

**Research Plans
&
Statement of Budget

FY 2013**

March 2013

Central Research Institute of Electric Power Industry

Contents

Research Plans in FY2013

| | Page No. |
|---|----------|
| On Preparation of FY2013 Research Plans and Statement of Budget | 1 |
| Overview of FY2013 Business Activities | 3 |
| Research Activities | 6 |
| I. Research Plans | 6 |
| II. Research Promotion | 14 |
| Administration | 17 |
| Workforce | 20 |

Statement of Budget

| | |
|------------------------------|----|
| Budget Compilation | 23 |
| Budget | 24 |

Research Plans

On Preparation of FY2013 Research Plans and Statement of Budget

With no indication yet as to when nuclear power plants will resume operations, the electric power industry's business environment remains extremely difficult. Moreover, although the general direction of reforms to electric power systems has been outlined, specific plans laying out how electric supply systems will be structured in the future and how the technology base supporting this system will be maintained and expanded have yet to be developed.

Given this situation, CRIEPI, the central research institute for the electric power industry, has focused its activities on the following three areas in order to help resolve urgent issues and lay a foundation for future operations with our electric technology.

Reformulated research strategies and brush-up research plans (thorough review)

We discerned issues that must be addressed to develop a robust and flexible new energy supply/demand structure, and identified the research and development subjects essential to the electric power industry in order to resolve these issues. After clarifying the role that CRIEPI should play and their priorities, we carefully reviewed our existing research plans in terms of the electric power industry's needs and reflected the results of our review in future research plans.

Strengthened communication with electric power industry

As part of our efforts to brush-up our plans, we further strengthened both the quality and quantity of our communication with the electric power industry at all levels and in all fields. This was intended to carefully identify the industry's needs and ensure a shared understanding as we resolve the issues facing the industry.

Further reinforced research structure

While we expect research funding to continue to face constraints for extended period of time, in order to provide high-quality, appealing research output, we will use ingenuity in pursuing research, and also reinforce the research structure and streamline management by drastically reviewing expenditures in all activities and making greater reductions in personnel expenditures further.

We reflected the output from these activities as much as possible to prepare the fiscal 2013 research plan and statement of budget.

CRIEPI functions as a pool of knowledge that has built up diverse know-how, human resources, facilities and wide-ranging domestic and international human networks. In this role, we will fulfill our mission to support the electric power industry, which is based on technology, by generating highly effective research results that meet the expectations of the electric power industry and society.

Overview of FY2013 Business Activities

Research Activities

< Research Plans >

As in fiscal 2012, in fiscal 2013 CRIEPI will conduct research subjects consist of priority subjects, priority subjects with limited terms and basic technology subjects under the three research pillars, described below, which govern our mid-term research directives.

In light of the reformulation of our research strategies and brush-up of our research plans (thorough review), we will further strengthen approaches that will help resolve the electric power industry's pressing issues, such as raising the nuclear power plant safety, supporting the nuclear power plant maintenance, measures against nature disasters for electric power transmission and distribution facilities, developing more advanced thermal power technology and expanding renewable energy. At the same time, we will maintain our underlying research capacity while significantly slowing the pace of research on nuclear power uprates, the development and demonstration of the metal fuel FBR cycle, the development of functional materials such as high-temperature superconductivity and high-performance SiC power semiconductors, and the promotion of electrification through the utilization of electric vehicles.

(1) Establishment of optimal risk management

We will conduct research on “nuclear power plant safety”, “radiation risks”, “nuclear fuel cycle and backend technology”, “natural disaster reduction on electric power transmission and distribution facilities” and “evaluation and analysis of energy and environmental systems”, and contribute to manage and reduce the risks related to the stable supply of electricity.

(2) Further improvement of facility operations and maintenance technologies

We will conduct research on “nuclear power plant maintenance”, “construction, operation and maintenance of power generation facilities” and “operation and maintenance of electric power transmission and distribution facilities”, and technically support the stable supply of electricity which is the responsibility of the electric power industry.

(3) Development of a supply/demand infrastructure for next-generation electric power

We will conduct research on “developing more advanced thermal power technology”, “establishing next-generation power grid technology” and “development of energy saving technology”, and contribute to further enhance the

efficiency of electricity supply and electricity use, ensure energy security and realize energy conservation and low carbonization.

< **Research Promotion** >

In research promotion, we will focus our efforts as follows.

