January 4, 2001

MEMORANDUM TO: Chairman Meserve
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
Commissioner Merrifield

FROM: Janice Dunn Lee, Director /S/
Office of International Programs

SUBJECT: OFFICIAL REPORT ON JAPAN'S LONG-TERM PROGRAM FOR RESEARCH, DEVELOPMENT AND UTILIZATION OF NUCLEAR ENERGY

The Japan Atomic Energy Commission (AEC) has issued a formal report (attached) on Japan's "Long-Term Program for Research, Development and Utilization of Nuclear Energy." The report reflects on the health of their nuclear program following the problems of the last several years, and it repeats earlier findings for strengthened regulatory oversight, and need for better transparency. It defines roles and responsibilities for the Japan's government and the private sector to adopt in order to strengthen a growing role for nuclear energy. The report also calls on Japan to expand its international role in the research, development and utilization of nuclear energy, noting that it "has become the front runner in this field." The AEC believes that Japan should use its technologies and experience, working with other nations to solve nuclear safety and waste issues. The report recommends Japan make the reprocessing of spent fuel, and the use of recovered plutonium and uranium its basic policy. The nuclear utilities already plan to have around 18 LWRs utilizing MOX fuel by the year 2010.

Japan's nuclear power industry and complete fuel cycle is among the most advanced in the world. Through the International Council, I will encourage the major program offices to consider this new AEC report in the context of NRC's ongoing cooperative program with Japan, particularly in areas where NRC's priority needs benefit.

Attachment: Japan AEC Report: "Long-Term Program for Research, Development and Utilization of Nuclear Energy," dated November 2000

cc w/Att.: EDO
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ATTACHMENT

Long-Term Program for Research, Development and Utilization of Nuclear Energy

(Unofficial Translation)

November 2000

Atomic Energy Commission, Japan

CONTENTS

Introduction

(The Atomic Energy Commission of Japan and the Long-Term Program)

In the middle of the 1950s, shortly after it experienced the tragedy of the atomic bombings, Japan launched into the research, development and use of nuclear energy with the primary aim of harnessing it for peaceful purposes. Since then, and to this day, the nation has carried on its nuclear research and development solely toward peaceful use in accordance with the Atomic Energy Basic Law. The Atomic Energy Commission of Japan (AEC), which was set up under the Atomic Energy Basic Law, is charged with the important tasks of planning, deliberations, and decision-making necessary to secure peaceful utilization of nuclear energy and to ensure that Japan's research, development and use of nuclear energy are moved ahead in a coherent manner. Since the first Long-Term Program for Research, Development and Utilization of Nuclear Energy (Long-Term Program) in 1956, the Atomic Energy Commission has formulated a total of eight Long-Term Programs, one approximately every five years. From the infancy of the use of nuclear energy, these programs have played an important role in the systematic implementation of research, development and use of nuclear energy. Moreover, while spelling out a set of fundamental principles, such as the commitment to safety and adherence to peaceful use, the Long-Term Program has been a firm, universally applicable foundation for the sound implementation of nuclear energy research, development and utilization.

In order to clearly show to the Japanese people, the international community, and all parties involved with nuclear energy, Japan's basic policy and the policy measures it must take, based on an analysis of changes in conditions since the previous Long-Term Program as well as the outlook for the 21st century, the Atomic Energy Commission of Japan undertook to formulate a new Long-Term Program, referring study for the formulation of this program to the Council for the Formulation of a Long-Term Program for Research, Development and Utilization of Nuclear Energy (hereinafter referred to as the "Long-Term Program Council") in May 1999.

(Discussions by the Long-Term Program Council)

Discussions on a new Long-Term Program would be taking place at a time of increased public distrust and anxiety in the wake of a series of nuclear-related problems and scandals, including a fire at the prototype reactor "Monju." With, moreover, the 21st century near at hand, the council would have to revisit various problems that the Japanese

nuclear power industry had thus far experienced, as well as forecast future developments. With that recognition, the Long-Term Program Council began to draw a vision for the Japanese nuclear power industry in the coming century by returning to the starting point for research, development and use of nuclear energy. Yet, immediately after the council initiated its discussions, a criticality accident occurred at a uranium-processing plant operated by JCO Co., Ltd., in the village of Tokai, in Ibaraki Prefecture (this accident is hereinafter referred to as the "criticality accident at a uranium-processing plant"), serving only to increase the level of public distrust of the Japanese nuclear power industry. Affirming anew the importance of discussions from the starting point, the Long-Term Program Council widened its view and continued with its work.

