

# **Research Plans**

## **FY2009**

March 2009

Central Research Institute of Electric Power Industry



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## Research Plans in FY2009

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## Statement of Budget

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Basic Management Policy

- Contributing to the electric power industry and serving the community
- Solving problems before they occur and demonstrating creativity
- Enhancing vitality and creating an upbeat, energetic workplace

Tatsu No.2, August 12, 1980

# **Research Plans in FY2009**



## **Basic Policy**

Japan's electric power industries are facing with many problems for stable electric power supply harmonizing with global environment, including international approach to the global warming issue, worldwide rapid stagnation of the economy, and violent fluctuation of fuel prices along with oil prices.

To contribute to resolution of these issues, CRIEPI presents desirable future images such as low carbon societies and sustainable societies and promotes business activities based on the following items under the mission of "ensuring energy security and response to global environmental problems" as a leader of required technical development related to energy and environment.

1. We will actively be engaged in technical development at demand sides such as high efficient energy utilization in addition to technical development related to the electric power supply, leading to the sustainable society and driving the low carbon trend in the entire society from energy production to utilization, maintaining stable electric power supply.
2. We will cultivate and develop fundamental technologies, which are effective for problem solution and innovative technology creation, as well as to steadily respond various problems in the electric power industry with the comprehensive strength through interdisciplinary research combining fundamental technologies.
3. We will ensure transparency in the business activity and earn the trust of society, and enforce research infrastructure considering the best use of the feature of individual area to establish business activity foundation.

## Research Activities

### I. Research Plans

To realize the low carbon society and sustainable society, we will define "nuclear technology", "stable electric power supply technology" and "environment and energy utilization technology" as three basic principles to conduct technical development at the supply sides for maintenance and improvement of power supplying force as well as technical development leading to low carbon society through high effective energy utilization at demand sides, biomass utilization, use of renewable energy and others.

In FY2009, we will concentrate research related to "environment and energy utilization technology", particularly will allocate research resources focusing on performance assessment of electrical kitchen and heat pump, development of high effective and compact power transmitter, and development of safe and high efficiency secondary battery.

In research promotion, we will exert comprehensive strength under the lateral promotion organization combining eight professional research institutes\* having fundamental technologies effective for problem solution. In particular, we will actively promote researches related to the aged light water reactors management involving urgent issues in the electric power industry as a "special project".

#### 1. Project subjects (Table 1)

For subjects with high expectation in the electric power industry and society and those which should acquire timely accomplishment and application, we will define the project subjects (37 subjects) to promote research in comprehensive strength. Major implementation items are as follows.

##### (1) Nuclear technology

For nuclear technology, which is to support stable supply foundation in the future and to play a central role for the energy security and global warming measures, we will promote researches to support safe and stable operation of the aged light water reactors (LWR), backend project support, seismic reliability improvement, advanced fuel cycle technology, and radiation safety.

**Material deterioration and structural integrity for aged light water reactor:** We will promote researches to clarify irradiation embrittlement mechanism of reactor pressure vessels under high neutron irradiation dose, stress corrosion cracking extension behavior at the dissimilar metal weld joints, and also pipe wall thinning mechanism under liquid single phase and liquid-vapor dual phase conditions. We will also start researches for nondestructive inspection of dissimilar metal weld joint and integrity evaluation of electric cable insulation materials.

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\* Note: Socio-Economic Research Center, System Engineering Research Laboratory, Nuclear Technology Research Laboratory, Civil Engineering Research Laboratory, Environmental Science Research Laboratory, Electric Power Engineering Research Laboratory, Energy Engineering Research Laboratory, Material Science Research Laboratory.

**Nuclear fuel cycle backend research project:** For interim storage of the recycled fuel, we will study SCC measures technology to keep sealing performance of a canister in the concrete cask. For high level radioactive waste, we will perform experiments by centrifuge aiming at clarification of mutual interaction of disposal pit surrounding rock and engineered barriers. In addition, we will promote researches to clarify performance solution methods of engineered barrier system for low-level radioactive waste(LLW) disposal facility, especially on alteration mechanism of deterioration for bentonite or cement materials in the environment of sub-surface disposal for LLW.

**Improvement of seismic reliability:** Through the microearthquake observation, we will investigate and extract an index to represent the successive rupture of active faults. And also, basic framework of the seismic margin assessment method will be integrated using the seismic PSA method.