- Augment research plans and generate interesting new subjects by continuing brush-up (thoroughly review) and strengthening communication with the electric power industry
- Further reinforce the research structure so that we can constantly produce appealing and high-quality results despite funding constraint
- Maintain and strengthen research capacity and ability to resolve issues by steadily introducing large-scale research facilities and building human networks with domestic and international research institutes

Administration and Workforce

In consideration of the funding constraint, we will cut costs across all operations and curb the number of employees thoroughly, but will continue to reinforce reestablishment of the research bases, which are so essential to maintaining and improving our future research capacity, while ascertaining our balance.

- Extensive review of expenditures to cut costs, including personnel costs
- Reestablishment of the research bases in accordance with balance
- Encourage personnel to exhibit skills and hire and retain diverse personnel in accordance with business development
- Reinforce presentation of results with the aim of enhancing CRIEPI's value

Income and Expenditure Budget

Business activity income is expected to amount to 28.6 billion yen, the total of 26.3 billion (maximum set in line with fiscal 2012) in donation income, which accounts for most of CRIEPI's revenue, business income and other income. Business activity expenditures will total 29.12 billion yen, the total of 27.12 billion yen in business expenditures and 2.0 billion in management expenses. This is a 510 million yen decrease over the previous fiscal year. Non-business activity income will be down 230 million yen as a result of loss on retirement of equipment and other capital. Accordingly, we expect general net assets to decline 750 million yen.

Designated net assets, whose use is restricted, are expected to decline by 200

million yen as a result of 90 million yen in subsidies and a 290 million yen transfer to general net assets.

As a result, net assets are expected to fall 950 million yen in fiscal 2013 (the total of fluctuations in general net assets and designated net assets), which will result in a 35.64 billion yen balance of net assets at the end of the fiscal year.

Research Activities

I. Research Plans

1. Priority subjects and priority subjects with limited terms

CRIEPI has selected issues from among the technologies that we believe are essential or will be essential for the electric power industry that it will prioritize in addressing, maintaining and continuing, and expanding. We pursue research on these 32 priority subjects. Those priority subjects into which CRIEPI's comprehensive resources should be invested for a quick resolution are designated "priority subjects with limited terms" (10 subjects).

Of these 32 issues, seven have been newly designated this year, in order to reinforce initiatives to improve the safety of light water nuclear reactors, including hazard assessment of natural external phenomena for nuclear reactors and fragility assessment of nuclear reactors exposed to natural external phenomena. At the same time, one of the eight subjects, research on the technology for disposing of power transformers contaminated with trace PCBs, which was carried out in fiscal 2012, has been completed as the anticipated goals were achieved. In light of the electric power industry's needs, the eight subjects, including the development of a high-functioning SiC power semiconductor device, energy conservation assessment for electric kitchens and the development of technology to promote electrification utilizing electric cars, will no longer be priority subjects, but basic research capacity in these subjects will be maintained.

Priority subjects and priority subjects with limited terms that should be addressed together have been grouped into 11 subject groups so that research can be carried out effectively. In particular, improving the safety and maintenance of light water reactors have been identified as the most prioritized subjects, and the special research teams are established in fiscal 2012. The teams will coordinate the expertise across several specialized fields to enhance research activities. Below we outline the main research plans in the pillars for our research for each subject group.

(1) Establishment of optimal risk management

With the aim of reducing risks and management associated with the stable supply of electricity, CRIEPI evaluates the impact that social and economic changes and natural phenomena have on the electric power industry, and addresses issues that offer solutions, including social systems and frameworks.

Specifically, we address issues related to enhancing the safety of light water

reactors and identifying radiation risks, and will focus even more on developing technology that could alleviate these risks an urgent issue for the electric power industry. Moreover, we will steadily promote research contributing to effective natural disaster countermeasures at electric power transmission and distribution facilities and research on ways of supporting radioactive waste disposal operations. CRIEPI engages in research related to the evaluation and proposal of energy and environmental policies that can achieve social consensus from a scientific and objective perspective.

Nuclear power plant safety

- By participating in the analysis of international benchmarks, CRIEPI identifies the issues with severe accident analysis code and clarifies the analysis models in order to enhance effectiveness evaluations for measures to prevent or mitigate severe accidents at nuclear reactors. In addition, CRIEPI develops level 1 PRA (probabilistic risk assessment for core damage frequency) models incorporating key safety component fragilities caused by external hazards for the typical light water reactors.
- CRIEPI develops numerical analysis methods for estimating the behavior and the impact force of tsunami driftage to apply the backfit program under the new regulatory standards. In addition, we will introduce a tsunami and flood channel that can generate tsunami at a scale of 1/3 to 1/10 the size of a nuclear power plant so that the fragility against a tsunami can be assessed.
- We introduce a resonant oscillation table that can increase the acceleration of existing shaking capability (maximum of 2G) to the world's highest acceleration (20G), and will carry out oscillation experiments to verify the function assurance acceleration of crucial equipment installed in nuclear power plants.
- Based on real-time monitoring data from the Tohoku earthquake, CRIEPI will develop methods that are required for earthquake- and tsunami-resistant designs for nuclear power plant facilities. They include an integrated source model with earthquake and tsunami and a method estimating the magnitude of tsunami source. In addition, we will develop a numerical ash-fall model that involves the climatic impacts in a dispersal process so that it can be used in assessing ash-fall hazards in the new regulatory standards.
- In order to obtain the verification data needed to appropriately assess fire prevention countermeasures at nuclear ~~reactors~~ power plants, CRIEPI will carry out high energy arcing faults tests with non-arc proof high-voltage switch gears using high power test facilities.

