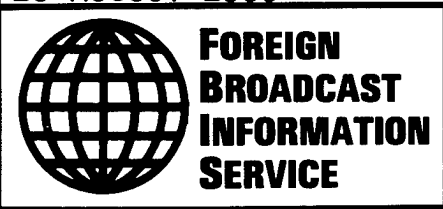


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SCIENCE & TECHNOLOGY

JAPAN

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FY87 Aircraft Procurement List Reported

43062082 Tokyo AEROSPACE in Japanese Apr 88 p 26

[Text] Defense

FY87 Aircraft Orders

On 27 and 29 February, the Central Procurement Office of the Japanese Defense Agency (JDA) contracted for the purchase of almost all of the FY87 aircraft purchases requested by the Ground, Maritime and Air Staff Offices. The exception was the EP-3 aircraft, which is a new purchase for the Maritime Self Defense Force. In the past, most contracts as large as these were concluded at the very end of the fiscal year, in mid-March or later, but for this fiscal year, the contracts have been concluded a month early, and this will facilitate the payment of advancements and contracting for parts. The following is a breakdown of the aircraft and engine orders that have been contracted:

Ground Self Defense Force (GSDF)

AH-1S anti-tank helicopter

Airframe: 8 units; Fuji Heavy Industries; Y7,387 million; delivery
25 March 1990

Engine (T53-K703): 8 units; Kawasaki Heavy Industries; Y1,071.2 million;
delivery 30 November 1989

OH-6D observation helicopter

Airframe: 12 units; Kawasaki Heavy Industries; Y1,572 million; delivery
10 March 1989

Engine (Alison 250C-20B): 12 units; Shin Toa Koeki; Y248.73 million;
delivery 30 September 1988

HU-1H multipurpose helicopter

Airframe: 8 units; Fuji Heavy Industries; Y3,220 million; delivery
24 March 1989

Engine (T53-K13B): 8 units; Kawasaki Heavy Industries; Y802.4 million;
delivery 30 November 1987

C4-47 transport helicopter

Airframe: 4 units; Kawasaki Heavy Industries; Y13,696 million; delivery
24 March 1990

Engine (T55-7-2): 8 units; Kawasaki Heavy Industries; Y2,113.6 million;
delivery 30 September 1989

Maritime Self Defense Force (MSDF)

P3-C anti-submarine patrol aircraft

Airframe: 9 units; Kawasaki Heavy Industries; Y33,860.871 million;
delivery 20 February 1991

Engine (T56-14): 36 units; Ishikawajima-Harima Heavy Industries; Y8,172
million; delivery 16 July 1990

Propellers (54H60-77): 36 sets; Sumitomo Precision Products; Y2,352.132
million; delivery 16 July 1990

U-36A training support aircraft

Prototype (Lear Jet 36A): 1 unit; Toyo Menka; Y844.16 million; delivery
15 December 1988

Remodeled U-36A: 1 unit; Shin Meiwa Industry; Y326.48 million; delivery
30 March 1990

Remodeled KM-2 basic pilot training aircraft

Airframe: 2 units; Fuji Heavy Industries; Y461.44 million; delivery
28 March 1989

Engine (250-C20B): 2 units; Shin Toa Koeki; Y53.565 million; delivery
30 November 1988

LC-90 liaison aircraft

Prototype (TC-90): 1 unit; Itoh Aviation; Y214.5 million; delivery
15 October 1988

Aircraft remodeled into LC-90: 1 unit; New Japan Aircraft Servicing Company; Y95.14 million; delivery 7 February 1989

HSS-2B anti-submarine helicopter

Airframe: 17 units; Mitsubishi Heavy Industries; Y21,369 million; delivery 20 March 1990

MH-53E minesweeping helicopter

2 units; Mitsubishi Corporation; Y6,398 million; delivery 30 March 1991

OH-6D basic pilot training helicopter

Airframe: 2 units; Kawasaki Heavy Industries; Y242.38 million; delivery 15 March 1989

Engine (250-C20B): 2 units; Shin Toa Koeki; Y42.037 million; delivery 10 March 1988

Air Self Defense Force (ASDF)

F-15 fighter

Airframe: 12 units; Mitsubishi Heavy Industries; Y44,610.6 million; delivery 29 March 1991

Engine (F100-IHI-100): 24 units; Ishikawajima-Harima Heavy Industries; Y23,592 million; delivery 31 August 1990

T-4 medium class training aircraft

Airframe: 20 units; Kawasaki Heavy Industries; Y26,840 million; delivery 30 March 1990

Engine (F3-IHI-30): 40 units; Ishikawajima-Harima Heavy Industries; Y9,280 million; delivery 30 September 1989

CH-47J transport helicopter

Airframe: 2 units; Kawasaki Heavy Industries; Y6,805.4 million; delivery 31 January 1990

Engine (T55K-712): 4 units; Kawasaki Heavy Industries; Y1,054 million; delivery 15 August 1989

V-107A rescue helicopter

Airframe: 4 units; Kawasaki Heavy Industries; Y3,166.4 million; delivery 28 February 1990

Experimental Production of Afterburner for F3

Recently, JDA's Technical Research and Development Institute (TRDI) placed a Y302.155 million order with Ishikawajima-Harima Heavy Industries for research and experimental production of a reheating fan engine.

This reheating fan engine refers to the so-called afterburner of a jet engine. Specifically, afterburner equipment for supersonic speeds will be attached to a subsonic speed F-3 engine, which was developed for T-4 use, and then will be tested. The goal is to increase thrust by 1.5 times or more. Since the thrust of the F-3 is 1.6 tons, the F-3 with afterburner will have a thrust of 2.4 tons.

Incidentally, according to TRDI's plan, after experimental production of a complete engine such as the F-3, research will be conducted on each component and then an engine consolidating these components will be manufactured at the proper time. Experimental models of high-performance engine control equipment, fans, etc., have been produced, and after production of the afterburner, blades are to be experimentally produced in FY88.

Remodeling of F-4, F-104

Under the FY87 budget, ASDF placed an order with Mitsubishi Heavy Industries to improve the capability of the F-4EJ and convert the F-104J into a robot aircraft. Full-scale implementation of both of these remodeling tasks was to begin in FY87.

Airframe remodeling for the purpose of raising the capability of the F-4EJ: To realize full-scale implementation of the plan to improve capability through remodeling, which is substantiated by experimental production of two units, a Y4,065.056 million contract for the remodeling of eight units was concluded with Mitsubishi Heavy Industries under the FY87 budget. Delivery is for 31 March 1990, but this contract only covers remodeling the aircraft with materials that are ordered separately by the government.

Experimental remodeling to convert the F-104 to a robot aircraft (Part 1): An order was placed with Mitsubishi Heavy Industries for Y2,815.763 million, which will cover system design, aircraft remodeling design and experimental remodeling of two aircraft. Delivery is for 30 September 1989. The first flight of the experimental aircraft will be in FY89, and it will be tested in FY90-FY91. At the same time, however, full-scale remodeling work will commence, and after the testing has been completed, equipment will be installed in the mass produced remodeled aircraft in FY92.

12967/08309

30-Year Energy Technology Forecast Released

43062547 Tokyo ENERUGI FORAMU in Japanese Dec 87 pp 78-81

[Article by Isao Hashiguchi and Satoru Kondo, chief researchers, of Future Engineering Research Institute: "Investigative Report on Energy Technologies Forecasting"]

[Text] Recently, the Science and Technology Agency carried out an investigation of technology forecasting for the next 30 years according to the Delphi method (repeated questionnaire method), and released the investigative results in an effort to find a technological development orientation from the long-term viewpoint. Forecasting research was begun in 1971, and has been carried out at approximately 5-year intervals. The current research is the fourth investigation conducted by the Future Engineering Research Institute as assigned by the Science and Technology Agency. The total number of forecasting problems to be resolved has reached 1,071 subjects, covering 17 fields. It is a large-scale research project which is the first of its kind in the world. In this article, the authors will outline the results found for the energy field in particular.

The Future Engineering Research Institute has selected 51 topics from the viewpoint of the respective energy policies of (1) fossil energy, (2) nuclear energy, (3) natural energies, such as solar heat, (4) biomass, (5) energy application technology (superconductivity, heat pumps), which are all arranged based on the major future needs and from the viewpoint of the respective energy processing methods of (1) probing, (2) sampling and extraction, (3) transportation and storage, (4) power generation, (5) improved application of resources, (6) improved substitution, etc.

The research items specified per topic, which were investigated by the research institute, cover "degree of importance," "time of realization," "restrictions regarding the realization or non-realization," "promotion method of research and development," "major party of research and development promotion," and "national policy". Questionnaires were issued twice to energy experts selected from industrial, academic and governmental circles in June and October 1986. (The number of respondents to the second questionnaire numbered 131.)

Highly Evaluated Nuclear Energy and Coal

The institute requested each respondent to evaluate the degree of importance of a given problem or topic according to Japan's social situation. Therefore, the subject evaluated as the most important in this field can be believed to be the most important problem to be resolved in terms of Japan's energy security. The results of the evaluation disclose that the subjects evaluated as having "great" and "medium" degrees of importance by a majority of the respondents amount to 8 and 26 problems, respectively, sharing about 70 percent of the total answers. This reveals that energy-related problems are believed to be the most important subject in the effort to maintain and develop Japanese society in the future.

As clearly indicated in Table 1, the seven problems whose degrees of importance are ranked the highest are shared by nuclear energy-related topics, revealing that the importance of nuclear energy as Japan's main energy source will be ever-increasing in the future. The problem evaluated as being the most important covers waste disposal processing and the high breeder reactor (HBR), including nuclear fuel cycles. The spent fuel stored in the light water reactor site can be thought of as a precious energy resource in a sense. However, these spent fuels can be practically used for the first time only when reprocessing and waste processing technologies are established. It is absolutely necessary for Japan to further develop these technologies and the reprocessing methods for fast reactor fuels and low cost fast breeder reactors (FBR) since Japan is not blessed with uranium resources. Therefore, the development of these technologies is believed to be the most important in the effort to maintain Japan's future energy levels.

In addition to nuclear energy, coal application related technologies, such as coal gasification, is thought to be extremely important. This is because the quantity of worldwide coal resources is huge compared to that of petroleum, and the establishment of this application technology will be capable of improving the degree of safety in terms of security due to the verification of energy resources.