**Advanced fuel cycle technology:** For meeting the requirements from national evaluation about FBR cycle technologies in FY2010, we will continue research and development on metal fuel and pyro-reprocessing technology by executing the metal fuel irradiation test at "JOYO" and dry reprocessing of irradiated materials.

**Radiation safety:** Aiming at rationalization of radiation protection system, we will conduct elucidation of biological mechanisms of the low dose radiation effects such as bystander response, and practical performance assessment of radioactivity distribution measuring technology in the large sized waste, and also aim to disclose our research outcomes actively.

## (2) **Technology for the stable electric power supply**

We will integrally develop rationalized technologies on diagnosis, operation, and maintenance for aged facilities from the electric power generation to the electric power distribution to ensure electric power long-term stable supply and those on expansion and high efficient operation of fuel types for the thermal power generation effective for stable resource supply, effective use, and CO<sub>2</sub> reduction.

**Maintenance and operation of electric power generating facilities:** To achieve improvement of operational reliability of the electric power generating facilities and cost reduction, we will develop an ultrasonic non-destructive inspection method available for local thinning detection at the electric power plant piping and the damage monitoring method of components using high temperature optical fiber AE sensors.

**Maintenance and operation management of electricity supply facilities:** We will study applicability of the deterioration diagnostic technology of the electric power transmission lines and substation equipment to the field site and will enhance the field observation systems and observe continuously, on snow related failures of the transmission lines, resulting in clarification of phenomena of snow related failures. In

addition, we will promote researches intensively on practical application and technical national qualification for the simple disposal and instrumentation technology of low concentration PCB in insulation oil in a transformer.

**Next generation thermal power technology:** We will improve the co-combustion technology which raises the utilization of low grade fuel at the coal thermal power generation, assess the performance of coal gasifier in IGCC, construct the biomass storage management guide, and assess combined combustion performance. For CCS technology to capture and storage CO<sub>2</sub> from the thermal power plants, we will evaluate basic gasifier performance of high efficient IGCC system with CO<sub>2</sub> capture and will research for monitoring technology of CO<sub>2</sub> stored in the ground and its environmental influence assessment.

### (3) **Environment and energy utilization technology**

We will actively promote technical development to realize the low carbon society in the future including the environmental research centering on influence assessment and adaptation support for global warming; electrification and energy saving technology contributing to the effective energy utilization at demand sides and improvement of living environment; next generation grid technology for acceleration of smooth introduction of renewable energy power to the electric power system.

**Global warming projection and impact assessment:** We will predict the regional scale of global warming in Japan region for details around for thirty years ahead and will conduct the long-term global scale projections for hundreds of years, and will analyze information on global warming impacts, contributing to the adaptation support research through easy-to-understand delivery.

**Electrification and energy conservation technologies:** Aiming at acceleration of electrification at demand sides and improvement of living environment, we will conduct performance assessment of business cooking devices and next generation Eco-cute. In addition, we will develop a low loss SiC power semiconductor of advanced power electronics having excellent energy saving ability and design and control technology of all SiC inverter, as well as will researches related to battery technology intensively including development of Eco-cute combined charged system using the secondary battery and all solid state lithium secondary battery with high safety.

**Next generation grid technology:** To realize the next generation grid responding to introduction of a large amount of renewable energy, we will start in full swing the demonstration test of demand/supply joint operation/control also promote basic design and assessment of information communication infrastructure essential upon realization. We will also develop a quantitative assessment tool for influence due to expansion of a ratio of the renewable energy power and base power, and clarify targets to be responded in joint system by trunk system and demand side system.

We will investigate the future vision to harmonize global warming through utilization of electricity, economy, and energy security, and resultant strategy and policy of technical development and popularization for realization to promote research on "energy technical strategy" leading to proper information delivery.

## **2. Base technology subjects (Table 2)**

For the base technology as a key resource to solve problems, applying and developing feature and specialty of eight professional laboratories, we will determine base technical subjects (35 subjects) including succeeding and maintaining technology, developing technology, technology required for new research extension such as high energy utilization at demand sides to establish and elevate the base technology focusing to the future.

## **3. Research promotion method**

### **(1) Exerting comprehensive strength**

We will correctly and promptly share information based on three basic principles (field, actual things and fact) to acquire effective accomplishment for the electric power industry and society and will solve problems in a matrix-like approach for base technical subjects and project subjects.

### **(2) Promotion of outcome management**

Overviewing an entire process from research planning stage to accomplishment delivery, we will fix the outcome management activity to maximize propagation effect of research accomplishment. To promote intensively and timely research activity we will further apply advanced technical survey data.