Radiation risks

- Based on health risk data on long-term exposure to low dose-rate radiation obtained in epidemiological studies of residents living in high natural background radiation areas, we confirmed that the health risks do not increase at low dose-rate radiation of about 10 mSv/year, and we will work to reflect these results in an UNSCEAR report through publishing papers.
- In order to underpin the above results, CRIEPI conducts experiments to establish biological mechanistic models demonstrating that effects of low doses-rate radiation would not accumulate due to the turnover of stem cells within a living body as a global frontrunner.

Nuclear fuel cycle and backend technologies

- We will evaluate the impact that increasing the density of bentonite used as an artificial barrier in low-level radioactive waste disposal and the curing conditions of cement have on the material characteristics by carrying out laboratory experiments, and analyze the long-term alteration behavior in the artificial barrier. In addition, CRIEPI will carry out geochemical and groundwater flow analysis and evaluation at the Rokkasho site to address safety reviews at disposal facilities.
- As to spent nuclear fuel storage technology, CRIEPI will develop a method for the remote measurements of the concentration of chloride adhering to the surface of canisters, which may cause stress corrosion cracking (SCC), in order to evaluate the occurrence of SCC in metal canisters stored in concrete casks.

Natural disaster reduction on electric power transmission and distribution facilities

- We will analyze past data on damage to overhead transmission facilities due to snow storms, and will make clear meteorological conditions and characteristics of facilities where damage tends to occur, in order to develop practical methods for predicting snow accretion and galloping. We will also construct full-scale test facilities for snow-storm damage to overhead transmission lines, and will carry out full-scale tests to elucidate snow-storm damage to overhead transmission facilities and examine the effect of measures against it.
- We will quantitatively assess the electromagnetic immunity level of equipment and identify malfunction mechanisms in order to establish guidelines of lightning protection for electric power equipment where information and communications technology (ICT) is applied.

Evaluation and analysis of energy and environmental systems

- CRIEPI will survey the practical issues that would result from new rules and operations associated with the separation of electric power transmission from generation and supply, and will evaluate their impacts on the profitability, investment planning and management policy.
- We will look at cost effectiveness to determine the effectiveness of programs in order to present the best approach to the introduction of energy conservation and renewable energy and environmental systems.
- We will present a rational and feasible long-term approach for the reduction of carbon dioxide and other greenhouse gas emissions, including emission reduction measures, based on socio-economic evaluations taking into account the most recent climate science and low-carbon technology.

(2) Further improvement of facility operations and maintenance technologies

In order to provide technical support for the stable supply of the electricity that supports public live and economic activity, we will carry out research and development to enhance the effectiveness and economic value of power generating facilities and distribution facilities.

Specifically, we will steadily develop multi-purpose supporting technology for the preservation and management of light water reactors, essential to their ongoing operation, as well as technology supporting the construction, operation and maintenance of thermal and hydro power generating facilities and electric power transmission and distribution facilities.

Nuclear power plant maintenance

- We will improve the accuracy of the current neutron irradiation embrittlement prediction code at higher fluence region based on the analysis of surveillance data. The results will be incorporated in a revision of the present code on irradiation embrittlement prediction (JEAC 4201).
- Based on plant data, we will verify FALSET, software that CRIEPI developed to predict flow acceleration corrosion (FAC) and liquid droplet impingement erosion (LDI) for a pipe wall thinning management.
- In order to develop a method for evaluating the degradation of cable insulation in a radiation environment, we will improve the current degradation prediction method formulated from the irradiation experiments on the cable insulation materials containing different additives under various conditions. Then we will verify the prediction method using the data from aged cables in service.
- We will verify the validity of the test specimens of Performance Demonstration