The Long-Term Program Council was composed not only of parties concerned with nuclear power, but of persons of learning and experience from various circles, including the business community, legal circles, local siting communities, and the mass media. Its members were thus from a wider range of fields than those of previous councils. The Long-Term Program Council insured transparency in its deliberations by opening to the public all 16 of the meetings of the council, and all meetings of its six subcommittees (115 members, 57 meetings), which were set up to deal with specific important subjects, and by publishing materials considered in those meetings and the minutes, on the Internet and elsewhere. The council also gave due consideration to discussions of the Round-Table Conference on Nuclear Policy, which had held 23 sessions since fiscal 1996 with aggregate panelists by 210, and recommendations submitted by the Round-Table Conference as to the significance of nuclear power as an energy source, and options after the resumption of operation of the prototype reactor "Monju." In addition, the Long-Term Program Council endeavored to reflect the voices of the people in the new Long-Term Program by inviting people to advance their opinions and by holding open forums. In all, 1,190 opinions were submitted by 773 people, and the views of 31 citizens were heard directly in open forums.

(Principles in the Formulation of a New Long-Term Program)

The Long-Term Program Council considered the following when it deliberated on a new Long-Term Program, in comparison with earlier programs.

- Based on the history of nuclear energy in the 20th century, the new Long-Term Program should define problems to be solved and prescribe long-term strategies to be carried out to develop the diverse potential of nuclear energy. By returning to the starting point, the significance and role of nuclear energy should be reexamined in comparison with

other energy options, taking into consideration changes in lifestyles, societal values, views of the international community, and developments in science and technology.

- Amid growing public concern and distrust of nuclear energy, a prerequisite for any nuclear energy policy is winning the understanding and confidence of the Japanese people, society, and the international community. In order to do so, the new Long-Term Program should not only provide specific guidelines to parties involved in nuclear energy, but should also send a clear message domestically and to the world.

- The new Long-Term Program should determine the roles of the central government and the private sector, with emphasis on concepts and policies that must be adhered to and pursued steadily, now and in the future. As regards research and development to meet needs in changing situations, the new Long-Term Program should provide diverse options for carrying out research and development projects flexibly, based on timely and proper assessment.

The Long-Term Program consists of two parts. Part I includes messages to the people and the international community, and Part II includes specific policies on promoting nuclear research, development and utilization. The sources of information referred to in formulating the Long-Term Program, and a glossary of terms used in this report, are given at the end, for reference and the convenience of readers. The Long-Term Program Council hopes issuance of this Long-Term Program will give members of the general public an opportunity to think about the nuclear energy issue as one that affects them directly, and to help those in all walks of life to gain a better understanding of nuclear energy policy.

Part I :The Current Status of Research, Development and Utilization of Nuclear Energy, and Future Plans

Chapter 1: Science and Technology in the 20th Century

Science and technology has achieved remarkable developments in the 20th century and brought about substantial changes in lives and lifestyles. Material affluence and prosperity have been realized in much of the world. Progress in medicine has prolonged life dramatically. Advances in transportation enable people to travel far and wide. Consumer goods produced in large quantities have made daily life more convenient and comfortable. The development of information and communications equipment has enabled the collection and processing of huge amounts of information. People anywhere can now share that information in an instant.

Energy sources, which support material life, have changed from firewood, charcoal and hydro resources, to coal, oil and other fossil fuels. And nuclear power has come into practical use.

Nevertheless, industrial activities, which increased sharply in the 20th century, have combined with a population explosion to cause numerous problems, such as the depletion of resources, ecological and biosystem damage, global warming, and waste. Industrialized countries, which most enjoy the material affluence, have come to perceive the essential need to change from mass-production, mass-consumption, mass-disposal economic societies and lifestyles, into recycling-oriented ones that are in harmony with the global environment.

Today, human activities are regionally and internationally interdependent and interactive. In the 21st century, population growth and the pursuit of economic development in developing countries will lead to further strains on energy and natural resources, food shortages, deficiencies in water resources, and the depletion of tropical rain forests. Efforts are needed from a global perspective to address these problems. Meanwhile, people have come to entertain both expectations for, and concerns about, certain mega-technologies like nuclear energy and life science, which are making such rapid progress. In order for science and technology to continue to provide material benefits, the applied wisdom of both experts and ordinary citizens will be needed.