On the other hand, natural energy related technologies, such as wind and wave power generation, which are low in energy density, are evaluated as being "less important." This is because they involve a small amount of energy resources which are only applicable to improving the economical efficiency of solitary island service or as a part of multipurpose application and they cannot, at this time, be expected to be promising basic energy resources in terms of cost.

Important Problems To Be Realized in 21st Century

As illustrated in Figure 1, "Distribution of Realization Period," the realization period of the important problems forecast by all of the respondents are concentrated on the years 2001 to 2015, during which it is thought that 43 problems (84 percent) will be realized, while it is believed that only a small portion of the problems can be realized before the year

Table 1. Ratios of Problems Evaluated as Having "Great" Degrees of Importance (10 Highest Ranking Problems Included)

Problems	Degree of importance (%)	Realization (year)
Realization of practical application of storage control and disposal technologies to high levels of solidified radioactive waste.	88	2002
Realization of practical application of FBR system (Fast Breeder Reactor) including nuclear fuel cycles.	86	2013
Realization of practical application of processing and disposal methods involving low level radioactive wastes and their reutilization methods.	82	1999
Development of fusion reactor.	67	beyond 2015
Realization of unmanned nuclear power facilities (reactors, fuel cycle systems) with remote monitor and robotic systems.	63	2004
Separate nuclides having long half-life from high level radioactive wastes. (Example) Separation of ^{137}Cs ^{40}Sr and many actinoids.	58	2006
Development of new uranium enrichment technology based on laser methods, etc.	57	1998
Coal gasification complex cycle-based power station to be put into practical service.	53	2002
Large complex cycle-based power generation to be put into practical service by application of advanced highly efficient gas turbine (entry temperature 1300°C).	49	2002
Large area amorphous silicon solar cell with more than 12 percent cell conversion efficiency to be put into practical service.	45	2001

2000. It is generally believed that only a small portion of the problems can be realized with relative ease. The average realization period forecast is the year 2006. The processing and disposal of radioactive wastes, laser uranium enrichment, coal gasification, and gas turbine use are predicted to be resolved and put into practical service before 2005. However, the practical application of the "FBR system including the nuclear fuel cycle" is forecast to be realized in 2013. All of the respondents join those who regard the degree of importance as being "great" in finding it difficult to imagine the realization of the development of a nuclear fusion power demonstration reactor during the next 30 years.

Economic Restrictions Block Realization

The great majority of respondents point to "economic restrictions" and "technological restrictions" as being the major restrictions hindering the resolution of the problems. As a matter of fact, the problems regarded as being "impossible for practical application" due to these two restrictions amount to 21 subjects (41 percent) and 22 subjects (43 percent), respectively. In the field of energy, "technological restriction" or "economic restriction" constitute the restricting conditions hindering the resolution of almost every problem. Compared with other technological fields, the energy field features special problems which are subject to substantial economic restrictions.

Problems calling for the elimination of "technological restrictions," shared by more than 90 percent of respondents, amount to 4 subjects and include "development of a nuclear fusion power demonstration reactor" and the practical application of large complex cycle power generation based on a highly efficient gas turbine." As for nuclear fusion, the process to attain "critical condition" and the realization of the "self ignition" condition still require further technological breakthroughs. Especially, the technological breakthroughs involving high temperature materials are still thought to be difficult in terms of the gas turbine referred to previously. The problems which are predicted as impossible to realize before 2015 are limited to those faced with "significant technological restrictions."

On the other hand, problems cited as involving predominantly "economical restrictions" by the respondents are found to include those related to the fuel cell, methanol fuel, natural energy, coal and petroleum. As for electric power, the competition between nuclear power (light water reactor) currently available and thermal power constitutes the restricting condition, while the competition between gasoline and such engine fuels as light oil and heavy oil similarly constitutes the restrictive condition for transporting energy. However, these problems are subject to fluctuations in the cost of resources, such as oil prices, to a great extent.

Small and medium nuclear reactors designed for use in urban areas, and nuclear energy related problems, such as the processing and disposal of low level and high level radioactive wastes and the nuclear energy industrial complex, are cited as problems subject to "social restrictions,"

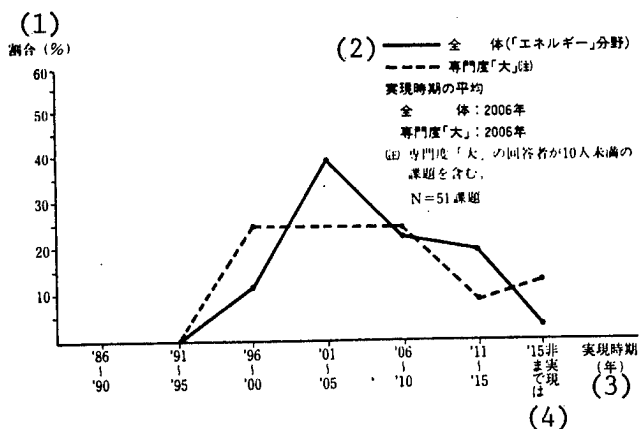


Figure 1. Distribution of Realization Period

Key:

(1) Percentage (%)

(2) ——— The entire energy field

- - - - - Degree of importance ranked as "great"

Average realization period

Total: the year 2006

The degree of importance ranked "great": the year 2006

Note: This includes subjects for which fewer than 10 respondents evaluated the degree of importance as "great"

N = 51 subjects or problems

(3) Realization period (year)

(4) Impossible to realize

comprising a greater percentage of the answers. With regard to the processing and disposal of radioactive wastes, and the installation of nuclear reactors in urban or industrial areas, it is absolutely necessary to have the public's confidence that nuclear reactors are free of hazards and safer than any other method.

Development of Independent Technology Urged by Many

With regard to the method of promoting research and development, the problems for which a great majority of respondents favor "development of independent technology" are composed of as many as 31 topics (shared by 61 percent). This clearly indicates the general trend favoring the development of independent technology. Subjects for which the promotion of independent technology is strongly urged include fuel cells, solar cells, geothermal applications, high temperature gas materials, and heat pumps. on the other hand, subjects for which the promotion of international joint development is called for comprise 13 topics (shared by 25 percent). High expectations are particularly placed on nuclear energy-related large

projects, such as nuclear fusion, FBR, processing and disposal of high level radioactive wastes and petroleum-related subjects, which are more cost effective when carried out overseas, since such resources as petroleum extraction from oil shale or oil sand and forced pumping from petroleum natural gas wells are available at low cost in foreign countries.

Private Sector-Based Promotion Measures Supported Only by Minority

Problems for which a great majority of respondents favor "joint promotion by national and local public organizations, including the private sectors" numbers as many as 42 topics (shared by 82 percent), generally indicating that high expectations are placed on the promotion of technological research and development through cooperation between the government and the people.

More than 80 percent of the problems requiring joint development by the government and the people comprise four subjects, that is, "practical application of FBR system including nuclear fuel cycle," "practical application of storage and disposal technologies of high level radioactive wastes," "practical application of processing/disposal and reutilization method of low level radioactive wastes" and "practical application of direct coal liquefaction technology." Especially, vast technologies faced with the practical application of FBRs or the processing of radioactive wastes indicate that closer cooperation between the government and the people is demanded.

Problems for which high expectations are placed on the promotion by the government and the people include such topics as "the development of a nuclear fusion reactor power demonstration reactor," "the development of annihilation disposal/nuclear conversion technologies of radioactive wastes by high energy elementary particles," and "the confirmation of the potential for engineering utilization of elementary particles." They are still in the stage of confirmation of principles or phenomena and are closely associated with vast science technologies demanding many technological breakthroughs. The subjects for which relatively high expectations are placed on the private sector-motivated drive are not found among basic energies, such as methanol energy and solar cells, but are found among energies for other services.

The problems for which "funds" or financial problems dominate other subjects as national politics number 46 topics (shared by 90 percent) and call for maintaining research/development funds involving many subjects.

Relaxed Petroleum Situation Reduces Need for Technological Development

Of the problems included in the current investigation, 9 topics are identical while 29 topics are similar to those included in the previous investigation. The 29 subjects whose degree of importance is regarded as "great" are reduced in ratio compared to the previous investigation, while 10 subjects have been reduced by more than 15 percent. In general, the investigation reveals a slightly declining trend. In addition, when

the forecasting realization periods are compared for the same 9 subjects, it is indicated that the average delay is 6 years behind schedule. Six problems are more than 5 years behind schedule, and their forecasting periods tend to lag behind schedule when compared to the previous investigation. The causes of delay may be explained by the fact that the development needs have slackened somewhat reflecting the recent worldwide petroleum demand and supply situation, thereby slowing the development pitch. Even the evaluation results of the first forecasting research carried out 16 years ago reveal that the energy field is greatly subject to the changes in the economic and social environment, such as the balance between the demand and supply of energy.

Application of Superconductivity and Electric Equipment May Be Accelerated

The discovery of perovskite-based superconductivity substances by Muller of IBM Zurich Research Institute in Switzerland created the international fever to develop high temperature superconductivity materials. However, when the second questionnaires regarding the present investigation were transmitted, Muller's discovery had not been made public. As a result, this investigation has been prepared without reflecting the influence of this fever. With regard to materials in particular, discontinuous or unexpected development cases are often observed. The discovery of superconductive materials illustrates the limitations of technological forecasting, and is an extremely valuable example in this respect.

In view of the recent development trend of superconductive materials, a third investigation was carried out regarding superconductivity-related subjects in the fields of "substances, materials and processing." Figure 2 shows the results of this investigation. As indicated in the figure, the forecasting realization periods for all the subjects have been expedited, thereby upgrading the evaluation of the degree of importance. In particular, the forecasting realization periods for the practical application of superconductive materials at a critical temperature exceeding that of liquefied nitrogen have been expedited from 2011 to 1994, thus shortening the period by 17 years. On the other hand, the forecasting realization period for the very large conduction coils to be used for electric power storage is not subject to a marked change, because the materials currently discovered are based on ceramics and have failed to produce the proper wire rod or thin film, and the electric current density is still insufficient.

