

6. Electric Power Engineering Research Laboratory

◆ Fault current technology

[Objectives]

To develop a fault current limiting technology and to establish adequate disaster prevention measures for power equipment for the purpose of preventing a public disaster at the time of power failure and ensuring a stable power supply.

[Principal Results]

- A model was developed to simulate a fault current interrupting arching horn which would operate under the current condition of up to 10 kA and serve 66/77 kV transmission lines. With this development, it has become possible to assess the effects of the introduction of such arching horns to a power system.
- The basic specifications required of a current-limiting device were clarified when a S-N transition-type super-conductive current-limiting device was installed at the feeder, bus or lower voltage side of the linked transformer of a model distribution system. As a result, it was found that the best performance was offered by installation at the feeder despite the necessity to install many devices as the required specifications would be met by existing technologies.

◆ Analysis of the transient phenomenon and electromagnetic waves

[Objectives]

To develop design technologies for electromagnetic compatibility between power distribution facilities and the ubiquitous society and a new power transport network for the purpose of achieving harmony between power facilities and society.

[Principal Results]

- An extra-fine line approximation method for numerical electromagnetic field analysis was developed for analysis of the propagation mode of electromagnetic noise on a transmission line. As a result, analysis of the propagation mode with power cables, which has been difficult in the past, is possible.
- Basic codes for the XTAP (eXpandable Transient Analysis Program), a program to analyse the instantaneous values of a power system, were completed for the analysis of a future power system where many power electric devices and high speed switching devices will be introduced. In addition, analysis of the instantaneous values of a simple power system was made possible through (i) the development of a fundamental part of a self-expansion type user interface to which equipment models can be easily added and (ii) the integration of a controlling part of the already developed dynamic characteristics analysis program for power systems (Y method).

◆ Next generation equipment insulation

[Objectives]

To provide a next generation equipment insulation technology capable of achieving both environmental harmony and the non-necessity for maintenance in response to the expected replacement demand for power distribution equipment in the near future.

[Principal Results]

- Using N₂ and CO₂ as the insulation gases instead of SF₆ gas to reduce the greenhouse effect of power equipment, the characteristics of the withstand voltage for lightning impulse (lightning over-voltage) were clarified and a new method was developed to determine the test voltage for the design of gas-insulated switchgear.

◆ Electromagnetic environment assessment

[Objectives]

To establish a method to assess the electromagnetic phenomena of emission and conduction of a direct current through the GHz band to ensure the convenience and reliability of power for both suppliers and users.

[Principal Results]

- For assessment of the biological effects of the magnetic fields caused by commercial frequencies, a program to assess the induction current in the human body under various magnetic field conditions was developed. The tool unified this program with the already developed calculation program for magnetic around the power facilities was developed.
- The distribution characteristics of the magnetic field strength near rising cables and roadside transformer and seasonal fluctuations of the strength of the magnetic field caused by transmission or distribution cables at four sites in Japan were clarified to contribute

to decision-making for the government policy regarding the impacts of commercial frequency magnetic fields on the human body.

◆ Applied measuring science using laser and photons

[Objectives]

To develop such element technologies as a deep part measurement and diagnosis technology and a laser-induced breakdown spectroscopy (LIBS) technology to ensure accurate equipment diagnosis and understanding of operating conditions.

[Principal Results]

- The conditions to accelerate electrons in a small X-ray generation device using a T-cube laser and the conditions for an optimal detection device (scintillator) were clarified to developed a radiographic test (RT) technology capable of externally measuring a decreasing inner thickness of a pipe in the field.
- A hydrogen gas visualisation technology using anti-Stokes Raman scattering light by a laser light was developed as a visualisation technology for leaked gas, such as hydrogen gas, into the air and it was confirmed that a leakage rate of more than 2 ml/min could be visualised. This technology can be used for molecular gases in addition to hydrogen gas.