Construction, operation and maintenance of power generating facilities

- We will develop a creep life evaluation method for 12Cr steel girth welded pipes based on a demonstration test result with actual pipes under bending-internal pressure creep conditions as well as results of nondestructive tests, observations of the microstructure and numerical analysis of the materials in anticipation of the development of equipment diagnostic techniques for high temperature structural components of high chromium steels..
- We will measure secondary air pollution, such as photochemical smog in urban areas, and verify the accuracy of the air pollution prediction model developed by CRIEPI. Using this model, we will assess the contribution of domestic and overseas sources of secondary air pollution, such as thermal power generation.
- We will develop a model capable of predicting the risk of bird collisions to wind turbines using data such as avian flight behavior, with the aim of developing an environmental impact assessment method for wind-generated power.
- We will develop a method for accurately predicting and estimating sediment deposition in rivers and dam reservoirs by combining meteorological analysis and flood analysis in order to support the safety and efficient operation of hydraulic power dams.

Operation and maintenance of electric power transmission and distribution facilities

- In order to support the efficient asset management of transmission and distribution facilities, we will develop tools for the optimal preservation of facilities and display the replacement time, taking into account load records based on system operation and the risk of accidents based on lightning risk.
- To establish soundness assessment technologies for aged overhead transmission steel towers, we will identify mechanisms causing corrosion and member vibrations, which are needed to elucidate and evaluate the degradation. In addition, we will develop comprehensive diagnostic methods for the soundness of steel towers, including a foundation stability assessment.

(3) Development of a supply/demand infrastructure for next-generation electric power

To prepare for, minimize and overcome future risks, we develop next-generation technical foundation that will enable greater efficiency and energy security in terms of

both energy supply and energy use, and will address issues facing energy conservation and low-carbon systems.

Specifically, we will proactively develop technology for the effective use of unused resources and low-grade resources. In addition, we will develop technology such as next-generation grids enabling the smooth introduction of solar power and other sources of renewable energy into the power system, as well as technology that promotes the efficient use of energy and energy conservation, such as next-generation heat pumps.

Developing more advanced thermal power technology

- To diversify the types of fuel utilized in coal fired power plant, we will clarify the suitable operation conditions during combustion of blends of bituminous and hard grindability coal.
- With the aim of increasing the biomass mixed combustion rate in coal-fired power plant, we will develop the biomass carbonization technology by evaluating the grindability and combustion characteristics of coal mixed with carbonized biomass.

Establishing next-generation power grid technology

- We will firstly develop a numerical PV model which can represents the dynamic behavior of photovoltaics inverters following system faults through experiments using power system simulator. Then, we will clarify the influence of high penetration of PVs on the dynamic stability of high voltage networks, through time-domain simulations using the developed PV model and some other related models which are already in use.
- We will identify the appropriate installment and operation methods for electric storage devices, which contribute to the stable operation of systems, in order to develop power supply/demand adjustment systems that can coordinate and synchronize operations with customers' equipment and distribution-type energy systems. We will also develop a PV control method that can stabilize the system's voltage in concert with the voltage regulator in the high voltage distribution line, and verify its functionality using simulated systems.
- We will develop tools supporting the design of smart meter wireless networks that can rationally take account of the region's characteristics and International Electrotechnical Commission (IEC) standard communication protocols for the prompt and efficient introduction of smart meters.
- We will analyze costs through demand response (DR) as a method of curbing the reverse power flows which can occur with the introduction of large volumes of PV and compare it to other methods (such as pumped hydropower on the supply side and storage batteries on the demand side) in order to assess

Development of energy saving technology

- With the aim of launching advanced heat pumps using a low-GWP (global warming potential) refrigerant on the market, we will develop a hot-air drying heat pump in industrial use and a hot-water space heating heat pump in residential use in cold regions.
- We will evaluate the long-term life of mass-produced lithium secondary batteries and develop technology to analyze the degradation of battery performances in long cycling using non-destructive methods for utilization of large lithium secondary battery system, which contribute to stabilization of electric power transition and distribution.

2. Basic technology subjects

Basic technology subjects are those that we address with the aim of identifying and resolving issues faced by the electric power industry and maintaining and strengthening our basic research skills that are the source of our problem-solving, using our knowledge pool made up of knowledge useful on the frontlines, personnel with advanced expertise, sophisticated research facilities and our overseas and domestic human network. Specifically, we will built up data and knowhow through studies, experiments and measurements on site, develop, establish and refine analytical methods and approaches, and conduct basic research to flesh out new concepts. We will also address issues that anticipate the needs of the electric power industry and society, and foster new basic research strengths.

We will continue to work closely with the national government and electric power industry to address the Fukushima Daiichi nuclear accident and make our own contributions to resolving technical issues for reactor decommissioning utilizing our basic technology.

We will designate 36 basic technology subjects in fiscal 2013 to capitalize on the strengths and specialized skills of eight laboratories with specific research fields*.