Thus, the advancement of science and technology in the 20th century has hurled a number of problems at society, including global environmental problems, and posed questions as to what the relationship between science-and-technology and human society should be. Yet science and technology must themselves be used effectively in order to solve those problems. Promoting the advance of science and technology as the intellectual property of humankind is effective in expanding the frontiers of human activity and insuring the further development of civilization. The key questions that must be answered are, how can science and technology help solve the various problems facing human society, and what should be done to gain public acceptance for science and technology? Answering these questions is more important than ever before.

Chapter 2: The Advance of Nuclear Science and Technology

(The Birth of Nuclear Energy)

The use of nuclear energy dates from nearly one hundred years ago, when radiation and radioactivity were discovered by Wilhelm Konrad Röntgen, Antoine Henri Becquerel, and Pierre and Marie Curie. Shortly after that discovery in 1895, x-rays were applied in a medical examination. X-rays and radium were then used in cancer therapy. The use of radiation in medical examinations and treatment thus began long ago. Around sixty years ago, the nuclear fission chain reaction was discovered. Since then, research, development and utilization of nuclear energy have been carried out steadily, with the aim of using various kinds of radiation in medicine, manufacturing and agriculture, and the enormous energy released by nuclear fission. Nuclear energy is indeed the signature science and technology.

(Nuclear Energy and Its Use for Military Purposes)

The use of nuclear energy, foreseen in the discovery of fission, unfortunately began as weaponry during World War II. In the 1950s, nuclear fusion was applied – again first – in the hydrogen bomb. Nuclear weapons have hung as a threat over all of humanity for half a century. Since the Cold War, progress has been made in efforts toward nuclear disarmament and non-proliferation. These have included substantial nuclear arsenal reductions, the indefinite extension of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), and agreement on the Comprehensive Nuclear Test Ban Treaty (CTBT). At the same time, new proliferation concerns are arising about the disposition of plutonium from dismantled nuclear weapons, nuclear tests by India and Pakistan, and allegations of Iraqi nuclear development.

(The Peaceful Use of Nuclear Energy)

As the 1950s opened, research and development efforts were beginning on converting military-application technologies to peaceful, civilian uses of nuclear energy. In 1953, U.S. President Dwight David Eisenhower delivered his "Atoms for Peace" address, from which grew an international framework to promote the use of nuclear energy for peaceful purposes while preventing the proliferation of nuclear weaponry. Japan's experience with nuclear energy began with tragedy of the atom bombings of Hiroshima and Nagasaki. About ten years later the Atomic Energy Basic Law was enacted, and, with the determination to harness nuclear energy solely for peaceful purposes, Japan initiated a peaceful nuclear program of its own, with overwhelming public support.

Meanwhile, a number of countries have made large commitments to the development and improvement of technologies for nuclear power generation. At present, more than 400 nuclear reactors are in operation throughout the world, supplying about 16% of the total generated output (as of 1998). In the United States, nuclear power generation accounts for nearly 20% of electricity supplies, while about 30% of electricity requirements are met by nuclear power generation in Europe. Since the Oil Crises, Japan has actively introduced nuclear power plants, which are now supplying more than one-third of its electricity. Nuclear power generation is one of the mainstay power sources for the nation.

(Nuclear Power Development in the World)

Industrialized countries around the world are backing away from the construction of new or additional nuclear power plants. Sweden closed its Barseback-1 nuclear power plant in 1999 after much discussion following a national referendum on nuclear power in 1980. Germany has also decided to discontinue nuclear power generation. The German government and the electric power industry reached an agreement on a ceiling for nuclear power output, on the premise that the existing nuclear power plants would, in principle, continue in operation for 32 years or so. France has decided to close its Superphenix fast breeder reactor. Behind these move are a number of factors, including public concern about nuclear safety in the aftermath of the Three Mile Island nuclear power plant accident in the United States, and the Chernobyl nuclear power plant accident in the former Soviet Union. Other circumstances unfavorable to nuclear power include the advance of deregulation in the electric power industry, the installation of wide-area supply networks for electricity and natural gas, a trend toward energy conservation, the accelerated introduction