When an attempt is made to evaluate the energy related-problems from the aforesaid standpoint, the forecasting realization periods of the "practical application of a superconductive energy storage system" of the "development of a nuclear fusion reactor power demonstration reactor" have been expedited somewhat, but are not subject to influence to a great extent. On the other hand, it is believed that the forecasting realization periods for such problems as the "popular application of superconductivity-based electrical equipment in industry" or the "practical application of superconductivity-based power generation and transmission" have been expedited to a great extent. In either case, the further technological development in this field has been forecast. At the same time, high expectations are placed on the application of technology to such services as power generation and transmission, nuclear fusion and energy storage.

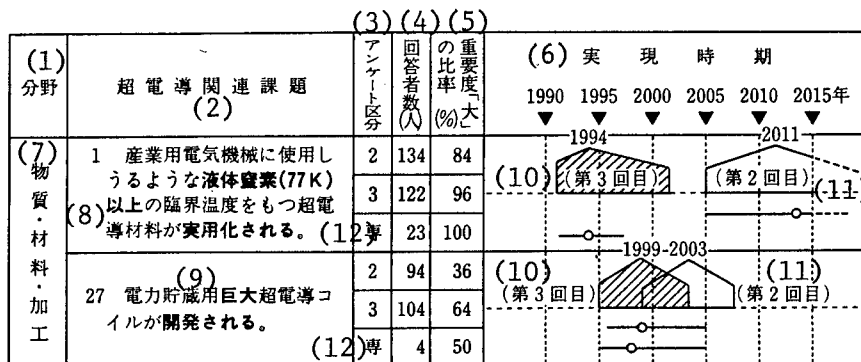


Figure 2. Forecasting Results of Superconductive Materials

Key:

- (1) Field
- (2) Superconductivity-associated problems
- (3) Classification of questionnaire
- (4) Number of respondents
- (5) Degree of importance evaluated as being "great" (%)
- (6) Realization period - year
- (7) Substances, materials and processing
- (8) 1 Superconductive materials having critical temperatures exceeding that of liquefied nitrogen (77K) applicable to industrial electrical equipment can be put into practical service
- (9) 27 Massive superconductive-based coils for storing electricity can be developed
- (10) Third investigation
- (11) Second investigation
- (12) Professional level

Mirror Reflecting Changes in Economy and Society

The investigative results of technology forecasting for the next 30 years clearly indicate that the weight of nuclear energy will increase continuously and that the verification of such energies as coal is also important. Moreover, the investigation helps us understand the forecasting realization periods of these problems and the promotion direction of research and development. As is the case with superconductivity, it has been confirmed that technological breakthroughs can expedite the realization period of the associated problems and are effective in upgrading the degree of importance.

The investigative results are believed to form a valuable database when planning future research and development, exploring future technology prospects, or forecasting changes in future society if it is necessary to change our viewpoint about technological innovation or economical and social technologies. Therefore, the authors hope that the readers of this

article, based on the respective standpoint, will attempt to make the best use of the information contained in this report in the development of future scientific technology and societal progress. For those who wish further information, please read "Japan's Technologies," published by the Future Engineering Research Institute (two volumes).

In conclusion, the authors wish to express their appreciation to Professor Umetaro Yamaguchi of Tokyo University who is in charge of this section and to the many experts who kindly participated in the questionnaire.

20136/7310

Nuclear Development-Related News Updated

43062086 Tokyo GENSHIRYOKU SANGYO SHIMBUN in Japanese 12 May 88 p 2

Commencing Testing of 3-Percent Enrichment by Chemical Method

(1) Asahi Chemical Industry Co., Ltd.

Commencing Testing of 3-Percent Enrichment by Chemical Method
Comprehensive Evaluation to Be Undertaken This Year
Demonstration by Means of a "Super" Method

[Text] Asahi Chemical Industry Co., Ltd., which has been studying chemical methods for uranium enrichment, has since March been conducting industrial demonstration tests involving the use of an enrichment tower model plant, which measures 1 meter in diameter and is located in the City of Hyuga, Miyazaki Prefecture. By the end of the year, the company hopes to draw conclusions from its development effort and conduct evaluations, including economic analyses.

At the model plant, which started test runs in December 1986, the company conducted preliminary tests in July 1987, and succeeded in harvesting some 3 kilograms of uranium enriched to a 1.5-percent concentration. Since September of that year, the company has been conducting tests involving continuous extraction of enriched uranium.

Further, since November of that year, the company has conducted enrichment experiments designed to achieve sufficient reproducibility and stability. After a concentration of 1.8 percent was achieved, between December and January 1988 the company successfully extracted 1.8-percent uranium batches continuously for one month.

The chemical method for uranium enrichment involves passing a solution of uranium through an ion exchange resin. The underlying principle of this method is that the ion exchange process results in a slightly higher concentration of uranium 235 deposited on the resin. By repeating the deposition and dissolution cycles thousands of times, the process yields a 3-percent enrichment of uranium 235.

Earlier in 1972, the U.S. Atomic Energy Commission, studying the feasibility of this method, concluded that because of the exceedingly small degree of

enrichment that can be achieved per cycle it would take 560 years to produce a 3-percent concentration. A similar study conducted by the French Atomic Energy Agency in 1978 held that it would take a year and half. Through independent development of ion exchange resins, however, Asahi Chemical Industry Co., Ltd. has determined that the same degree of enrichment can be achieved in three months.

Recently, the company has developed a process called the "super" method, whereby regeneration of the oxidizing and reducing agents for attaching uranium 235 to the resin and removing the same from the resin is carried out in the same enrichment tower, and has demonstrated its high economic potential.

Applying the "super" method to the operation of the model plant, since March of this year the company has been conducting experiments intended to accomplish a 3-percent enrichment. During FY 1988 the company is planning to put together a report summarizing the results of its research effort and evaluating the performance of the process.

In view of the recent easing of demand relative to supply of enriched uranium and the decline in the price of imported enriched uranium due to the appreciation of the yen, enriched uranium is a buyer's market. However, the company expects the process it is developing to prove commercially viable in the future.

These results were reported at the uranium discussion meeting of the Atomic Energy Commission held on 26 April.

(2) Reactor Core Thermal Design Guidelines Established by the Atomic Energy Safety Commission

Intended for Pressurized Water Nuclear Reactors

[Text] The Atomic Energy Safety Commission established "Guidelines for Reactor Core Thermal Design and Evaluation for Power-Generating Pressurized Water Nuclear Reactors" on 21 April.

The purpose of the guidelines is to assess the appropriateness of reactor core thermal design relating to the critical thermal flux in pressurized water reactors (PWRs) for power generation (a thermal flux whereby there is a drop in heat conduction from the fuel-clad tubes to the coolant, resulting in a surge of temperature in the fuel-clad tubes).

In accordance with the "Guidelines for the Review of Safety Design on Power-Generating Lightwater Nuclear Reactor Facilities" and the "Guidelines for Review of the Safety Assessment of Power-Generating Lightwater Nuclear Reactor Facilities," the new guidelines are intended to ensure adequate evaluation of minimum critical thermal flux ratios (minimum DNBRs) during routine operations and in the event of abnormal transient changes during operation of a power-generating pressurized water nuclear reactor.

The guidelines provide that even if evaluation of a reactor core thermal design relating to critical thermal flux is not in compliance with the guidelines, such a design will not be rejected outright if there are acceptable grounds for the divergence.

The guidelines are also subject to revision in the future as new information comes into light through design improvements or through accumulation of experience.

According to the judgement criteria provided in the guidelines, the minimum DNBR will be the allowed limit or less for routine operation or in the event of an abnormal transient change during an operation.

One of the necessary requirements for evaluation is the DNB correlation formula. Such a formula must: (1) be prepared based on a test encompassing the principal dimensions of a fuel assembly; and (2) take into consideration the effect of any non-heat-generating rods in the fuel assembly and the effect of any non-uniform distribution of generated heat in the axial direction. Also, (3) if an evaluation is to be made by taking into consideration the effect of fuel assembly support grids, the formula must be based on tests simulating the fuel assembly support grids, and the reasonableness of such tests must be demonstrated; and (4) the reactor core coolant conditions must be included in the coolant conditions in the tests forming the database for the preparation of the DNB correlation formula.

Also, the reasonableness of the subchannel analysis code used for the evaluation of the minimum DNBR must be demonstrated by comparison with test data.

Furthermore, the principal input data must be selected in such a way as to make the results of the evaluation stringent; however, any principal input data that are reasonable within the scope of the objective of the assesement may be employed.

Also, if minimum DNBR assessments are to be carried out by statistical thermal design techniques, the evaluation of the probability distribution of DNBRs must be performed adequately, and appropriate evaluation of probability distribution of the input data to be treated statistically must be made.

(3) The Power Generation Facility Inspection Association Establishes a Policy Regarding the Initiation of Maintenance Management Research

[Text] As part of its 1988 project plan, the Power Generation Facility Technology Inspection Association has decided to conduct (1) tests on nuclear reactor vessel pressurization and thermal shock tests, (2) demonstration tests on practical nuclear power generation facility inspection technology, (3) development of techniques for prolonging the service life of nuclear power plants, and (4) development of a technology for improving the operating efficiency of lightwater reactors.

Pressure vessel pressurization and thermal shock tests are being conducted, since 1983, over a course of 7 years to ensure the integrity of pressurized nuclear reactor vessels which have become fracture-prone due to the effects of neutron radiation. This year, based on the tests conducted to date before and after irradiation, the Association will conduct an overall evaluation of the impact of neutron radiation on fracture toughness of reactor structures.

Also, using materials simulating the condition of reduced toughness, the Association will conduct modelling experiments in order to evaluate and demonstrate the behavior of fractures under pressurized thermal shocks.

The practical nuclear power plant facility inspection technology demonstration test program involves the development of a Reinack X-ray fault probe method, ultrasonic holography, and an electromagnetic ultrasonic defect probe method in order to improve the accuracy and efficiency of inspection methods. This year, the Association will conduct at its Tsurumi Test Center performance assurance of inspection equipment manufactured in preceding years, and undertake research and enhancement efforts with a view toward achieving practical utilization of such equipment.

The program for prolonging the service life of nuclear power plants will initiate some tests based on a prolongation technology development demonstration test plan, which has been drawn up according to the results of feasibility studies, and will evaluate component technologies and carry out system design work.