(Examples of projects on basic technology subjects)

- We will analyze system reforms related to the use of nuclear power following the earthquake, and identify areas of improvement in the nuclear power damage compensation system and nuclear power disaster prevention.
- We will analyze the behavior of platinum Group Metals and the mechanisms of formation of the calcined layer in the glass melting furnace as the final stage of the nuclear fuel reprocessing in order to support the completion of the

- We will take data on electrochemical properties and reduction behaviors by conducting experiments using simulated fuel debris containing Pu as part of a basic investigation toward the decommissioning of the Nos. 1-4 reactors at the Fukushima Daiichi Nuclear Plant.
- We will thoroughly analyze and evaluate the test data from the Nakoso IGCC (Integrated coal Gasification Combined Cycle) demonstration plant, and investigate the statuses of the operations and maintenances of overseas IGCC plants.
- To enlarge the effective use of coal ash, we will enhance developmental research with evaluating the possibility of commodifying the zeolite generated concrete manufacturing technology that we developed by utilizing unused low-quality fly ash. We will also develop a sodification process of fly ash in which the leaching of trace elements is controllable and massive production is achievable.
- We will establish an analytical modeling technique for improving the existing earthquake-resistance evaluation tools of transformer equipment based on implementation of the knowledge of both shake table experiments on transformer bushing and earthquake observations on aerial equipment at substation.
- We will improve the convenience of CRIEPI's Power System Analysis Tool (CPAT) as well as tailor it to its use in electric power operations.
- We will enhance the functions of the XTAP (eXpandable Transient Analysis Program) by speeding up the computation rate, adding optimization function, and so on.
- We will develop tools supporting the design of the rinsing procedure and cost approximation work to achieve low-cost rinsing process for power transformers contaminated with poly-chlorinated biphenyl (PCB).
- We will accumulate outdoor performance data of domestic photovoltaic modules as well as foreign ones, and will evaluate electrical performance degradation from analysis of the outdoor data.

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 and Materials Science Research Laboratory

II. Research Promotion

1. Augmenting research plans by continuing with brush-up (thorough review)

- We are augmenting our research plans by continuing with brush-up of research plans pursued in fiscal 2012. In fiscal 2013, we will place particular emphasis on clarifying CRIEPI's role, and will focus our resources on specific areas, as well as create new issues.
- We will participate in various committees, committees with a special focus, gatherings for exchange of opinions, and research societies to reinforce communication with electric power companies and carefully identify information and opinions at various levels. This will enable us to accurately reflect front-line needs in our research plans in a timely manner.
- We will provide information on our basic technology strength in a way that is easy to understand and use, and will also augment our liaison department so that we can provide the electric utility industry with prompt and accurate solutions.

2. Further strengthen research structure

- On the assumption that budget constraints will continue for a considerable period, we will strengthen our research structure so that we can continue to generate appealing, high-value results. Specifically, we will first rigorously select priority research subjects, and then reduce the number of experiments, compensate for fewer experiments by expanding the application range of our simulation technology. By using ingenuity in pursuing our research projects, we intend to further reduce operating costs.
- We will continue to carry out our research on the assumption that budget constraints will continue for a considerable period, and will strengthen our research structure so that we can continue to generate appealing, high-value results. Specifically, we will first rigorously select priority research, carry out research evaluations and endeavor to raise the quality of our research output.

3. Maintaining and enhancing research capacity and problem-solving skills

- We will establish research bases and introduce carefully selected, large-scale research facilities in order to build the research foundation that will serve as the source of impressive research skills in the future. When introducing research facilities, we will strive to ensure that specifications are tailored to the level needed for the research plans, and we will also reduce costs by effectively using existing facilities and utilizing competitive bids. The main facilities that we plan to

- Tsunami physical simulator: To be used to evaluate safety of electricity facilities in the face of a tsunami
- Strong shake generator: To verify the seismic margin of important equipment in nuclear power plants
- Full-scale test facilities for snow-storm damage to overhead transmission lines: To closely study snow-storm damage to overhead transmission lines
- Advanced combustion test facility to utilize various types of solid-fuel: To contribute to the diversification of fuel types and the reduction of fuel costs in coal-fired power station
- Light water reactor fuel coolant limitation testing facility: To utilize in research to enhance the safety of light water reactors (planned completion date of fiscal 2014)
- With a view to the future, we also consider the need to maintain and develop basic technology capacity and ensure the diversity of our research fields. In addition, we train personnel that can apply expertise in a specialized field to problem-solving by interacting with the electric power industry on its frontlines.
- We will build and expand a highly effective network with Japanese and overseas universities and research institutes with impressive expertise (such as the US-based Electric Power Research Institute, Électricité de France, Japan Atomic Energy Agency and the Marine Ecology Research Institute) in order to produce effective and advanced research results through mutually complementary scientific knowledge.