### **(3) Promotion of funded research**

Applying CRIEPI's base technology we will actively promote research responding to the field demand in the power industry and will selectively receive research from the national government for subjects on energy and environment related to the electric power industry. As a reliable test institute with neutrality, we will promote PD sensor project for engineer's qualification of ultrasonic flaw detection for nuclear power plant components and large-scale electric power test project for a short-circuit test of the electric power components.

### **(4) Systematic introduction and renewal of large capacity research facilities**

We will systematically introduce large capacity research facilities to support the electric power base technology. In FY2009, we will introduce "business-use kitchen experimental facilities (first term)" viewing popularization and development of business-use electrical kitchen compatible for energy saving needs and heating comfort, and will renew making switches and circuit breakers to ensure and maintain reliability of the high electric power test facility.

## **II. Management and application of intellectual property**

As a research institute effective for the electric power industry and society, we will ensure the intellectual property at the maximum, accomplishment of research activity to widely apply in the proper management.

### **(1) Visualization campaign of intellectual property**

We will prepare the intellectual property reports to transmit information through website to promote visualization of intellectual property, thus resulting in intelligence sharing actively to external parties.

### **(2) Promotion of technical succession and transfer activity**

To apply CRIEPI's intellectual property to the electric power industry, we will hold presentation of research accomplishment as well as promote technical succession activity through technical exchange courses and technical seminars. For further development of the electric engineering field, we will cooperate personnel cultivation of human resources at electric power industries. In addition, we will actively promote technical transfer through application of technical transfer organization and joining to external exhibitions.

### **(3) Contribution to rules and standards formulation**

Applying features as a neutral academic research institute, we will contribute to formulation of various rules, standards, and technical guides (maintenance and control standards for nuclear components, etc.) related to energy and environment through joining to various committees.

## **Business Management**

To strongly promote research activity, we will establish the management system quickly responding to changes of the times and full apply CRIEPI's management resources.

### **(1) Promotion of application plan at each area**

For research localization applying features at each area, we will study the application plan at each area (establishment of large capacity research facilities and research environment, etc.) for maintenance facility in the entire institute. For a development of new research focusing on the energy demand side, we will acquire adjoining lands at CRIEPI Yokosuka area.

### **(2) Drastic cost reduction**

To promote land acquisition and research localization at each area, we will study the priority of business activity considering implementation times and scale for drastic cost reduction than before.

### **(3) Personnel planned application**

We will maintain the present workforce to maximize working ability of the present personnel.

Personnel engaged in research works will be assigned for new research focusing on the energy demand side. For targets requiring accomplishment in the short period, we will employ external personnel as a special contract researcher.

Personnel engaged in office works will be reduced through rationalization and employing streamlined business style.

### **(4) Information transmission of policy, technical presentation, and research accomplishment**

To raise the presence of CRIEPI in the society, we will release information timely about policy, technical presentation, and research accomplishment through research presentation, forum, symposium, website, etc. Also to penetrate CRIEPI's energy technology and environment technology to the society, we will also hold the environment seminars, lecture meetings and working on various writing activities.

### **(5) Response to new corporation system**

To contribute to the electric power industry and the society, we are preparing for shifting to the new corporation by keep watching the actual conditions of new corporation system, and will establish guideline for risk management and internal control system.

## Workforce

Workforce in FY2009 is as follows.

(Expected as of April 1 2009)

| <b>Item</b>                            | <b>Numbers</b> | <b>Percentage<br/>distribution (%)</b> |
|--|----------------|--|
| 1. Research                            | 713            | 88.4                                   |
| (Breakdown)                            |                | [100.0]                                |
| (1) Electricity                        | 115            | 16.1                                   |
| (2) Civil engineering and construction | 94             | 13.2                                   |
| (3) Engineering                        | 82             | 11.5                                   |
| (4) Chemistry                          | 70             | 9.8                                    |
| (5) Biology                            | 55             | 7.7                                    |
| (6) Nuclear engineering                | 51             | 7.2                                    |
| (7) Environment science                | 45             | 6.3                                    |
| (8) Information & communication        | 40             | 5.6                                    |
| (9) Socioeconomics                     | 44             | 6.2                                    |
| (10) Research management               | 117            | 16.4                                   |
| 2. Office duties                       | 94             | 11.6                                   |
| Total                                  | 807            | 100                                    |