Of the lightwater reactor operating efficiency enhancement technology development projects, the development of techniques for conducting in-operation inspections will be pursued by fabricating basic test units and running experiments using vibration, oil analysis, and ultrasonic methods whose development started last year. The Association will also evaluate techniques for testing during plant operation the integrity of motors and valves. In the area of streamlining the process of safety certification, an important element of the effort to develop a technology ensuring high operational efficiency of lightwater reactors, the Association will study specific check items, taking into consideration the need for extended cycle operations. The Association, along with proposing an implementation plan, will study optimal certification methods for ensuring a high rate of reactor operation through the life cycle of the reactor. Further, for streamlining the certification methods, the Association will evaluate the effectiveness of integrity evaluation methods and test procedures, and will study procedures applicable to real systems.

Starting this year, the Association will undertake technology evaluation research on the inspection and maintenance management of fossil fuel and nuclear power plants.

In the area of testing and inspection of the welding of power generating equipment being conducted by the Association, the Association is planning to inspect a total of 19 facilities, including both existing and new fossil fuel and nuclear power plants, (10 fossil fuel and 9 nuclear power facilities); for a total of 14.8 MKW in generating capacity (6.5 MKW for fossil fuel and 8.3

MKW for nuclear); and some 400,000KW for private fossil fuel power generating facilities.

The Association is planning to participate in routine inspections of 11 nuclear reactors for nuclear power generation as a continuation of work from last year, and 27 nuclear reactors as new starts for FY 1988.

(4) Laser Enrichment Research Consortium Establishes Policies

Priority Effort on Equipment Improvements Extended Performance Tests Envisioned

[Text] The Laser Enrichment Research Consortium (Chairman of the Board of Directors: Masatoshi Toyoda) has put together a project plan for 1988. The Consortium was established in April 1987, drawing most of its membership from electric power companies, pursuant to the Mining Industry and Technology Research Consortium Act, in order to carry out enrichment tests using an experimental uranium enrichment machine during 1990, in accordance with the Atomic Laser Act.

Over the course of a four-year project, the Consortium hopes to set up a system with an annual enrichment capacity of 1 to 1.5 tons SWU, about one-hundredth of the capacity of a commercial plant.

According to the new project plan for the year, the Consortium will give priority to the development of component technologies for experimental apparatus, such as laser equipment, and the enhancement of the enrichment separation cell apparatus.

In the area of development of a copper vapor laser, the Consortium will design, fabricate, and enhance an amplifier in the 100-watt power range, considered to be the optimum for the purpose, and will conduct performance evaluations from the standpoint of assuring long-term operation. Further, with the goal of developing a high-output laser, the Consortium will conduct laser performance tests, such as the stability and output stability of laser generation.

In the area of development of a color laser, the Consortium will carry out experiments using a previously fabricated 40-W color laser; in addition, it will make improvements in the equipment in order to achieve greater stability in oscillation frequency.

In the development of separation cells, the Consortium will conduct evaluations on the reactivity of a previously selected material with uranium, the fluidity of uranium, and its compatibility with larger systems, in order to select materials to be used for the construction of a real machine. The Consortium will undertake improvements in the vapor recovery unit and will conduct performance tests by designing and constructing a vapor recovery unit on the scale of the experimental system.

The Consortium will carry out improvements on the linear filament electron gun used to vaporize uranium metal, and will conduct performance evaluations by designing and building a 300-kilowatt electron gun.

In the area of overall design of the experimental system, the Consortium will advance from the basic design carried out last year to the detailed design phase.

The Consortium will also continue to run experiments using preliminary experimental machines, previously conducted by electrical utility companies as a research topic common to the whole electrical industry. During the new fiscal year, the Consortium will conduct uranium enrichment experiments using three different wavelengths and three experimental phases.

(5) Capable of Realtime Measurements

Fuji Electric Co., Ltd. Develops a Rem Counter

[Text] Fuji Electric Co., Ltd. has recently developed a lightweight, highly sensitive rem counter for measuring on a realtime basis the amount of neutron radiation leaking from an atomic power facility or accelerator.

Until now, Japanese companies have been relying on imported neutron radiation meters, but these meters have had the drawbacks of excessive weight, lack of mobility, and lack of sensitivity.

By contrast, the new apparatus made domestically by Fuji Electric Co., Ltd. uses a helium proportional counter in its sensor part, and is capable of measuring neutron radiation with a high degree of sensitivity; it agrees well with the rem response standards of the International Committee on the Protection from Radiation (ICRP); it incorporates a spherical detector with excellent directionality, and has been designed with utmost attention to detail in order to achieve size and weight reductions.

Also, the display unit of the system uses a combination of an LED and LCD to provide both analog and digital displays, making it easier to read data. Also, it incorporates a built-in 8-bit microcomputer. Offering an automatic measurement range and time constant switching capability, when a measured value reaches a certain level of precision, the unit displays an indicator indicating that the data are now ready for reading.

Also, the device allows integrated radiation amount measurement (with a preset timer), as well as measurement of the rate of radiation. It also supports the "remaining time for measurement" display and self-test capabilities.

As for specifications, the device offers a detection sensitivity of 50 cps/millirem/hour and a measured radiation rate range of 10 microrems/hour to 999.9 millirems/hour. With a size of 210 millimeters x 314 millimeters (at the longest part), the device weighs 6.5kg.

The range of display is 0.1-999.9 microrems/hour or 0.1-999 millirems/hour in the digital display part; 10^{-6} microrem/hour in the analog display part. The

device is capable of 12 hours of continuous operation and offers an energy range of 0.025 electron volt to 8 mega electron volts; it uses nickel-cadmium batteries (rechargeable by a recharger supplied with the main unit).

In addition to the recently developed neutron survey meter, Fuji Electric Co., Ltd. has also completed commercialization of a neutron area monitor. The company is working on establishing a rem response neutron radiation measurement system, including a personal radiation exposure dose meter designed for neutron radiation.

(6) Japan Atomic Energy Research Institute

Begins Research on a Harsh Environment Sensing System Intelligent Robots for Use in Nuclear Power Plants Flexible Response

[Text] As a new program to be launched in FY 1988, the Japan Atomic Energy Research Institute has started research on a harsh environment sensing system toward the development of intelligent robots for use in nuclear power plants. This year's plan calls for the development and testing of various sensing devices that can be operated in an intensely radioactive environment and research on intelligent sensors that can be used in harsh environmental conditions. The ultimate goal of this long-term plan is development of basic technology for constructing an intelligent system that can withstand a radiation intensity of 10^6 roentgens per hour. For this effort, the Institute is earmarking 69 million yen from this year's budget.

Nuclear power plants have a crying need for the development of automated remote control systems (intelligent robots) capable of dealing with unpredictable situations in a flexible manner in an environment where radiation levels lethal to human beings prevail. The first step toward achieving this goal would be a sensor system technology that would enable the robot to assess the conditions prevailing in the harsh environment. However, the existing sensor systems for use in remoted control robots can work only in low-radiation environments.

In view of this fact, the Institute is undertaking research on the development of a basic technology toward the construction of a harsh environment sensor system capable of withstanding a radiation rate of 10^6 roentgens per hour, a cumulative radiation dose of 10^8 or 10^9 roentgens, and an ambient temperature of 200 degrees Celsius, parameters which are considered to represent the harshest conceivable conditions prevailing in a nuclear power plant; such a sensor system should also be capable of operating in a small, narrow space.

As a necessary step, this year the Institute will undertake the development of various sensing devices capable of operating under high temperature, pressure, and magnetic field, as well as offering a high degree of tolerance to the effects of intense radiation, and will undertake research on intelligent harsh environment sensor technology using ultrasonic devices which are considered to offer a high degree of resistance to radiation, with the goal of developing intelligent systems capable of withstanding extremely harsh environments. In the development of harsh environment sensing devices, the Institute will

this year undertake research toward improving the radiation tolerance of photoelectric conversion devices and photoelasticity devices for use in fiber optics technology, since this technology offers much promise because of its strong resistance to the effects of electromagnetic radiation, and its potential for application in non-contact measurements.

Toward this goal, the Institute will acquire photo-application sensing devices and optical instruments as necessary hardware resources.

As for future plans, the Institute will continue the development of optical sensing devices; also starting in 1990, it will undertake the development of sensing devices for remote control of ultrasonic sensing devices.

In the area of intelligent harsh environment-tolerant sensor technology, the goal is to develop systems capable of accurately assessing the conditions prevailing in a given environment, based on signals received from harsh environment-tolerant sensors. During FY 1988, the Institute will conduct as a priority task the development of environmental sensor methods using substitute devices that are more radiation-tolerant.

In the area of vision research, the Institute will conduct research on ceramics ultrasonic devices which are more radiation-resistant than a conventional TV camera. Similar research will be carried out in the area of environmental sensing based on contact sensing.

Toward this goal, the Institute will assemble experimental intelligent harsh environment-tolerant sensors, and will undertake the development of intelligent sensor software well attuned to the hardware.

As for future plans, the Institute aims to develop by 1992 intelligent signal processing techniques for use in individual, environmentally tolerant sensors. Concurrent to this effort, the Institute will also during the 1991-1992 period undertake the development of a comprehensive intelligent sensor system integrating individual sensors.

(7) Aida Engineering, Ltd. to Form a Business Tieup with a West German Firm - Taking up Work on Laying Foundations for Nuclear Power Plants

[Text] Aida Engineering, Ltd. [AE] has recently signed a business tieup agreement with Bauer Company (headquartered in Schrobenhausen, FRG), one of Europe's leading foundation construction companies.

Under the tieup, AE will work on soil-hardening for constructing foundations for nuclear power plants and radioactive waste disposal sites, construction of underground continuous walls for water leak prevention, construction of piles for supporting large buildings, and ground improvement of soft grounds. Bauer Corporation has had experience in the design and execution of all phases of such foundation work, and is a leading European supplier of special machinery used in construction work.

The tieup allows AE exclusive use of Bauer's know-how in Japan. In addition, it provides for joint research on new technologies based on AE's software automation technology, exploration of Japanese markets for Bauer's foundation construction equipment, and joint bidding on foundation construction projects in third-party countries. As a first result of the business tieup, AE has purchased a "BC-30" underground continuous wall excavator, which is scheduled to arrive in Japan in November.