4. Management and application of intellectual property

- We endeavor to strategically secure, maintain and utilize intellectual property in accordance with the characteristics of our research output, emphasizing intellectual property that can be expected to make a significant contribution to the electric power industry and society. In particular, we carefully review the need to submit and maintain and overseas patents in terms of cost effectiveness, and resign patents that are expected to have low utilization.
- Being aware of our social responsibilities as a research institute, we properly manage the security trade control on our research output and carry out extensive risk management, including the prevention of misconduct.
- We will continue to offer a free download service for our research reports in order to encourage the broad use of our research output. In addition, we publish The Intellectual Property Report, which summarizes our activities in terms of our

- We will proactively provide our patents and software with external customers to encourage their utilization. We will also strive to spread technology to engineers working on the front lines of industries through technology exchange courses and technology lectures in order to contribute to the electric power industry and society.
- We will capitalize on our strengths as an academic research organization to participate in national and academic committees, thus contributing to the establishment of specifications, standards and technical standards for the energy and environment.

5. Promoting funded research

- We will proactively undertake founded research that meets the needs of the electric power industry, and will promptly provide the anticipated results. We will also receive government funding for research that meets our research strategies and that will contribute to the electric power industry through the establishment of specifications and standards.
- As an independent testing center, we will facilitate the activities of the PD Center, which gives certification exams for experts of ultrasonic inspection working with nuclear power plant components. We will also facilitate activities of the High Power Testing Laboratory, which performs short-circuit tests on electric power equipment.

Administration

1. Thorough review of spending for cost-cutting

- We already cut costs by about 10% across business activities in fiscal 2012. In addition to this, we identified room for further cost-cutting while still ensuring safety and maintaining the quality of operations. We will cut operating costs by a further 10% compared to fiscal 2012.
- We will prepare rational specifications and strengthen our supervisory system at the pre-order stage and encourage competition with our commissions and procurement, with competitive bids as our guiding principle. We will clarify standards and ensure suitability in those cases in which there is only a limited tender contract.
- We will make our decisions on facility construction and upgrade by carefully reviewing priorities for the facility environment based on needs and urgency, including plans that were put off in fiscal 2012.
- Anticipating an increase in fixed asset taxes as we transition to the status of a non-profit general foundation, we will retire and sell idle facilities and attempt to reduce our tax burden and maintenance costs. In addition, we will endeavor to reduce maintenance costs by reviewing the need, priority and repairs required for the facilities and assets that we will continue to use.
- We will increase the cuts to personnel expenses that we have already made to 25% for executive compensation and a maximum of 10% for senior officers' annual salaries. In addition, we will consider reducing general employees' salaries by about 10% in line with income and expenditure as we endeavor to make further reductions. We also plan to take measures to reduce spending on the benefit programs overall, for example by closing directly-operating recreation facilities and reducing the cafeteria plan.

2. Establish research bases in line with income and expenditure

- Research bases are essential in maintaining and improving our research capacity as a central research institute for the electric power industry and a research institution with advanced scholarship for the future, and as such we establish these research bases with unflagging resolve. When doing so, we move ahead while at the same time flexibly adjusting both timing and scale to fit our revenue.
- We are moving ahead with a detailed design for the laboratories for the large-scale research facility at the research base in the Yokosuka area, which we hope will become a research base for the energy industry technology. We will begin construction on offices in preparation for staff to be shifted from the Komae area.

- We will prepare a specific plan and gradually begin carrying it out in the Abiko area, which is intended as a research base for nature and the environment, on the premise that the existing facilities and equipment will be used effectively.
- We will begin making arrangements for the equipment transfer, removal and relocation at the research base in the Komae area, whose research equipment and personnel are to be transferred to the Yokosuka area. In order to raise the funds needed for the construction of the aforementioned research base, we will begin preparations and outside coordination to sell some of the land (about 10,000m² of about 57,000m² total land area).
- In line with progress made in focusing our research sectors at these two research bases, we will begin considering specific organization and system designs for the transfer and reorganization of the administrative and management divisions with the aim of streamlining operations to address cuts in administrative personnel, reduce operating costs and strengthen the research support system. We will make preparations to implement these measures from fiscal 2014.

