System Engineering Research Laboratory

Brief Overview

The System Engineering Research Laboratory has been contributing to the development of the electric power industry and society through research, development, experiment and evaluation of (i) planning, operation, control and analytical technologies regarding electric power generation systems including distributed generators, transmission systems, distribution systems, communication systems and information systems and (ii) end-user technologies to ensure the efficient use of electricity.

Achievements by Research Theme

System analysis and stability assessment

[Objectives]

To contribute to the maintenance and development of the fundamental power system technologies which meets both the efficiency and stability requirements through (i) the advancement of system analysis technologies to secure power system stability and the transparency and economy of operation and (ii) the development of on-line system operation support technologies

[Principal Results]

- An accurate power system demand prediction method in several tens of minutes ahead using on-line data was developed to estimate loads flow conditions for the short-term system stability evaluation. In regard to the equivalent reduction of external systems, which is important for the on-line stability evaluation, an accurate reduction technique reproducing multiple oscillation modes of a power system was developed (Fig. 1).
- To develop a practical simulation technique for the dynamic system characteristics at the time of changing supply and demand condition, the long-term dynamic system analysis technique was improved. In addition, functions of the CRIEPI's power system analysis tools (CPAT)were enhanced.

Impact assessment of wind power generation on a power system

[Objectives]

To develop a system analysis model for wind power generation, to extract the characteristics of the output fluctuations of wind power generation and to develop a battery control technology for leveling the output in order to accurately analyse and reduce the impacts of wind power generation on the power system

[Principal Results]

- For evaluation of the impacts of wind power generation on the power system, a model was developed to simulate the dynamic performance of constant speed and variable speed wind power generators, including their prime movers.
- For evaluation and prediction of the output of power generation, the meteorological factors with a significant impact on the fluctuation of the wind power generation output were identified through case studies.

System monitoring and control network

[Objectives]

To develop basic technologies for a system control communication network capable of gathering on-line detailed data on the system conditions in a wide area and of conducting high speed control during normal operation or system failure

[Principal Results]

- A scenario was developed with the participation of power companies, concerning how to apply an adaptation function middleware and a security function to the distributed real-time computer network architecture (DRNA) proposed by the CRIEPI to deal with problems for practical application.
- The effectiveness of the method to configure a reliable and efficient large-scale IP network was confirmed with a validation test using commercial equipment. A prototype was designed for a horizontally distributed emergency control network using IP technologies.

Communication media and network technology

[Objectives]

To secure communication media and network technologies required for the maintenance of electrical power apparatus in power companies and to develop control technologies and propagation characteristic analysis technologies for a future communica-

tion system for the power industry

[Principal Results]

- To efficiently establish a sensor network at system maintenance sites with the minimum resources, a technique was developed to assist the optimum allocation of sensor nodes while automatically collecting their fundamental transmitting performance data for radio signals.
- To enable wide band wireless access to system maintenance locations, an efficient technique using the optical wavelength control technology was developed to configure a radio-on-fiber network to transmit millimeter wave signals via optical fibre. In addition, a simple technique was developed to estimate the required communication bandwidth satisfying the delay time conditions using IP traffic monitoring data.

Information technology

[Objectives]

To develop fundamental information technologies for maintenance of the reliability and cost reduction of the electricity business using IT-equipments and expertise in related domain.

[Principal Results]

- To ensure the effective use of site-monitoring cameras installed at electrical facilities, images taken by monitoring cameras under different conditions (weather, day or night and moving object, etc.) were used to check the detection accuracy of the moving object detection method developed by the CRIEPI. It was confirmed that this technique using images taken by monitoring cameras have satisfactory detection accuracy for practical use.
- A new technique was developed to pick up signs of unusual conditions of bearing vibration in hydor-power plant using the pattern recognition technology so that rare occasions of power equipment abnormality can be detected at an early stage.

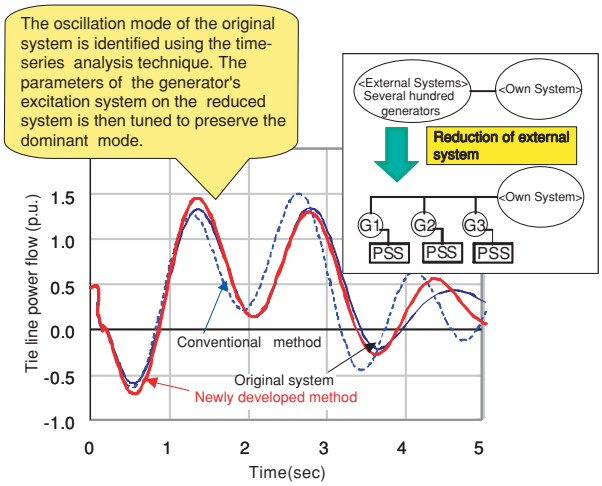

Fig.1 System Reduction Technique appliable to Multiple Oscillation Modes

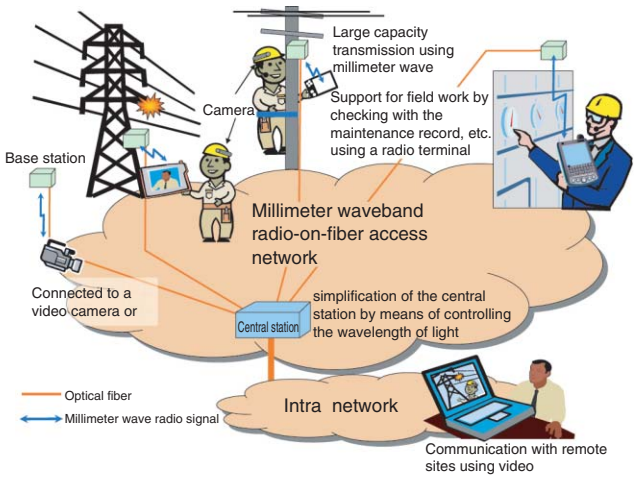

Fig.2 Millimeter Waveband Radio-on-FiberNetwork