The BC-30 is a deep-ground excavator for construction of underground continuous walls; it is capable of excavating, at a width of 1.5 meters, to a depth of 100 meters. The equipment is capable of handling soft sedimentation/clay layers, gravel layers, limestone rocks, sand rocks, and related medium-hardness rocks (105 kilograms/cubic centimeter). It is also capable of directly cutting the joints of a previously constructed concrete continuous wall. Also, through the use of an electronic verticality measurement apparatus, the system is capable of maintaining an accuracy of 1/1000 or better at any depth.

When the excavator arrives, AE will line up experimental construction work for use of the new machine, and will undertake joint work with Bauer for installation of AE's automated work execution software. At the same time, the company will import Bauer's latest technologies in the areas of vibrational fastening construction method and large-scale special piling method in order to work out their applications in Japan with the goal of developing high levels of expertise over all facets of foundation construction. This should enable AE to participate in big projects both in Japan and abroad.

(8) Demand for Electricity and Planned Fabrication of Nuclear Reactors
- from a Report by the Japan Electric Research Committee

Steady Increase in the Proportion of Nuclear Power Generation - 9.78 MKW of Outstanding Orders for Plant Construction

[Text] As reported in the previous issue of this newspaper, the Japan Electric Research Committee on April 1 put together and published an "Electric Power Survey Report" addressing Japan's electric power supply plans and the status of production of electric power equipment. According to the report, the peak demand for electric power in 1997, ten years from the date of the report, will be 151.21 MKW (with an average annual growth of 2.9 percent), and as of April 1 Japanese nuclear reactor makers have a total backlog of 9.775 MKW in orders received. A summary of the report follows.

Demand for Electric Power

The total nationwide demand for electricity during FY 1987 was 568 billion KWH (including estimates), up 5.6 percent from a year earlier, showing a high upturn of 6 percent compared with the 0.7 percent decline posted in 1986. Accounting for the increase are the high level of consumer demand spurred by large increases in the number of new housing units started, the large numbers of new office buildings erected in big cities, and the onset of a hot summer. In the area of industrial demand, the government's policy to stimulate

domestic demand had induced a rapid recovery of the economy by the middle of last year, which in turn pushed up the demand for electricity.

Table 1. Nationwide Peak Electrical Demand and Supply, Measured at the Source of Power Transmission, for August of Each Year From 1986 Through 1997 (in megawatts) (including desired capacity expansions)

	(1) 昭和62年 (実績)	% 増	(2) 昭和63年	% 増	昭和64年	% 増	昭和65年	% 増	昭和66年	% 増	昭和67年	% 増	昭和72年	% 増
火力	80,449		85,647		86,485		88,633		91,267		92,513		100,701	
原子力	20,879		20,999		23,698		24,576		24,387		26,054		34,105	
水力	26,653		27,252		27,466		27,503		27,902		28,283		31,875	
計	127,991		133,898		137,649		140,712		143,556		146,850		166,681	
(3) 電力 自発電受電 計	26		15		15		15		15		15		15	
	128,017	2.2	133,913	4.6	137,664	2.8	140,727	2.2	143,571	2.0	146,865	2.3	166,696	2.7
最大需要電力	114,488	3.6	120,379	5.1	123,598	2.7	126,994	2.7	130,281	2.6	133,571	2.5	151,212	2.5
供給予備力	13,529		13,534		14,066		13,733		13,290		13,294		15,484	
(4) 供給予備率(%)	11.8		11.2		11.4		10.8		10.2		10.0		10.2	

(注) 昭和62年度末における電調委決定分設備のほか希望分設備をも含んだ場合の最大電力需給対照を示す。(5)

Key:

1. 1987 (actual)
2. Percent increase
3. Supply capacity
 - Thermal
 - Nuclear
 - Hydroelectric
 - Subtotal
 - In-house power generation
 - Total
4. Peak electrical demand
 - Reserve supply capacity
 - Reserve supply capacity as a percentage of the total capacity
5. Note: Includes peak electrical demand and supply including utility companies' desired capacity expansions in addition to those approved by the Electrical Research Commission as of the end of FY 1987.

The fact that FY 1987 was a leap year also may account for some of the increases.

In projecting the electrical demand for 1997, the report took into account the government's forecasts on the performance of the economy, and assumed a 4-percent economic growth for the projection period, the same as the factor used in the government's forecast last year. Taking into account the increasing industrial restructuring reflecting the persistence of the high yen, as well as recent trends in electric demand, the report also assumed a 3.5-percent growth rate or less for the mining and industry projection index, below the overall rate of economic growth.

The increasing size of home electric appliances, increasing functionality of appliances, increasing popularity of climate control equipment, advancements in urban redevelopment, increasing use of information technologies, and

internationalization of economic activities are seen to push up the consumer

demand for electricity, such as for lighting and workplace-related consumption, despite the spread of energy-conserving appliances and buildings.

On the other hand, the persistence of the high yen will force the steel and related primary materials industries to undertake more and more streamlining efforts, induce export-oriented manufacturing industries to move their production to offshore sites, and prompt companies to undertake expansion or new construction of in-house power generation facilities to achieve greater efficiency in energy utilization. These factors are seen to dampen the growth of industrial demand for electricity, both in macro and micro terms, compared with the high growth in the consumer sector.

In sum, the total nationwide electric demand during FY 1997 is projected at 790 billion KWH, with an average annual growth of 2.5 percent during the 1986-1997 period.

Peak Electric Demand

During FY 1987, the peak electrical demand for the entire country was 114.49 MKW, up 3.6 percent from the previous year.

Projecting into 1997, increases in space heating by heat pumps, increasing use of information technologies, and increasing internationalization of economic activities resulting in an increased number of buildings operating for long hours, and increases in nighttime electric demand will improve the load factor; on the other hand, increases in consumer-oriented electrical demand, the spread of climate control equipment, and the declining importance of high-load-factor primary materials industries will tend to reduce the load factor, so that the overall load factor will continue the current trend of gradual decrease.

Table 2. Nationwide Peak Electrical Demand and Supply, Measured at the Source of Power Transmission, from 1986 through 1992 and through 1997 (in megawatts)

(2) 第2表 昭和61年度から昭和67年度および昭和72年度の全国の送電端電力量需給対照(単位10⁶kWh)

	(1)	昭和62年度		昭和63年度		昭和64年度		昭和65年度		昭和66年度		昭和67年度		昭和72年度	
		推定実績	%増	実績	%増	実績	%増	実績	%増	実績	%増	実績	%増	実績	%増
火力		354,637		360,416		367,346		365,245		375,246		381,528		391,062	
原子力		176,786		173,969		181,679		198,094		203,504		212,203		282,231	
水力		76,468		86,036		86,826		87,956		89,362		90,216		96,976	
送電端電力量計	(3)	607,891		620,421		635,851		651,295		668,112		683,947		770,269	
需要電力量		4,581		4,137		4,080		4,000		2,821		2,153		1,919	
発電場合		9,055		10,715		11,286		12,023		12,980		13,487		18,686	
送電端電力量計	(4)	603,417	5.6	613,843	1.7	626,645	2.4	643,272	2.3	657,953	2.3	672,613	2.2	753,522	2.3
送電端電力量の不足		0		0		0		0		0		0		0	

(注)1. 昭和62年度末における決定分設備のほか希望分設備をも含む場合の電力量需給対照を示す。2. 昭和72年度の%増幅は昭和67-72年度の平均増加率を示す。(5)

Key:

1. Percent increase
2. 1987 (projected and actual)
3. Supply Capacity Thermal
Nuclear

Hydroelectric
 Subtotal
 In-house power generation
 For water pumping
 Total

4. Electrical demand, measured at the source of power transmission
 Deficit
5. Note 1: Includes peak electrical demand and supply including utility companies' desired capacity expansions, in addition to those approved by the Electrical Research Commission as of the end of FY 1987.
 Note 2: The percentage increase column for FY 1997 indicates the average increase for the 1992-1997 period.

Table 3. Planned Power Generation Capacity Expansions - Ordered and Yet to be Ordered (in megawatts)
 (Approved capacities through 1992)

Key:

1. Planned start of operation
2. Already ordered capacity expansions
 Number Plant capacity
3. Yet to be ordered capacity expansions
 Number Plant capacity
4. Total
 Number Plant capacity
5. 1988 Thermal
 Nuclear
 Hydroelectric
 Total
6. 1989 Thermal
 Nuclear
 Hydroelectric
 Total
7. 1990 Thermal
 Nuclear
 Hydroelectric
 Total
8. 1991 Thermal
 Nuclear
 Hydroelectric
 Total
9. 1992 Thermal
 Nuclear
 Hydroelectric
 Total
10. 1993 Thermal
 Nuclear
 Hydroelectric
 Total
11. Total Thermal
 Nuclear

第3表 新增発電設備の発注・未発注別
 総括表 (単位10³kW)
 (昭和67年度までの決定分設備) (3)

(1) 運転開始 予定年	設備の 区分	発注済の設備		未発注の設備		計 (4)	
		台数	設備容量	台数	設備容量	台数	設備容量
昭和63年	火力	12	1,131	0	—	12	1,131
	原子力	0	—	0	—	0	—
	水力	10	900	0	—	10	900
	計	22	2,031	0	—	22	2,031
(5) 昭和64年	火力	5	3,150	2	17	7	3,167
	原子力	1	820	0	—	1	820
	水力	14	213	2	4	16	217
	計	20	4,183	4	21	24	4,204
(6) 昭和65年	火力	6	2,650	2	55	8	2,705
	原子力	2	2,200	0	—	2	2,200
	水力	7	95	4	10	11	105
	計	15	4,945	6	65	21	5,010
(7) 昭和66年	火力	4	2,390	4	2,143	8	4,533
	原子力	2	1,759	0	—	2	1,759
	水力	0	—	7	96	7	96
	計	6	4,149	11	2,239	17	6,388
(8) 昭和67年	火力	3	350	1	700	4	1,050
	原子力	1	1,180	0	—	1	1,180
	水力	0	—	6	402	6	402
	計	4	1,530	7	1,102	11	2,632
(9) 昭和68年	火力	0	—	0	—	0	—
	原子力	0	—	1	540	1	540
	水力	0	—	0	—	0	—
	計	0	—	1	540	1	540
(10) 合計	火力	30	9,671	9	2,915	39	12,586
	原子力	6	5,959	1	540	7	6,499
	水力	31	1,208	19	512	50	1,720
	計	67	16,838	29	3,967	96	20,805

(注) 昭和68年は1月1日から3月31日までの期間。
 (12)

Hydroelectric
Total

12. Note: The figures for 1993 represent the period from January 1 through March 31.

As a result, the peak nationwide demand for electricity for 1997 is estimated at 151.21 MKW; for the 1986-1997 period the peak demand is likely to increase 2.9 percent annually, slightly above the growth rate of total electric consumption.