3. Promoting personnel's job performance and hiring diverse staff in line with research development

- Personal support that helps each individual employee demonstrate their skills is the most important point of our human resource management, and we strive to create an environment that will further enhance its effectiveness. In addition, we will consider introducing new personnel measures and benefit systems that will raise motivation in line with the distinct features of research positions and administrative positions.
- We will consider introducing and creating a new framework with more expansive possibilities in terms of compensation and benefits, as well as responsibilities and authority by setting employment contract periods flexibly. This will enable CRIEPI to hire research staff on an ad-hoc basis and thus correspond to our future research development based on brush-up of our research plans.
- While we will continue to reduce administrative personnel, we will introduce limited-term administrator system for formulaic, standard general administrative work in order to diversify our staff employment possibilities.

4. Strengthening output presentation to enhance CRIEPI's value

- We will continuously disseminate information such as research results and activities in a timely manner through various media with the aim of enhancing our presence as a research institution. Specifically, by effectively circulating information based on original research results and scientific objectivity, we will contribute to the promotion of social understanding of the issues facing the electric power industry and initiatives designed to resolve them. Moreover, we will introduce our research results based on our advanced expertise and collective strengths at research symposiums and in publications such as "TOPICS."
- We will strive to strengthen our ability to collect information from all those related to the electric power industry in order to carry out public relations activities on external situations and the needs of the electric power industry. Moreover, we will proactively exchange views with authorities on science and industry experts and reflect these views and information effectively in our business operations.

5. Sound and rigorous pursuit of business operations

- We will strive to strengthen governance and risk management and establish and improve compliance awareness among executives and regular employees, as well as ensure sound and rigorous administration with radical autonomy as a non-profit general foundation.
- We will complete our Plan on Expenditures for Public Benefit within the intended period.
- We view information security as the most important issue for management as any security breaches could put the existence of research institute at risk. We will ensure a rich administrative structure by improving technological countermeasures. We will also strengthen IT-BCP measures from a medium- to long-term perspective.

Workforce

The current workforce numbered approximately 840 as of the start of fiscal 2012, and CRIEPI's basic policy aims to reach an equilibrium point of about 800 by the end of FY2015.

Accordingly, we will keep the number of research staff unchanged, but will gradually decrease the number of office staff through streamlining office work and utilizing human resources, and will also be selective in accepting other staff, such as special visiting researchers. We will also carefully review the number of personnel needed for future projects and their makeup, and after reviewing the need for research and operation on an individual basis, we will consider initiatives to reduce the workforce, for example through outsourcing and a suspension of the employment of temporary contract employees.

The workforce in fiscal 2013 is as follows.

(Expected as April 1, 2013)

| Item | Number (people) | Percentage distribution (%) |
|--|------------------------------------|-----------------------------|
| 1. Research | 722 | 87.9 |
| | ※Including 26 visiting researchers | |
| [Breakdown] | | [100.0] |
| (1) Electricity | 115 | 15.9 |
| (2) Civil Engineering and Construction | 92 | 12.7 |
| (3) Mechanical | 100 | 13.8 |
| (4) Chemistry | 69 | 9.6 |
| (5) Biology | 57 | 7.9 |
| (6) Nuclear Engineering | 45 | 6.2 |
| (7) Environmental Science | 43 | 6.0 |
| (8) Information and Communication | 38 | 5.3 |
| (9) Socio-economics | 49 | 6.8 |
| (10) Research Support and Management | 114 | 15.8 |
| 2. Office work | 99 | 12.1 |
| Total | 821 | 100 |

Appendix Table: Operations in Clause 1, Article 4 of the Articles of Incorporation and the corresponding research activities in fiscal 2013 are as follows.

| Operations in Clause 1, Article 4 of the Articles of Incorporation | Corresponding plan |
|--|--|
| (1) Research, studies and experiments on the electricity, civil engineering, environment, thermal and nuclear power, new energy and electricity applications related to energy transmission and distribution | Research activity I. Overall research plan Research activity II. Overall research promotion |
| (2) Research and studies on economics and legislation related to electricity | Research activity I. Overall research plan Research activity II. Overall research promotion |
| (3) Dissemination and utilization of output such as preparation of specifications and standards related to power technology | Research activity II. Research promotion 4 |
| (4) Other items needed to achieve objectives of a general foundation | No corresponding plans in fiscal 2013 |

Statement of Budget

Budget Compilation

The fiscal 2013 budget for CRIEPI operations was compiled based on research plans. The main points are as follows.

1. Changes in general net assets

(1) Ordinary revenue amounted to 2,863 million yen.

- Benefit income from electric utility companies amounted to 26.3 billion yen.
- Business revenue stood at 1,910 million yen.

Of this business revenue, revenue from nationally funded research accounts for 1.0 billion yen.

Other business revenue totals 910 million yen, including revenue from short-circuit tests and revenue from joint research.

- Other revenue, such as interest payments, amounted to 100 million yen.