of renewable energy sources, and participation of the political parties advocating an anti-nuclear policy in the governments. In the United States, electric utilities are adopting coal- and natural-gas-fueled thermal power plants that can be constructed more easily and that offer greater short-term economic efficiency than nuclear power plants. There has been no new order for a nuclear power plant in the United States for over twenty years. Still, by increasing operating rates, existing nuclear power plants in the United States have demonstrated the ability to compete with other power sources in terms of economic efficiency. On the other hand, in the Asian region, where high economic growth and resultant increases in energy demand are expected in the medium-to-long term, some countries are planning to introduce nuclear power generation or add to their existing nuclear power plants, because fossil fuel resources are not abundant in this region. Thus, the current state of nuclear power generation and future outlook differs from country to country, and those differences are largely due to differences in energy situations specific to the countries and areas concerned.

(Use of Radiation)

Radiation, as one of the applications of nuclear energy, is being used in areas ranging from basic and applied research to practical applications. Various types of radiation provide means indispensable for cutting-edge research and development projects, such as observation, measurement and microfabrication in the microscopic realms of atoms, molecules and atomic nuclei. Moreover, radiation is a driving force for the advancement of science and technology, as it helps generate new knowledge as to the very essence of a substance. Radiation-applied technologies, such as x-ray therapy and cancer treatment, rubber and plastic reformation, sterilization of medical instruments, radiation breeding, and food irradiation, are now being widely used around the world, although to differing degrees in different places.

(Nuclear Energy in the 20th Century)

Nuclear energy has thus far played important roles in energy supply and in providing indispensable means and impetus for the development of science and technology, bringing health and affluence to people through the use of radiation in medical, industrial and agricultural fields – well serving humankind in the 20th century. On the other hand, the development and use of nuclear energy has brought problems – nuclear proliferation, safety issues, and the need to disposal of radioactive waste. Today, society is asking anew if human beings will be able to solve those problems in ways acceptable to society.

Chapter 3: The Current Situation of Research, Development and Utilization of Nuclear Energy in Japan and the Future Prospects

1. Nuclear Power Generation

1-1. The Climate Surrounding Nuclear Power Generation

Japan's first commercial nuclear power plant went into operation in 1966. Since then, Japan has pushed ahead actively with the introduction of nuclear power plants as a form of energy replacing oil, starting up new reactors at an average rate of 1.5 units a year. A total of 51 commercial nuclear power plants with a total installed capacity of 44,920,000 kW are now in operation. Looking back at how nuclear power generation has developed in Japan, we see that, during the 1970s, nuclear power plants were generally operating at low availability due to a succession of problems. Based on investigations of the causes, increasing availability factor then improved gradually, thanks to the implementation of drastic measures, improvements, and standardization efforts. In the late 1990s, the overall availability factor of nuclear power plants remained above 80%.

During fiscal 1999, nuclear power plants supplied the nation with 316.5 billion kWh of electricity, 34.5% of the total power output of 917.6 billion kWh. Viewed in terms of primary energy, nuclear power plants produced electricity equivalent to nearly 80,840,000 kiloliters of crude oil in fiscal 1998, 13.7% of the nation's primary energy supply. In the 1990s, with concern over global warming growing in the international community, great expectations were entertained in Japan for nuclear power generation, which, unlike thermal power generation using fossil fuel, emits no carbon dioxide in the generation process, as an effective means of reducing the emission of carbon dioxide, one of the greenhouse gases.

Meanwhile, having seen from Chernobyl in 1986 how one major accident can cause serious damage from radioactive contamination and have a tremendous social impact, people are beset with unease, wondering if human beings can manage this monumental technology called "nuclear" in a safe manner. In addition, public concern about nuclear power is growing as a result of recent nuclear power plant accidents in Japan, associated cover-ups, and falsification scandals. Those incidents and accidents have bred public distrust of the parties involved in the nuclear power industry. People suspect, moreover, that the government and nuclear operators are not disclosing information that does not suit their convenience. Knowledge of radiation and information about accidents at nuclear facilities are not fully or clearly transmitted to the general public. This is also cited as a

cause for public concern and distrust of nuclear power. Also, in addition to a policy lag seen in taking steps for the disposal of high-level radioactive waste produced by nuclear power plants, and concern, as well, about health hazards for future generations, the United States and many European countries are now less enthusiastic about nuclear power development than they were a while back. Some have policies of moving away from nuclear power generation. There are moves to introduce renewable energy sources as means to check global warming. For these reasons, a growing number of Japanese citizens believe that Japan should also restrain its further use of nuclear energy and promotion of the nuclear fuel cycle.