Supply Capacity

The nationwide electric supply capacity stood at 128.02 KW as of last August. The nationwide supply capacity in August 1992 will increase 18.75 KW over August 1987 for a total of 146.77 KW, if the facilities determined by the Electric Research Council are built; if the facilities desired by electric utilities in addition to those approved by the Electric Research Council are constructed, there will be 100,000 KW of additional capacity, pushing the total to 146.87 KW.

The nationwide supply capacity as of August 1987 will increase 13.25 KW over August 1992 for a total of 160.02 KW if the facilities determined by the Electric Research Council are built; if the facilities desired by electric utilities in addition to those approved by the Electric Research Council are constructed, there will be 6.68 MKW of additional capacity, pushing the total to 166.7 KW.

Electric Supply Volume

During FY 1987, the total volume of electricity generated throughout Japan was 603.4 billion KWH (including estimates), up 5.6 percent or 32 billion KWH from a year earlier. Of this amount, atomic power accounted for 176.8 billion KWH (29 percent of the total electricity generation), compared with 159.7 billion KWH (28 percent) for the previous year.

The volume of electrical supply during FY 1997 is estimated at 753.5 billion KWH.

In terms of the relative weights of thermal, atomic, and hydroelectric power generation, the percentage ratio was 58-29-13 for FY 1987, changing to 56-31-13 in 1992 and 51-37-12 in 1997; thus, the percentage of atomic power in the overall electrical supply picture will increase.

Power Generation Facility Capacity

As of the end of 1987, the nationwide power generation plant capacity stood at 99.83 MKW for thermal power, 27.88 MKW for nuclear power, and 35.23 MKW for hydroelectric power, for a total of 162.94 MKW.

The nationwide power generation plant capacity, including the increases desired by electric utility companies at the end of FY 1997, will be 115.42

MKW for thermal power, 46.63 MKW for nuclear power, and 41.35 MKW for hydroelectric power, for a total of 203.4 MKW, or 57-23-20 in a thermal, nuclear, and hydro ratio. Thus, the percentage of nuclear power generation will increase substantially.

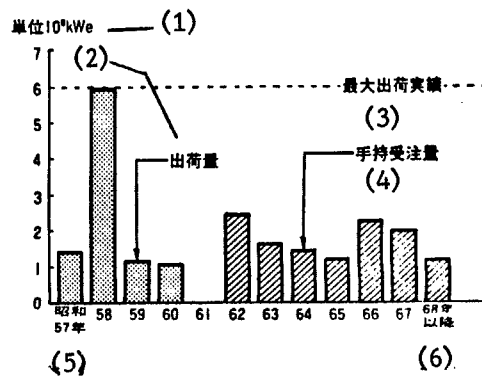
Current Status of Nuclear Reactor Fabrication

As of April 1 1988, nuclear reactor makers have a total backlog of 9.78 MKW in orders received, the same as the volume indicated in the previous report. For 1988, these companies are expecting to deliver 1.68 MKW in new nuclear reactor capacities.

Status of Nuclear Reactor Fabrication (those with a minimum capacity of 100 x 10³ kWe)

Key:

- 1. Unit: 10³ kWe
- 2. Volume of shipments
- 3. Maximum actual volume of shipments
- 4. Volume of orders on hand
- 5. 1982
- 6. 1993 and beyond



Status of Production of Electrical Power Generating Machines

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	タービン 発電機 (10 ⁴ kW)	水車 発電機 (10 ⁴ kW)	ボイラ (10 ⁴ /h)	蒸気 タービン (10 ⁴ kW)	水車 (10 ⁴ kW)	電力用 変圧器 (10 ⁴ kVA)	原子力 (10 ⁴ kWe)
(8) 昭和62年出荷実績 (対前年比率%)	10.0 (112)	1.1 (67)	30.7 (130)	10.7 (113)	0.8 (150)	58.8 (77)	2.5 (-)
(9) 昭和63年出荷予定量 (対前年比率%)	10.5 (105)	1.4 (123)	10.8 (35)	8.9 (83)	1.4 (181)	56.8 (97)	1.7 (67)
(10) 手持受注量 (対前期比率%)	28.2 (90)	5.8 (103)	35.4 (107)	28.4 (91)	4.1 (98)	54.9 (89)	9.8 (100)

Key:

- 1. Turbine generators
- 2. Hydraulic turbine generators
- 3. Boilers
- 4. Steam turbines
- 5. Hydraulic turbines
- 6. Electrical transformers
- 7. Nuclear power
- 8. Actual shipments during 1987
(Percent change from previous year)
- 9. Actual shipments during 1988
(Percent change from previous year)
- 10. Volume of orders on hand
(Percent change from previous year)

Volume of Shipments of Nuclear Reactors (100³ kWe minimum) and Volume of Orders on Hand (unit: 10PT3PT kWe)

原子炉(100³kWe以上)の出荷量および手持受注量(単位: 10³kWe)

	昭和62年(1)				昭和63年		64年	65年	66年	67年	68年	昭和63年 (2) 4月1日 現在の手持受注量
	(3) 1-9月 (出荷済)	10-12月 (出荷済)	1-12月 (出荷済)	1-3月 (出荷済)	4-12月	1-12月						
500×10 ³ kWe未満												
電気事業用	0	0	0	0	0	0	0	0	0	0	0	0
工場用その他	0	0	0	0	0	0	*286.0	0	0	0	0	286.0
輸出用(4)	0	0	0	0	0	0	0	0	0	0	0	0
計	0	0	0	0	0	0	286.0	0	0	0	0	286.0
500-1,000×10 ³ kWe未満												
電気事業用	1,399.0	0	1,399.0	0	579.0	579.0	0	0	0	890.0	0	1,469.0
工場用その他	0	0	0	0	0	0	0	0	0	0	0	0
輸出用(5)	0	0	0	0	0	0	0	0	0	0	0	0
計	1,399.0	0	1,399.0	0	579.0	579.0	0	0	0	890.0	0	1,469.0
1,000×10 ³ kWe以上												
電気事業用	1,100.0	0	1,100.0	0	1,100.0	1,100.0	1,180.0	1,180.0	2,280.0	1,100.0	1,180.0	8,020.0
工場用その他	0	0	0	0	0	0	0	0	0	0	0	0
輸出用(6)	0	0	0	0	0	0	0	0	0	0	0	0
計	1,100.0	0	1,100.0	0	1,100.0	1,100.0	1,180.0	1,180.0	2,280.0	1,100.0	1,180.0	8,020.0
合計												
電気事業用	2,499.0	0	2,499.0	0	1,679.0	1,679.0	1,180.0	1,180.0	2,280.0	1,990.0	1,180.0	9,489.0
工場用その他	0	0	0	0	0	0	286.0	0	0	0	0	286.0
輸出用(7)	0	0	0	0	0	0	0	0	0	0	0	0
計	2,499.0	0	2,499.0	0	1,679.0	1,679.0	1,466.0	1,180.0	2,280.0	1,990.0	1,180.0	9,775.0

(注) *は原型炉である。(8)

Key:

1. 1987
2. Volume of orders on hand as of 1 April 1988
3. January-September (already shipped)
4. Less than 500 x 10³ kWe
For electrical utilities
For factories and others
For exportation
Total
5. Between 500-1,000 x 10³ kWe
For electrical utilities
For factories and others
For exportation
Total
6. Greater than 1,000 x 10³ kWe
For electrical utilities
For factories and others
For exportation
Total
7. Total
For electrical utilities
For factories and others
For exportation
Total
8. * Prototype reactors

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SCIENCE & TECHNOLOGY POLICY

Overview of Major STA Policies for FY88

43063031 Tokyo PUROMETEUSU in Japanese May 88 pp 10-17

[Text] "To promote creative, basic research in science and technology in pursuit of the harmonious advancement of mankind and society." This is the Science and Technology Agency's [STA] guiding principle for formulation of S&T policies. In fiscal 1988, STA will again pursue, even more vigorously, implementation of policies in compliance with the guideline.

First of all, STA's total budget for fiscal 1988 is Y440.2 billion, up by 1.8 percent compared to the current year's Y432.5 billion.

Next, major individual STA policies are discussed below. (The figures in the parentheses represent allocations from the fiscal 1987 budget.)

1. Comprehensive Management of S&T Policy Formulation: Y9.5 (8.5) billion

A comprehensive approach will be taken toward strengthening of the S&T policy research structure which forms the basis for policy formulation. A Science and Technology Policy-Making Research Institute will be established to perform comprehensive and systematic fact-finding research and surveys regarding S&T activities.

2. Promotion of Creative Basic Research: Y5.6 (4.8) billion

Through promotion of creative endeavors in basic research, contributions can be made to the welfare of international society, as such efforts lead to fundamental innovations which become common assets of mankind. In pursuit of this concept, the government of Japan will sponsor a multilateral basic research program, namely the human frontier science program, which seeks to unravel outstanding human biological capabilities. STA will conduct studies regarding the specific implementation of the program. Also, STA will push implementation of the International Frontier Research System, as well as the System for Promotion of Creative Innovations in Science and Technology.

3. Promotion of International S&T Cooperation: Y32.4 (29.7) billion

Research invitation to foreign guest researchers will be sought. Efforts will be made to promote transfer of Japan's S&T knowledge to other countries. In

addition to the promotion of personnel and information exchange, efforts will be made to encourage active Japanese participation in international cooperation projects such as bilateral joint programs.

4. Maintenance of R&D Foundation: Y10.3 (9.4) billion

Promotion of regional S&T activities will be pushed. Tasks include the establishment of a regional research exchange and advancement program centered around the installation of a research information network.

Assessment of the construction of a large-scale synchrotron orbit radiation (SOR) facility will be held. It is believed that the SOR facility will make significant contributions to basic research efforts in a broad range of fields.

Also, in an effort to promote research interaction among researchers of industry, academia and government, and to promote distribution of S&T information, programs such as the High Tech Consortium System will be implemented. In addition, in order to strengthen the management of genetic resources -- the collection, storage and supply of genes -- a dedicated program for the establishment of a gene bank will be initiated.