**Table 1 Project Subjects (37 Subjects)**

**(1) Nuclear technology**

**Material deterioration and structural integrity for aged light water reactor (special project)**

**○ Newtron irradiation embrittlement for reactor pressure vessels**

- Mechanical characteristic test and observation of micro structures of highly irradiated pressure vessel stored material
- Construction of uniform management system of domestic plant monitoring test data

**○ Stress corrosion cracking for piping and vessel internals**

- Acquirement of crack propagation data at weld boundary and different material joint
- Study on effect of surface hardness and plastic strain affecting SCC generating characteristic

**○ Pipe wall thinning and seismic evaluation for thinning pipe**

- Development of pipe wall thinning evaluation method for flow accelerated corrosion and liquid droplet impingement erosion in single-phase flow as well as steam-water two-phase flow by laboratory test and analysis using computational fluid dynamics code
- Consideration of seismic issue of thinning pipe by hybrid excitation facility

**○ Nondestructive examination of dissimilar metal weld joints and diagnosis of cable insulation materials**

- Clarification of adaptive limit of conventional phased array method using an angle beam flaw detection for slit specimen
- Clarification of deterioration trend of artificial damaged sample by various component analysis

**Nuclear fuel cycle backend research project**

**○ Transport and storage of spent nuclear fuel**

- Presentation of SCC countermeasure technology to keep confinement performance of concrete cask canister
- Life assessment of leak tightness of transport container and environmental impact assessment of MOX fuel transport container at dropping into the sea

**○ High-level radioactive waste disposal**

- Development on estimation method of deep geological condition by conducting in-situ experiment at Horonobe underground research laboratory
- Clarification of mutual behavior of rock and engineered barrier around disposal pit using centrifuge

**○ Low-level radioactive waste disposal**

- Assessment of progressive mechanism for cement eluviation and bentonite deterioration under the sub-surface disposal environment and development of quality control and facility inspection technology
- Assessment of geochemical environment at the near field of the sub-surface depth disposal facility and establishment of groundwater flow analysis and verification technology

**Improvement of seismic reliability**

**○ Seismic margin evaluation of civil engineering structures in NPP**

- Investigation of successive rupture index of active faults considering fault geometry and velocity structure estimated by micro-earthquake observation
- Investigation of basic framework for probabilistic seismic margin (residual risk) assessment method using the seismic PSA method

### **Advanced fuel cycle technology**

#### **○ Feasibility study of metal fuel cycle technology for practical use**

- Production of metal fuel pin for Joyo irradiation test and post irradiation test of metal fuel irradiated at Phoenix reactor
- Small-scale pyro-reprocessing test with irradiated fuels and engineering-scale test with unirradiated materials

### **Radiation safety**

#### **○ Assessment of low dose radiation effects**

- Conduct an experiment on bystander response at low dose rate
- Conduct an epidemiological survey at high background radiation areas in China and India

#### **○ Rational radiation safety technology**

- Study of clearance level verification technology and radioactivity distribution assessment in large capacity waste
- Trial calculation to drive surface contamination exemption levels using risk based approach

## **(2) Technology for the stable electric power supply**

### **Maintenance and operation management of electricity supply facilities**

#### **○ Diagnostics and use of considerably aged substation and underground transmission apparatus**

- Upgrading of water-treeing diagnosis technology to XLPE cable and development of partial discharge measuring method at junctions and terminals
- Implementation of corrosion test using various paint coating film specimen and study of adaptability of electro-chemical measurement for film deterioration evaluation

#### **○ Assessment of wind damage, snowstorm, and sea-salt corrosion on overhead power transmission facilities**

- Continuous observation of the snow related failures using the field observation systems installed on the existing steel towers in FY2008
- Measuring eddy current continuously to diagnosis of corrosion deterioration for various conductors
- Field observation of sea salt particle and study of adaptability of airborne deposit efficiency prediction method

#### **○ Measurement technology and easy treatment of PCB contaminated transformers**

- Upgrading of PCB bio sensor and development of PCB simplified quantitative instrumental analysis method
- Quantitative assessment of transformer exciting vibration effect at electrical natural circulation cleaning

#### **○ Strategic restoration support of electric power distribution and substation equipment against natural disaster**

- Upgrading of damage estimation model, diversification of hazard response, and development of optimum recovery planning support method under uncertain information for disaster support of distribution equipment
- Development of seismic risk assessment tools, upgrading real-time operation system of earthquake ground motion, and construction of tsunami information system for substation equipment

○ **Lightning protection measures for the ICT (Information and Communication Technology) society**