1-2. Considerations in Securing Energy Supply

Looking at the climate surrounding the world's supply of energy, it is apparent that consideration must be given to the rapid increase in energy consumption in developing countries in Asia. With the 21st century near at hand, the world is confronted by a number of problems such as population increases and environmental disruptions. These and other problems are closely connected with the energy issue. How a stable supply of energy and environmental protection can be achieved simultaneously is a key question that must be answered.

In Japan, the government entrusts private business enterprises with providing energy, taking full advantage of their search for economic efficiency. But the government must implement appropriate measures to guide such businesses from a long-term perspective in order to secure a stable supply of energy, protect the environment and promote the public interest.

The first priority in Japanese energy supply policy is securing the steady supply of energy necessary to support the lives of the people. What is important in this regard is to take measures with due consideration for the geographical-and-resource facts that, unlike the United States or Europe, Japan is an island nation that cannot exchange energy supplies with neighboring countries through transmission lines or pipelines, and that it is poor in energy resources and relies on foreign suppliers for most of its energy requirements. To this end, efforts are needed to diversify overseas suppliers of major energy resources and to create an adequate stockpiling base in order to provide for all contingencies, including supply cutoffs. Moreover, because, among economically and industrially advanced nations, Japan has the highest rate of primary energy dependence on oil, and an alarmingly high rate of reliance on

Middle Eastern oil imports, an important strategy involves the use of alternative energy sources to the extent feasible.

The second task is to minimize the environmental load from energy consumption. To this end, steps must be taken to promote energy conservation to the fullest possible extent and to accelerate the introduction of energy sources that impose relatively small loads on the environment. Particularly important are measures to reduce emissions of greenhouse gases such as carbon dioxide and methane. Japan, which chaired the Third Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3) in Kyoto, pledged there to achieve a target of reducing greenhouse gas emissions by 6% on average from the 1990 level, for the five-year period from 2008 to 2012. In order to achieve this target, Japan is required to make manifold efforts to improve energy utilization efficiency, such as through the introduction of cogeneration systems, which are useful as dispersed energy supply sources, and to promote energy-saving technology by encouraging people to make changes in their lifestyles, which consume much energy. At the same time, a set of policy measures must be put in place to shift power sources from fossil fuels to nuclear power and renewable energy, which involve smaller amounts of carbon dioxide emissions and, as an interim step, to shift from oil to natural gas.

Much attention is focused on natural gas, partly because it produces the least amount of carbon dioxide per unit of energy output among the fossil fuels, and partly because recent technological breakthroughs have lowered the power generating cost of natural-gas-fired plants. Even so, when the use of natural gas is promoted, it is necessary to recognize that natural gas does still produce carbon dioxide when it burns, and to take into account that, from the perspective of supply stability, multiple sources of supply must still be employed in a balanced manner, according to their individual characteristics.

Along with research and development on energy-saving technology and fuel cells, efforts are needed on technologies for exploiting the potential of nuclear and renewable energy sources. In addition, what is important from a long-term perspective is to develop those diverse potentials with creativity, in order to provide for the advent of various needs based on new senses of values, as well as on new constraints in the future. Among other things, this includes research and development on practical technologies for the recovery of carbon dioxide. It is also important to ensure that highly motivated business enterprises receive support for activities designed to translate technological breakthroughs into practical

applications and commercialization. It must be stressed that by making active efforts to solve these energy and environmental problems, Japan is both contributing to the international community, and, even more particularly, helping to solve energy problems in Asia, a region not necessarily rich in fossil fuel resources, but where increased energy consumption can surely be expected.

(Energy Conservation)

With the Oil Crises of the 1970s as its turning point, Japan has pushed ahead with drastic energy-conservation measures. As a result, the nation's final energy consumption per GDP in 1998 stood at about half that of the United States, a country with high energy consumption. Japan's final energy consumption also remains below the levels of European countries. Nevertheless, energy demand in the household, commercial and transport sectors has been increasing steadily, and, in the industrial sector, a slowdown in investment in energy conservation is expected for the moment as a result of the recession, which has brought about lower energy consumption. It is therefore difficult to predict what progress will be made in this area.