5. Promotion of R&D in Frontier, Vital S&T Areas

1) R&D for and Use of Nuclear Energy, and Implementation of Safety Measures: Y271.5 (273.4) billion

Because of the scarcity of natural resources, Japan must regard nuclear power generation as a primary energy source. With regard to R&D for nuclear power generation and the use of it, steady implementation of the long-term program for atomic energy development & utilization will be pursued. Emphasis will be placed on efforts to obtain public consensus on the safety and utility of nuclear energy.

In view of the accident at the Chernoble Nuclear Power Plant in the Soviet Union, safety measures for nuclear power plants will be stepped up this year, and vigorous implementation of these measures will be pursued. Also, public relation efforts will be expended to restore public confidence in the safety of nuclear power generation.

With regard to the issue of protection against nuclear hijacking, legislative measures as well as other preventive measures will be sought.

Next, in order to establish Japanese independence with regard to the nuclear fuel cycle, R&D efforts will be stepped up in the areas of uranium enrichment, spent-fuel reprocessing, and nuclear waste disposal. Also, appropriate administrative measures and incentives to encourage programs by private industry to build nuclear facilities, and to aid in site selection will be taken. Further assistance will be provided to corporations to help ease difficulties in setting up the new operations.

Construction will continue on the fast breeder reactor "Monjyu." Also, to advance the program for the development of a prototype reactor for the new

conversion reactor, R&D for related technologies will be conducted.

In the area of nuclear fusion, the plasma density testing equipment, JT-60, awaits construction. Advanced R&D will be conducted on component devices in order to warrant high performance from the plasma equipment. Also, programs will be implemented for the planned participation in the International Thermonuclear Experimental Reactor (ITER) Program.

As for minor aspects, R&D will continue on the nuclear powered vessel. Basic pioneering research works are much needed in the area of high temperature engineering in order to establish a foundational technology for efficient high-temperature gas reactors. For this reason, the construction of a high-temperature engineering test reactor is being planned. This year, a program for preliminary design work will be initiated.

2. Space Exploration: Y98.5 (94.6) billion

With respect to the exploration of space, mankind's new frontier, it is essential to develop Japan's own technology base based on independent R&D efforts while maintaining accord with international activities.

On the development and launching of artificial satellites, R&D programs for satellites in telecommunications, broadcasting, and meteorological observation will be continued. The new entry this year concerns the initiation of R&D for an earth observation platform engineering satellite.

R&D will be continued for the H-II rocket which possesses a payload capacity of up to 2 tons for a launch of a stationary satellite.

With regard to the Space Station Program, renewed efforts will be expended on development of the onboard space station experiment module (JEM).

3. Ocean Engineering: Y9.5 (7.7) billion

For the sake of multi-purpose development and utilization of the waters off Japanese coasts, a comprehensive package of research activities will be administered. This includes the development of a survey submarine in a 6,000-meter dive class.

4. Materials Science: Y11.2 (9.4) billion

Materials science provides a basis for every branch of science and technology. Active research efforts will be provided in this area through execution of the multi-core project for superconductor materials research.

5. Life Science: Y12.8 (11.9) billion

Advancements in life science contribution to the improvement of the welfare of mankind through a broad range of applied fields. In this

area, research of cancer-related and aging problems will be pursued.

6. Other Vital Research Areas

Aside from the major categories listed above, other areas of research, just as vital, must be pursued. These are earth science, aerospace technology, and laser technology. Comprehensive research activities will be provided for these fields.

Summary Tables of STA Budget for Fiscal Year 1988

By General Affairs Department, Director's Office, STA

Category	Initial budget for FY87	Budget for FY88	Increase (^=decrease)	Comparison FY87 budget
1. General account	(debt) 139,353 333,674	(debt) 140,925 340,410	(debt) 1,572 6,736	% 102.0
2. Special account for industrial investment	4,300	4,700	400	109.3
3. Special account for promotion of electrical energy R&D	(debt) 82,060 94,552	(debt) 79,410 95,083	(debt)^2,650 531	100.6
(1) Site selection related	12,596	15,032	2,436	119.3
(2) Multi- purpose applications	(debt) 82,060 81,956	(debt) 79,410 80,051	(debt)^2,650 ^1,905	97.7
STA Total	(debt) 221,413 432,526	(debt) 220,335 440,193	(debt)^1,078 7,667	% 101.8

(Unit: million ¥ (debt): responsible national treasury debt)

Major Budgetary Appropriations

Item	Initial budget for FY87	Budget for FY88	Increase (^=decrease)	Comments
	A	B	B - A	
1. SkT management and administration	8,483	9,530	1,047	112.3%
(1) Establishment of SkT Policy Research Institute	0	252	252	To be inaugurated on 7/01/88; Office for Natural Resources Assessment will be closed
(2) Fulfillment for SkT promotion & adjustment funds	8,400	9,200	800	Advancement of research in internationally fast changing fields, etc.
2. Advancement of creative, basic research	(debt) 491 4,843	(debt) ^ 491 5,631	788	116.3% (including amounts appropriated from other categories)
(1) Exploratory life science programs	(150)	(300)	(150)	Estimated amount to be allocated from SkT Promotion & Adjustment Funds
(2) Funding for International Exploratory Research System	(debt) 491 1,535	(debt) ^ 491 1,515	^ 20	Fulfillment of research for physiological homostasis, and exploratory materials technology. Initiation of a new research project (thought processes)
(3) Funding for Creative SkT Promotional System	3,158	3,816	658	3 new projects (quantum mechanical structures, pico- second chemistry, information transfer materials of plants)
3. International SkT Cooperation	((debt)43,736) 29,719/	((debt)42,431) 32,366/	((debt)^1,305) 2,647/	108.9% (including amounts appropriated from other categories)
!General account	(debt) 43,736	(debt) 42,431	(debt) ^1,305	(debt) 41,853
!	29,383	31,880	2,497	Cooperation with advanced nations: 26,370
!Special account	336	486	150	Cooperation with developing nations: 2,183
! for industrial				
! investment				

Aggregate total from above for International exchange of personnel & information	1,807	1,918	111	(including amounts appropriated from other categories) Exchange with advanced nations: 1,285 Exchange with developing nations: 350
<hr/>				
4. Advancement of R&D foundations	9,439	10,288	849	109.0%
<hr/>				
(1) Promotion of regional S&T	81	162	154	(including amounts appropriated from other categories) Funds for advancement of regional R&D
<hr/>				
(2) Development of SOR	69	612	543	(including amounts appropriated from other categories) R&D for SOR facilities
<hr/>				
(3) Advancement of research exchange between industry, academia & government	2,499	2,512	13	Government & private specially designated joint research programs: 151 Domestic & overseas training of government research fellows: 473 High tech Consortium System: 209 New Technology Development Corp.: 1,536 /Total, covering creative science and high tech research: 5,561/ Limit of contract awards for entrusted development contracts: 5,200,000,000 yen
<hr/>				
(4) Advancement of S&T information distribution / General account / Special account / industrial investment	6,373 2,073 4,300	6,769 2,069 4,700	396 4 400	Funds for Japan S&T Information Center: 6,761 Allocations: Database services: 4,380 Online services: 3,077 Development of the new online service system (JOIS-III): 468 Operation and management of International S&T Information Network (STN): 737 Development of computer translation system: 359
<hr/>				
(5) Establishment of a comprehensive system for collection, storage & supply of genes	490	330	157	Services for cell & gene storage: 215 Services for micro-organism storage, & supply: 101
<hr/>				

5. Advancement of leading-edge, vital S&T areas	(debt) 221,363	(debt) 220,334	(debt) ^1,029		
	412,553	417,467	4,914	101.2%	
<hr/>					
(1) Nuclear power R&D, usage & safety measures	(debt) 118,359	(debt) 113,304	(debt) ^5,055		
	273,363	271,490	^1,873	99.3%	
[General account]	(debt) 36,299	(debt) 33,894	(debt) ^2,405		
	178,811	176,407	^2,404	98.7%	
a. Measures for nuclear power safety & measures against nuclear proliferation	1,982	1,944	^ 38		
				Enforcement of reactor regulations:	88
				Security measures, and measures against nuclear theft:	602
b. Japan Atomic Energy Research Institute	(debt) 23,129	(debt) 22,309	(debt) ^ 820		
	99,462	97,310	^2,152		
				(debt) 8,002	
				Research of safety measures:	11,217
				Nuclear fusion R&D:	(debt) 3,960
					23,356
				Allocations:	
				Construction & operation of JT-60:	
				(debt) 3,200	
					17,151
				Participation in ITER program:	(debt) 760
					1,747
				R&D of nuclear powered vessels:	7,313
				Design for high temperature engineering test reactor:	950
				Advanced radiation technology:	(debt) 5,803
					2,313
				R&D for SOR facilities:	178
c. National Inst. of Radio-logical Science	(debt) 3,100	(debt) 5,704	(debt) 2,604		
	7,085	8,118	1,033		
				Production of a heavy particle beam instrument for cancer treatment:	(debt) 5,704
					2,656
d. Nuclear energy research of Institute of Physical & Chemical Research [RIKEN]	(debt) 4,330	(debt) 450	(debt) ^ 3,880		
				Construction & operation of heavy ion accelerator:	(debt) 450
					3,452
				R&D for uranium enrichment technology by use of laser	395
				R&D for SOR facilities:	285
e. Nuclear energy research of national research institutions	1,789	1,815	26		
				Aggregated amounts allocated by all governmental agencies for nuclear energy experimental research	

[Special account for measures to promote develop- ment of energy resources]	(debt) 82,060 94,552	(debt) 79,410 95,083	(debt)^ 2,650 531	100.6%	
a. Assistance funds for site selection for power facilities	12,596	15,032	2,436	119.3%	Entrusted funds for safety measures for nuclear power generation: 5,975 Grants for measures to aid power facility site selection: 4,088 Special grants for power facility site selection: 1,424 Grants for safety measures of nuclear power generation: 3,412
b. Funds for power source diversification programs	(debt) 82,060 81,956	(debt) 79,410 80,051	(debt)^ 2,650 ^ 1,905	97.7%	
A) Power Reactor & Nuclear Fuel Develop- ment Corp.	(debt) 82,060 77,264	(debt) 79,410 75,806	(debt)^ 2,650 ^ 1,458		Construction of fast breeder reactor "Monjyu": (debt) 60,908 48,745 R&D in spent fuel reprocessing: (debt) 18,502 8,430
B) Miscellaneous	4,692	4,245	^ 447		Entrusted projects for R&D in nuclear reactor decommissioning technology: 1,796 Entrusted projects for R&D in uranium enrichment laser technology: 740 Assistance funds: 429