(2) Ordinary expenses amounted to 29,120 million yen.

- Business costs related to research totaled 27,120 million yen.

Of these business costs, personnel expenditures such as salaries and retirement benefit costs, totaled 10 billion yen.

Operating expenses, including consumable costs, outsourcing costs, and amortization costs amounted to 17,120 million yen.

- Management costs related to headquarters operations were 2.0 billion yen.

Of this, personnel expenditures such as compensation for executive officers, salaries and retirement benefit costs totaled 1,170 million yen. Operating expenses, such as consumable costs, totaled 830 million yen.

(3) Non-recurring costs totaled 234 million yen, consisting of losses on the retirement of fixed assets.

2. Changes in designated net assets

(1) Revenue from funded research, including revenue from the Japan Society for the Promotion of Science, is 90 million yen.

(2) Transfers to general net assets totaled 293 million yen due to amortizations related to the designated net assets included in special assets and other factors.

3. Balance of net assets at fiscal year-end

Net assets in this fiscal period fell a total of 954 million yen, which is the sum of fluctuations in general net assets and designated net assets. Accordingly, the balance of net assets at the end of the fiscal year was 35,641 million yen.

Budget

The fiscal 2013 budget, compiled based on the above, is as follows.

Fiscal 2013 Budget for Revenues and Expenditures

From April 1, 2013 through March 31, 2014

(Unit: Million yen)

| Subject | Budget | Remarks |
|--|--------|---------|
| I Changes in unrestricted net assets | | |
| 1. Operating activities | | |
| (1) Revenues and gains | | |
| ① Benefit income | | |
| Current benefit income | 26,300 | |
| ② Business income | 1,910 | |
| Funded research business income | 1,000 | |
| Other business income | 910 | |
| ③ Other income | 100 | |
| Interest revenue | 5 | |
| Facility use fees received | 90 | |
| Miscellaneous income | 5 | |
| ④ Transfers from restricted net assets | 293 | |
| Total revenue and gains | 28,603 | |
| (2) Expenses and losses | | |
| ① Expenses for projects and programs | | |
| Personnel expenditures | 10,000 | |
| Wages and allowances | 7,460 | |
| Retirement benefit expenses | 1,540 | |
| Welfare expenses | 1,000 | |
| Operating expenses | 17,120 | |
| Consumable costs | 1,080 | |
| Publication costs | 400 | |
| Lighting, heat and water utility costs | 920 | |
| Outsourcing costs | 5,780 | |
| Joint research contribution | 640 | |
| Repair costs | 1,270 | |
| Rental costs | 250 | |
| Tax and dues | 122 | |
| Travel and transportation costs | 720 | |
| Communication and transport costs | 110 | |
| Other operating expenses | 888 | |
| Amortization costs | 4,940 | |
| Sub-total for expenses for projects and programs | 27,120 | |
| ② General and administrative expenses | | |
| Personnel expenses | 1,170 | |
| Executive officer compensation | 153 | |
| Wages and benefits | 627 | |
| Retirement benefit expenses | 128 | |
| Welfare expenses | 160 | |
| Provision for directors' retirement benefits | 102 | |
| Operating expenses | 830 | |
| Consumable costs | 10 | |

| | | |
|--|--------|--|
| Publication costs | 58 | |
| Lighting, heat and water utility costs | 29 | |
| Outsourcing costs | 115 | |
| Repair costs | 15 | |
| Rental costs | 377 | |
| Tax and dues | 10 | |
| Travel and transportation costs | 38 | |
| Communication and transport costs | 18 | |
| Other operating expenses | 110 | |
| Amortization costs | 50 | |
| Sub-total of general and administrative expenses | 2,000 | |
| Total expenses and losses | 29,120 | |
| Total changes in operating activities for the year | Δ517 | |
| 2. Changes in non-operating activities | | |
| (1) Non-operating revenue | | |
| Total non-operating revenue | — | |
| (2) Total non-operating expenses and losses | | |
| Loss on retirement of fixed assets | 234 | |
| Total non-operating expenses and losses | 234 | |
| Total changes in non-operating activities for the year | Δ234 | |
| Total changes in unrestricted assets | Δ751 | |
| Unrestricted assets at beginning of year | 35,667 | |
| Unrestricted assets at end of year | 34,916 | |
| II Changes in restricted net assets | | |
| ① Subsidies received | 90 | |
| ② Transfer to unrestricted net assets | 293 | |
| Total changes in restricted net assets for the year | Δ203 | |
| Net restricted assets at beginning of year | 928 | |
| Net restricted assets at end of year | 725 | |
| III Net assets at end of year | 35,641 | |