- Development of prototype program to assess lightning risk based on lightning hazard data
- Development of prediction method for lightning surge/transient electromagnetic field phenomena generating at control, information, and communication circuits of electric power systems

**Maintenance and operation of electric power generating facilities**

○ **Disaster prevention and maintenance management for hydropower facilities**

- Clarification of failure characteristics of concrete gravity dams and spillway gates by model experiments, and framework development of seismic risk evaluation method
- Investigation of applicability of movable observation systems for turbidity flow and sediment transport in rivers

○ **Diagnostic of power plant components integrating inspection, prediction and monitoring techniques**

- Development and assessment of high temperature optical fiber AE sensor for online defect monitoring
- Acquiring of strength characteristic data by 650°C internal pressure creep test for the 9-chrome steel made actual pipe longitudinal weld specimen

**Next generation thermal power technology**

○ **Expansion of fuel types and improvement of efficiency in IGCC**

- Clarification of low reactive coke production behavior in gasification and pyrolysis process of high volatile low grade coal
- Development of slug flow property assessment method under pressurized condition assuming actual gasifier
- Acquiring performance data on desulfurization and removal of halogenated products to construct hot gas clean-up system for IGCC

○ **Low grade fuel utilization technology**

- Clarification of operation method to raise mixing ratio of sub-bituminous coal in co-combustion with bituminous coal in present facilities
- Expansion of applicable temperature range of sulfidation corrosion formula and improvement of its practical usage in real operation environment
- Effect of coal blending using bituminous and sub-bituminous coals on grindability and leaching property of coal ash

○ **Innovative biomass/waste energy utilization technology**

- Establishment of assessment technology of biomass/waste utilization such as CO<sub>2</sub> reduction potential
- Clarification of co-combustion and carbonization-gasification properties of wastes such as palm and Jatropha
- Clarification of spontaneous heat generation property of wooden biomass to establish safe storage control guide for biomass

○ **Thermal power generation systems with CO<sub>2</sub> capture**

- Development of gasification reaction model under high CO<sub>2</sub> concentration
- Study on carbon deposition property at high CO partial pressure condition and influence of coexisting halogenated products
- Evaluation of plant performance and cost in the feasibility study for demonstration scale plant

○ **CO<sub>2</sub> storage technology**

- Development two-phase (supercritical CO<sub>2</sub> and water) flow analysis by indoor experiments and acquiring of basic data on residual gas trap mechanism by indoor experiments
- Investigation of effectiveness on CO<sub>2</sub> mineral fixing and geological permeability using water flow test at Ogachi
- Development of marine concentration assessment method for marine environmental effect assessment on leakage of CO<sub>2</sub> stored underground to surrounding seabed of Japan

**(3) Environment and energy utilization technology**

**Global warming projection and impact assessment**

○ **Long-term global warming projection and adaptation**

- Long-term global warming projection experiments using an earth system model considering global carbon cycle
- Evaluation of uncertainty in global warming projections and future trends in extreme events through the analysis of up-to-date climate model projections

○ **Storm prediction and impact of regional climate change on electric facilities**

- Accuracy assessment of weather forecasting system by weather recurrence for 20 to 30 years in the past
- Accuracy increase in short period rainfall prediction using weather radar and practical application of flood predicting method for several days earlier

**Electrification and energy conservation technologies**

○ **Design support for electric kitchen**

- Development prototype of business-use electrified kitchen design support tools
- Assessment of component function and ventilation function of business-use kitchen

○ **Highly-efficient heat pump**

- Evaluation of performance of next generation Eco-cute using heat pump performance evaluation test facilities
- Development trend survey on low GWP (global warming potential) refrigerant for family and business application

○ **Low-loss power semiconductor**

- Clarification of basic conditions to increase growth speed at gas phase SiC single crystal growth and defect behavior in the single crystal
- Test production of high voltage SiC pin diode over 10 kV withstand voltage and clarification of its electrical performance

○ **Low-loss compact converter applied equipment**

- Design of inverter circuit and its control system fully to apply SiC-JFET devices
- Increase in analytical performance of inverter simulation program and development of SiC switching device model

○ **Application of secondary battery**

- Study of Eco-cute parallel installed storage system using secondary battery
- Planning of charging infrastructure setting policy of electric vehicle (EV) and study of possible application to influence assessment in civil environment
- Test production of EV basic performance assessment tools for prediction of introducing volume and power load

○ **Highly safety lithium secondary battery**

- Study of utilization technology of carbon series negative electrode to realize all solid state lithium secondary battery with highly safety

