II. Research Activities in Fiscal 2006

1. Method of Conducting Research

In FY 2006, we engaged in research activities with the aim of creating a "research institute with presence," relied on by both the power industry and the community, to respond to field requirements and to acquire achievements effective for field application.

The main research activities addressed in FY 2006 were classified into three groups from the viewpoint of field requirements and the propagation effect centering on the newly specified "five research pillars." These included "promoted project subjects" in order to focus on accomplishing urgent research, namely that with the highest demand, "project subjects" to supply easy-to-use solutions, and "basic research subjects" for field backup and future core technology development. We selected research subjects and concentrated resources to promote this research.

To carry out our research, we concentrated on the following items.

- Quick intelligence sharing based on the three basic principles (field, actual object, and fact)
- Effective promotion of cross-cutting research by applying a "research promoter" to oversee technical development and planning and coordination
- Attaining the targets of the overall plan and accelerating accomplishment by having external experts evaluate the research and the research progress.
- Proactively promoting funded research presentation on subjects the power industry confronts and those contributing to the community.

In addition, we introduced large-scale research facilities to support research activities, such as the "real component life assessment test facility" for piping in thermal power plants to demonstrate analytical prediction and nondestructive inspection methods at the corresponding scale and similar pressure and temperature to in-service plants.

The following is an overview of major research for the period.

1. Promoted project subjects and project subjects

In FY 2006, along with the "five research pillars," we conducted promoted project subjects, 12 subjects, and project subjects, 29 subjects as shown in Table 1.

(1) Nuclear Technology
- Supporting Foundations for a Stable Supply -

We consistently promoted research, including maintenance management for light water reactors, radiation safety, backend projects support, and metallic fuel cycles.

For the maintenance management of light water reactors, we integrally promoted the development of survey, assessment, and countermeasure technology for irradiation embrittlement, deterioration due to thermal hydraulics, and SCC (stress corrosion cracking). On the subject of irradiation embrittlement, we improved the embrittlement prediction methods developed by CRIEPI and based on microstructure observation of monitoring specimens, for the pressure vessel steel in domestic nuclear power plants, to reflect results to revising technical standards specified by Japan Electric Association.

For backend projects, we developed high- and low-level radioactive waste disposal technology and recyclable fuel storage technology to smoothly support projects by the national government and the power industry. For low-level radioactive waste, we clarified the effect of the bentonite material eluviation mechanism of cementitious materials on the hydraulic conductivity due to various ions in disposal site environmental conditions. For storage technology, we achieved our goal of showing that the SCC possibility of canister materials in the concrete cask storage system will be low for about 50-year storage.

(2) Advanced Maintenance Technology
- Rational Operation of Electric Facilities -

To achieve effective cost reduction in installation and maintenance of power apparatus covering power generation to distribution, we developed diagnostic methods and maintenance decision support tools that are ready to use.

For the development of a nondestructive assessment method for power plant components, we developed an easy-to-use and low cost ultrasonic inspection method (SPOD method) by demonstrating the detection of fatigue cracks with a size of about 2 mm, which is difficult by present methods.

For the development of asset management decision support tools of power apparatus, we developed several diagnostic methods of the hardware and reliability evaluation methods of related power system. As an example of asset management decision support tools, we proposed an evaluation tool of life cycle repairing cost, that considers the required service age and failure rates of a power apparatus to evaluate the life cycle cost. This tool has been utilized as a real tool.

(3) Environmental and Innovative Technology
- Sustainable Use of Fossil Fuels and New Energy -

To contribute to resolving global environmental problems, we promoted a scientific assessment of global warming impacts, highly efficient utilization technology of biomass energy, and the IGCC demonstration equipment that supports research. In addition, we also proactively engaged in urgent issues in the power industry, including PCB problems and coal ash recycling.

Among these, for the scientific assessment of global warming impacts, we completed global warming predictions for three types of IPCC emission scenarios to investigate scientific basis for the CO_2 concentration stabilizing target. This accomplishment was reflected in the IPCC fourth assessment report.

We also conducted a gasification gas engine power generation test using wooden biomass to verify that the rated power output of 320 kW can be stably obtained to deliver the possibility of the practical application of a high efficiency power generation system.

For PCB, we developed simplified cleaning technology of pillar-mounted transformers containing trace levels of PCBs. We also promoted commercialization of PCB biosensor developed by CRIEPI though external organizations to start analysis services.

(4) Optimum Energy Application Technology - Contributing to More Comfortable Living -

To develop energy utilizing technology supporting a rich lifestyle and satisfying comfort and environmental requirements, we handled urgent subjects such as operational performance assessment of the new Eco-cute system.

For the new Eco-cute system available for high efficiency, compact design, and cold area application, we established a performance assessment method and evaluated performance using a newly developed and installed "heat pump performance assessment test facility." For SiC semiconductor technology for customers' components, we achieved the successful development of epitaxial growth methods at the world's highest speed level in practical surfaces corresponding to four inches diameter in order to develop large capacity SiC power semiconductor.

(5) Social and Business Risk Management - Contributing to More Comfortable and Safer Communities -

To ensure the safety and security of the power facility, we comprehensively promoted research on countermeasures for natural disaster risks such as earthquakes, severe weather and lightning and for IT disturbance risk, as well as promoting research on disaster recovery support. Among these, for weather related disaster assessment, we developed a typhoon disaster prediction system for the distribution facility introducing the highest wind speed and wind direction prediction method considering wind speed increasing/decreasing effect due to complicated geography.

In addition, to support risk management of the power industry, we promoted research on the analysis and assessment of effectiveness of environmental tax and emissions trading system, a comprehensive evaluation of the Japanese model of electricity liberalization, and a method to improve human performance. Prior to the discussion from April in 2007, we organized a "study group on electricity liberalization" with external experts to study the issues of electricity liberalization and to make a set of recommendations on the direction of Japanese model of the liberalization.

2. Base research subjects

In FY 2006, we were steadily engaged in 37 base research subjects.

Applying the characteristics of individual institutes classified in special fields, we created new core technology by further strengthening our basic research power to challenge advanced fundamental research, aiming at a response to future subjects and seeds research.

3. Major funded researches from the national government and others

The main funded research executed in FY 2006 is as follows.

- Environmental effect assessment technical survey on decommissioning of power generating reactors
- Recycle fuel resources storage technical survey, etc.
- Demand structure analysis survey
- Power facility electromagnetic effect survey
- Thermal power relating environment review survey
- Geological disposal technical survey, etc.
- Intellectual security countermeasures accelerating project
- Technical development on rationalization of dry reprocessing process of metallic fuel
- Technical development on new control system for fuel non-replacing core
- Development of practical element technology of metal electrolytic method dry reprocessing process components
- Development of defect prevention technology for welding structures in next generation high temperature nuclear plants
- Technical development on dry reprocessing of oxide fuel applying electrolytic reduction method
- Technical development of special transformer, etc.
- Development of multi-component simultaneous determination technology of atmospheric nano particles
- Technical development of lithium secondary batteries for fuel cell vehicle applications
- Strategic technical development in practical application of solid high molecular fuel cell
- Technical development of stabilization in wind power generation system - climate forecasting system -
- Demonstration research of new power networking system, Demonstration research of power networking technology
- Technical development of solid oxide fuel cell system