【Principal Results】

- We developed a simulation code for the melting loss of the ground wires in the DC arc test to estimate the damage on ground wires by lightning strikes.