**Next generation grid technology**

○ **Supply and demand integrated operation and control of Autonomous Demand Area Power Systems (ADAPS)**

- Increase in control accuracy of demand control system at customer unit and assessment of demonstration of load flow control system sized for demand area system
- Preparation of numerical calculation model based on load and control response characteristics of demand load (Eco-cute, ventilator component)

○ **Next generation information and communication system**

- Basic design of customer gateway device installing smart meter function
- Presentation of physical construction of wired and wireless sensor networks available for simultaneous collection of sensor signals and voice and image signals for maintenance at substation

○ **Assessment of demand response**

- Development of simple energy management system and confirmation of its load reduction effect

○ **Coordinated operation of trunk transmission system with ADAPS**

- Clarification of problems for ordinary system stability and electric power quality maintenance to respond in cooperation with basic system and demand area system
- Probabilistic assessment for effect assessment at the demand area and development of demand and supply reliability (adequacy) assessment tools by demand and supply simulation

○ **Next generation power distribution components for ADAPS**

- Increase in critical current performance of magnetic shield type super-conducting current limiter and optimization of electrode structure of S/N conversion type super-conducting current limiter
- Design and fabrication of hybrid gas-insulation model electrode and acquisition of basic data of insulation design

○ **Energy technology strategy**

- Establishment of vision scenario aiming at satisfying both of global warming measures and ensuring energy security through promotion of electrification
- Construction of analysis tool model group for quantitative analysis of vision scenario
- Study of acceleration factors and disturbing factors for popularization of energy saving technology

**Table 2 Base Technology Subjects (35 subjects)**

**(1) Socio-economic Research Center**

**○ Business management and electric power policy**

- Survey and analysis of management of electric power companies, business competition system, and customer's action, as well as projection for electricity demand, and resultant presentation of strategy and policy

**○ Regional study**

- Demonstration analysis of regional economy, climate change measures, presentation of low carbon electrified city, and research related to risk communication

**○ Energy and technology policies**

- Social impact analysis along with penetration of end-use technologies environmental life cycle analysis, nuclear policy analysis, and its resultant policy presentation for low carbon society

**○ Human factor analysis**

- Research of safety culture cultivation support and human error preventive measures

**(2) System Engineering Research Laboratory**

**○ Electric power systems**

- Development of prediction method of system load property corresponding to mass introduction of renewable energy generation, real-time system monitoring and stabilizing control technology, system restoration support technology, and protection relay setting support tools

**○ Customers systems**

- Construction of energy demand database, development of office energy saving support tools and prediction method of power generation output of distributed power source within distribution system

**○ Communication systems**

- Concept design of electric power communication network to sustain required communication reliability at disaster damage and development of security measure technology for communication media technology and supervisory control system

**○ Mathematical informatics**

- Research applying information technology and mathematical method including development of countermeasures against cyber attacks and data analysis method for very rare anomalies, and design and implementation of contactless instrumentation system for body action

**(3) Nuclear Technology Research Laboratory**

**○ Basic light water reactor technology**

- Research on fuel cladding, core, thermal-hydraulics, and risk informed assessment technology for improvement of availability and power update of light water reactors

**○ Advanced fuel cycle technology**

- Construction of next generation cycle basic technology including metal fuel core technology, metal fuel FBR cycle technology, and technical development on wet reprocessing

**○ Nuclear reactor systems safety**

- Development and upgrading of light water reactor and FBR safety assessment method based on CSAU (Code Scaling, Applicability and Uncertainty) Evaluation Method

○ **Application of basic technology in nuclear/future technologies**

- Application of nuclear technologies with high performance and high reliability to other industry fields, and search for the future technologies to contribute to ultra-long term energy security, such as fusion power plant to generate electricity

**(4) Civil Engineering Research Laboratory**

○ **Geosphere science**

- Technical upgrading for geology and underground water, including geological property assessment, underground water flow assessment, volcano influence assessment, and active fault assessment

○ **Earthquake engineering**

- Upgrading of seismic/earthquake hazard assessment technology and seismic isolation design technology, and enhancement of disaster risk assessment technology from the perspectives of mitigating socio-economic impacts

○ **Structural engineering**

- Enhancement of performance-based verification procedures on steel and reinforced concrete structures and development of sound function evaluation method adaptable to life stage of various structures

○ **Fluids dynamics in science and engineering**

- Advancement of natural disaster reducing measures for wind, snow, and tsunami, as well as fluid science relating technology contributing to wind power, solar electric power generation, and nuclear power generation