(2) Advancement of space exploration	(debt) 94,190 94,569	(debt) 102,604 98,470	(debt)^ 8,414 3,901	104.1%	
a. National Space Development Agency	(debt) 94,035 92,648	(debt) 102,457 96,534	(debt) 8,422 3,886		Development of H-II rocket: (debt) 50,189 34,333 Development of Communications Satellite Type-3: 2,215 Development of Meteorological Stationary Satellite Type-4: (debt) 100 1,544 Development of Ocean Observation Satellite Type-1b: (debt) 1,949 613 Development of Broadcasting Satellite Type-3: (debt) 4,621 3,041 Development of Earth Resources Satellite Type-1: (debt) 3,829 3,041

Development of Engineering Test
 Satellite Type VI: (debt) 22,357
 4,949

Development of Meteorological
 Stationary Satellite Type-5: (debt) 487
 197

Development of an earth observation
 platform technology satellite: (debt) 2,005
 542

Development of Phase-I Materials
 Experiment System (debt) 1,244
 794

Participation in Space Station
 Program: (debt) 8,893
 6,436

b. Space engineer- (debt) 155 (debt) 147 (debt)^ 8 R&D in rocket engine fuel technology
 ing related R&D 1,387 1,400 13 for liquid oxygen & liquid hydrogen
 of National fuels for H-II rocket: (debt) 147
 Aerospace 217
 Laboratory (NAL)

(3) Ocean development (debt) 7,135 (debt)^ 7,135
 7,727 9,487 1,760 122.8%

Marine S&T Center (debt) 7,135 (debt)^ 7,135
 7,516 9,277 1,761

Deep water survey & research: 6,465
 Allocations:
 Construction of a 6,000m-class
 survey submarine: 3,777
 Construction of a mother ship
 for the submarine: 1,270
 R&D in underwater works technology: 1,181
 Allocations:

Allocations:

Research for medical application
of heavy particle beams: (debt) 5,704
2,815

(6) Advancement of R&D in earth science	(debt) 14,074 18,232	(debt) 8,371 17,651	(debt)^ 5,703 ^ 581	96.8%
a. R&D in earth observation technology	/(debt)14,049/ 15,677/	/(debt) 8,371/ 15,083/	/(debt)^5,678/ ^ 594/	(including allocations from other categories)
				Development of Meteorological Stationary Satellite Type-4: (debt) 100 1,544
				Development of Ocean Observation Satellite Type-1b: (debt) 1,949 613
				Development of Earth Resources Satellite Type-1: (debt) 3,829 3,041
				Development of Meteorological Stationary Satellite Type-5: (debt) 487 197
				Development of an earth observation platform technology satellite: (debt) 2,005 542
b. R&D in fire-preventive technology	(debt) 25 2,555	2,568	(debt)^ 25 13	National Research Center for Disaster Prevention 2,563
				Allocations: Research on earth-quake forecast: 924 Research on prevention of fire hazards caused by earthquake: 502 Research on measures for snow related hazards: 74
(7) Advancement of other vital comprehensive research	(debt) 1,034 18,988	(debt) 1,985 19,219	(debt) 951 231	101.2%
a. Aerospace technology related research of MAL	(debt) 494 8,880	(debt) 897 8,710	(debt) 403 ^ 170	R&D of fan jet STOL: (debt) 2,340 Research in component technologies for innovative aerospace transportation (space transportation included): (debt) 653 664 /Total of funds for MAL for aerospace research: (debt) 1,044/ 10,110/
b. Miscellaneous	(debt) 540	(debt) 1,330	(debt) 548	

Agency											
Environment Agency	7,752	^ 2.1	-	-	-	-	7,752	^ 2.1	46,836	^ 1.0	
National Land Agency	105	^34.1	-	-	-	-	105	^34.1	233,833	1.9	
Ministry of Justice	849	5.4	-	-	-	-	849	5.4	412,178	1.6	
Ministry of Foreign Affairs	-	-	2,655	4.9	3,762	^ 0.1	6,417	1.9	441,646	4.1	
Ministry of Finance	337	0.8	-	-	-	-	337	0.8	1,353,235	2.7	
Ministry of Education	163,757	6.7	-	-	127,416	1.0	191,173	2.8	4,576,594	0.1	
Ministry of Health & Welfare	132,319	8.1	-	-	1,128	^ 7.9	33,447	7.5	10,321,123	2.9	
Ministry of Agriculture, Forestry & Industry	161,195	0.2	-	-	1,847	^ 0.2	63,042	0.1	2,556,146	^ 4.6	
Ministry of International Trade & Industry	154,652	0.2	2,260	^ 18.4	11,471	^ 0.9	68,383	^ 0.7	620,186	^ 4.7	
Ministry of Transportation	112,461	^ 2.3	-	-	1,250	65.9	13,711	1.5	813,815	^ 2.4	
Ministry of Posts & Telecommunications	4,169	3.3	-	-	110	2123.0	4,279	5.9	24,787	1.2	
Ministry of Labor	601	^ 2.3	-	-	0.7	0.0	602	^ 0.1	489,029	0.1	
Ministry of Construction	5,206	3.3	-	-	254	^ 28.9	5,459	^ 0.8	3,681,637	^ 0.1	
Ministry of Home Affairs	543	1.4	-	-	-	-	543	1.4	71,525	^ 4.0	
Total	1417,272	4.2	164,680	^ 2.7	240,509	4.7	822,461	2.9	32,982,107	1.2	

(Reference 2) Category-wise general expenditure totals	S&T advancement funds	Energy related funds	Miscellaneous	Total
	417,272	461,625	32,103,207	32,982,107
	4.2	6.8	1.3	1.2

Notes: 1. In reference 1, the amounts of only those agencies and ministries which have compiled an S&T related budget are listed. The total, however, represents the general expenditure total of the entire government.

In addition, the totals of the major expenditure categories are listed as in reference 2. The other entries represent figures that exclude S&T advancement money and energy-related money from the general expenditure budget.

2. The above table was prepared by STA.

The listed totals may not exactly agree with the sums of the figures in the columns due to rounding discrepancies.

S&T Related Budget for Fiscal Year 1988 (Summary Table)

(Unit: 1 million yen)

Category	Fiscal year	FY87 budget	FY88 budget	Increase (=decrease)
S&T related appropriations from general account		799,540	822,461	2.9
Funds for S&T advancement		400,634	417,272	4.2
Funds for energy-related research programs		169,267	164,680	^ 2.7
Funds for other research programs		229,639	240,509	4.7
S&T related appropriations from special account		855,500	884,044	3.3
S&T related budget total		1,655,040	1,706,504	3.1

Reference:

General account total	54,101,019	56,699,714	4.8
General expenditure total out of general account	32,583,369	32,982,107	1.2

Notes: 1. The figure for the general expenditure represents the general account total that does not include the national debt repayment fund, the distribution of local allocation tax, and the social

- capital funds from the special account for industrial investment.
2. The table was prepared by STA.
 3. The listed totals may not exactly agree with the sums of the figures in the columns due to rounding discrepancies.

S&T Related Budget of Different Ministries & Agencies for FY88
(Part 2: Special Accounts & Totals)

(Unit: 1 million yen)

Category	Funds for S&T advancement from general account		Funds for S&T advancement from special account		S&T related budget total	
	1987	%	1987	%	1987	%
National Diet	517	8	-	-	517	8
Japan Academic Conference	903	47	-	-	903	47
National Police Agency	972	47	-	-	972	47
Hokkaido Development Agency	143	0.1	-	-	143	0.1
Defense Agency	82,700	8,565	-	-	82,700	8,565
Economic Planning Agency	716	7	-	-	716	7
Science and Technology Agency	340,410	6,736	90,545	1,014	430,955	5,723
Environment Agency	7,752	163	-	-	7,752	163
National Land Agency	105	54	-	-	105	54
Ministry of Justice	849	43	-	-	849	43
Ministry of Foreign Affairs	6,417	118	-	-	6,417	118

Affairs	:						
Ministry of Finance	:	337	3	641	^ 33	978	^ 31
Ministry of Education	:	191,173	5,241	621,781	27,538	812,954	32,780
Ministry of Health & Welfare	:	33,447	2,336	10,612	1,962	44,059	4,298
Ministry of Agriculture, Forestry & Industry	:	63,042	93	3,600	^ 200	66,642	^ 107
Ministry of International Trade & Industry	:	68,383	^ 488	152,843	305	221,226	^ 183
Ministry of Transportation	:	13,711	199	916	^ 88	14,627	111
Ministry of Posts & Telecommunications	:	4,279	237	26,000	1,000	30,279	1,237
Ministry of Labor	:	602	^ 0.4	3,106	73	3,708	72
Ministry of Construction	:	5,459	^ 46	-	-	5,459	^ 46
Ministry of Home Affairs	:	543	7	-	-	543	7
Total	:	1822,461	22,921	884,044	28,544	1,706,504	51,461

Notes: 1. The expenditure of 4.7 billion yen allocated to the Japan S&T Information Center from the S&T related budget of the special account for industrial investment of the Ministry of Finance is compiled into the figure for STA. The loan funds totaling 2.6 billion yen for research on pharmaceutical technology, allocated from the appropriation for the fundamental fund for assistance of victims of drug side effects and pharmaceutical research advancement, is included into the entry for the Ministry of Health & Welfare. 3.6 billion yen for the Organization for Advancement of Bio-industrial technology goes under the compilation for the Ministry of Agriculture, Forestry & Fisheries.

2.5 billion yen for the Organization for Comprehensive Development of New Energy & Industrial Technology (provisional designation) is compiled into MITI's figures. The expenditure of 26 billion yen for the Key Technology Center is divided and added to the figures of MITI and NPT. (The listed totals were calculated such that there is no double counting of this amount.)

2. The table was prepared by STA.
3. The listed totals may not exactly agree with the sums of the figures in the columns due to rounding discrepancies.

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END

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