**(5) Environmental Science Research Laboratory**

○ **Atmospheric and marine environment**

- Development of atmospheric environmental prediction technology, improving technology of urban atmosphere and environmental assessment technology of nuclear plants for low carbon and low environmental load society in the future

○ **Hydrospheric environment**

- Technical development contributing to respond changes of sand accumulation in reservoir and harbor, animals attached on intake channel due to global warming, and to solve problem such as residual flow for river ecology

○ **Biotechnology**

- Development of microorganism relating technology required for waste reduction and its recycling, as well as plant relating technology to create environment for energy saving and utilize renewable energy

○ **Biological environment**

- Development of cost effective countermeasures for aquatic nuisance organisms and birds/animals causing troubles in the operation of electric power plant, and ecosystem impact assessment methods considering on genetic diversity

○ **Environmental risk assessment**

- Development of technology to support environment risk assessment and control relating to chemicals and electromagnetic fields, and technology for effective use of wastes

## **(6) Electric Power Engineering Research Laboratory**

### **○ High-voltage and insulation**

- Clarification of deterioration mechanism of various insulating materials and sealing materials contributing to diagnostic and life assessment techniques of power equipments, upgrading of external insulation technology of power transmission facilities, and development of next generation insulating materials

### **○ Lightning and electromagnetic environment**

- Development of rational lightning protection measures and insulation coordination technology for power system under ICT society, construction of electromagnetic compatibility (EMC) technology for electric power transmission and distribution facilities and customer facilities

### **○ Applied high power physics**

- Fault current measure technology, application to innovative instrumentation technology of laser/light, and development of pressure rising assessment tools caused by arc discharge

### **○ Electric power application**

- Development of low loss current control technology in power electronics and development of non-contact electric energy transmission technology for acceleration of electrification

### **○ High current technique**

- Upgrading of short-circuit test technology and establishment/standardization of measuring technology of AC high current and impulse high current

## **(7) Energy Engineering Research Laboratory**

### **○ High efficiency power generation**

- Development of operation and maintenance technology for thermal power plants and gas turbine hot gas path parts, and development of combustion technology for new type fuel such as bio-fuel and oil sand for higher efficiency and improvement of operability of thermal power plant

### **○ Fuel reformulation engineering**

- Development of brown coal upgrading technology aiming at utilization of low grade fuel, and improvement of measurement technologies of trace elements in combustion flue and coal gasification gases

### **○ Energy conversion engineering**

- Technical development of system analysis, heat pump/heat storage, fuel cell aiming at popularization/expanding of energy saving technology at demand sides and realization of super-high efficiency power generating system

### **○ Numerical analysis of turbulent heat transfer and reacting flows**

- Development of thermal fluid/reaction numerical analysis technology for thermal power generating components such as powdered coal combustion boiler, gasification furnace, and gas turbine

## **(8) Material Science Research Laboratory**

### **○ Materials for nuclear energy**

- Improvement of water control/processing technology of light water reactor cooling water to support nuclear plant sites and clarification of natural environment corrosion mechanism

○ **Materials for thermal power plants**

- Development of super-high temperature materials and heat shield coating for improvement of thermal power generating efficiency and development of material assessment technology using innovative sensor contributing to operational reliability of power generating components

○ **Batteries and electrochemical materials**

- Development of high efficiency hydrogen production technology power generating characteristics assessment technology of photovoltaic systems, and materials for power efficiency improvement of solid oxide fuel cells (SOFC) for low carbon society

○ **Advanced functional materials**

- Development of multi-function materials in transition metal oxides showing high-T<sub>c</sub> superconductivity, giant thermoelectricity, and giant dielectricity; development of high-performance organic transistors for energy saving and its device application

○ **Improvement of PD system of ultrasonic examination**

- Analysis of the present PD test results for security at nuclear power plants by raising reliability of non-destructive inspection technology and survey on next generation PD qualification system

# **Statement of Budget**



## **Budget Compilation**

Business scale in FY2009 was determined to 36,180 million yen up 1,720 million yen to the previous fiscal year. Major points are as follows.

### **1. Revenue and expenditure in business activity**

- (1) Ordinary benefit revenue was 31,000 million yen up 1,780 million yen to the previous fiscal year budget.
- (2) Business revenue
  - Funded research business revenue was mainly from government-funded research to be 1,810 million yen down 490 million yen to the previous fiscal year budget (definitive term at beginning of FY2009.)
  - Other business revenue was 580 million yen down 80 million yen to the previous fiscal year budget.
- (3) Other income was 140 million yen down 30 million yen to the previous fiscal year budget.
- (4) Business expenditure was 24,550 million yen up 620 million yen to the previous fiscal year budget resulting from active approach and other measures for new research expansion.
- (5) Management expenditure was 2,060 million yen up 150 million yen to the previous fiscal year budget.

### **2. Revenue and expenditure in investigation activity**

- (1) Special asset virement income was 1,300 million yen by virement of special assets to acquire research facilities ready for renewal of "large capacity power short-circuit test facility".
- (2) Fixed asset sellout income was 500 million yen by selling idle assets.
- (3) Special asset acquiring expenditure was 1,800 million yen ready for "joint experiment building for energy utilization technology (tentative name)".
- (4) Fixed asset acquiring expenditure was 7,770 million yen including acquisition of Yokosuka adjacent area to ensure competitive power of CRIEPI.

### **3. Revenue and expenditure in financial activity**

There is no revenue and expenditure in investigation activity.

## Budget

The Budget in FY2009 arranged above is as follows.

### FY2009 Revenue and Expenditure Budget

From April 1 in 2009 to March 31 in 2010

(Unit: one million yen)

|   | Budget   | Revised budget to previous year | Up and down (△ down) |
|---|----------|---------------------------------|----------------------|
| I. Revenue and expenditure in business activity                               |          |                                 |                      |
| 1. Business activity income   |          |                                 |                      |
| (1) Base property operation income  | -        | -                               |                      |
| (2) Benefit income  |          |                                 |                      |
| Current benefit income  | 31,000   | 29,220                          | 1,780                |
| (3) Business income   | 2,390    | 2,960                           | △570                 |
| Funded research business income   | (1,810)  | (2,300)                         | (△490)               |
| Other business income   | (580)    | (660)                           | (△80)                |
| (4) Other income  | 140      | 170                             | △30                  |
| Business activity income total  | 33,530   | 32,350                          | 1,180                |
| 2. Business activity expenditure  |          |                                 |                      |
| (1) Business expenditure  | 24,550   | 23,930                          | 620                  |
| Personnel expenditure   | (9,880)  | (9,750)                         | (130)                |
| Payment of expense  | (14,670) | (14,180)                        | (490)                |
| (2) Management charge expenditure   | 2,060    | 1,910                           | 150                  |
| Personnel expenditure   | (1,220)  | (890)                           | (330)                |
| Payment of expense  | (840)    | (1,020)                         | (△180)               |
| Business expenditure total  | 26,610   | 25,840                          | 770                  |
| Difference between revenue and expenditure in business activity               | 6,920    | 6,510                           | 410                  |
| II. Revenue and expenditure in investigation activity                         |          |                                 |                      |
| 1. Investigation activity income  |          |                                 |                      |
| (1) Special asset virement income   |          |                                 |                      |
| Special asset virement income to acquire research facilities                  | 1,300    | 980                             | 320                  |
| (2) Fixed asset acquiring expenditure   | 500      | -                               | 500                  |
| (3) Long-term advance payment diversion expenditure                           | 230      | 230                             | -                    |
| Investment activity income total  | 2,030    | 1,210                           | 820                  |
| 2. Investigation activity expenditure   |          |                                 |                      |
| (1) Special asset acquiring expenditure                                       |          |                                 |                      |
| Special asset acquiring expenditure to acquire research facilities            | 1,800    | 1,800                           | -                    |
| (2) Fixed asset acquiring expenditure   | 7,770    | 6,200                           | 1,570                |
| Investigation activity expenditure total                                      | 9,570    | 8,000                           | 1,570                |
| Difference between revenue and expenditure in investigation activity          | △7,540   | △6,790                          | △750                 |
| III. Revenue and expenditure in financial activity                            |          |                                 |                      |
| 1. Financial activity income  | -        | -                               | -                    |
| 2. Financial activity expenditure   | -        | -                               | -                    |
| Difference between revenue and expenditure in financial activity              | -        | -                               | -                    |
| Difference between revenue and expenditure in the current period              | △620     | △280                            | △340                 |
| Difference in revenue and expenditure in the previous balance brought forward | 620      | 900                             | △280                 |
| Difference between revenue and expenditure of balance carried forward         | -        | 620                             | △620                 |

Note:1. Borrowing limit was 200 million yen.

Note:2. Debt burden is 1200 million yen in FY2010.