In order for Japan to shift to a recycling orientation that allows sustainable development, the current mass-production, mass-consumption economic society must be reconsidered. Efforts must be made to create technologies and systems that effectively use and recycle resources. And it is essential that people adopt lifestyles consistent with such a recycling orientation. Given the magnitude of equipment replacement, renewal and modernization involved, and the major social reforms that will be needed, it will be some considerable time before results can be achieved. But the Japanese government must work steadily and continuously to bring about these ends.

(Renewable Energy Sources)

Looking at the shares of renewable energy sources in total primary energy supplies, hydroelectric power accounted for 3.9% in fiscal 1998, and other renewable energy sources together had a share of 1.3%. Compared with other renewable sources, hydroelectric, biomass and geothermal power offer the advantage of relatively stable supplies. For the time being, however, developing large-scale untapped hydroelectric and geothermal resources is difficult because of environmental and siting constraints, and economic factors in constructing transmission lines and other facilities. Expanding the shares of these renewable energy sources to any substantial degree is a difficult task. Therefore, the focus

of efforts will be on the development of small and medium-size hydroelectric power plants, with due consideration to environmental preservation, and on the development of innovative technologies such as power generation utilizing hot dry rock.

For their part, photovoltaic, wind, and wave power, all of which depend on location and natural conditions, are unstable in supply and of low energy density. In addition, equipment costs per unit of power output are high. For the present, therefore, use of wind power in windy locations and photovoltaic power for private use in the household sector have been started. The most important thing now in regard to photovoltaic power is to improve its economic efficiency. To this end, efforts are needed to enhance the efficiency of solar batteries, reduce the cost of making the batteries, and improve the methods of installing photovoltaic generation systems. Photovoltaic technology could then support a number of applications, and be used, for example, as a power source to help meet peak demand in summer. As for wind power, because the terrain in Japan is complicated and wind conditions are unstable, sites suitable as "wind farms," i.e., for the installation of numerous wind turbines, are few. It should also be noted in this connection that when these unsteady power sources exceed a certain portion of the minimum load capacity of utility power systems, stabilizers must be installed in the utility power systems. This is cited as one of the factors contributing to cost. Nevertheless, plans call for expanding the capacity of wind power by selecting windmills that meet wind conditions at a site, based on detailed surveys, and by developing large windmills that have a unit capacity of 1,000 kW or so, in order to achieve the desired economic efficiency.

Another potential energy business involves generating electricity from waste materials, including "black liquor" and other biomass waste from the papermaking process, and construction and demolition waste. There is a limit to introducing waste-to-energy power generation, however, because the power generation potential is a function of the main processes that produce the waste substances, and because the availability of waste materials is limited.

In the medium-to-long term, every possible effort must be made to promote the rational introduction of renewable energy sources. All possible means must be employed to provide support for the use of renewable energy sources in dispersed, local areas. Under present conditions, however, it is difficult to expect these renewable energy sources, with the exception of hydropower, to play anything more than a supplementary role.

1-3. Characteristics of Nuclear Power Generation and Tasks

(Security of Supply)

Nuclear power generation offers a technical advantage over other energy sources in that nuclear fuel has a higher energy density and can be stockpiled easily. In addition, the fuel supply is stable because, unlike oil resources, uranium resources are dispersed in politically stable countries. When practical technologies capable of using uranium more highly efficiently in fast breeder or other advanced reactors become available sometime in the future, nuclear power generation will be able to supply energy for an even longer period of time. It will then stand truly as a promising technical option for providing humankind with its much needed energy.

(Environmental Acceptability and Radioactive Waste)

Nuclear power does not produce greenhouse gases, such as carbon dioxide, nitrogen oxides or sulfur oxides, in the generation process, and it thus imposes little load on the environment. On the other hand, risks are involved in that, in a nuclear power plant accident, radiation and radioactivity can be released into the environment. Steps must therefore be taken to minimize the effects of radiation. Radioactive waste, in turn, has been properly managed since the beginning of nuclear power generation in Japan. Efforts must be made to continue that management and to dispose of the waste in such a manner that radioactivity will not affect the human living environment.

For a given amount of energy, nuclear power produces a smaller amount of waste than other forms of generation, which, for example, does not require extensive space for storage or disposal. However, because that waste is radioactive, how to ultimately dispose of it is a top-priority issue that must be resolved in order to press ahead with nuclear power development. When a nuclear power plant with a capacity of one million kW is operated for one year, several hundred 200-liter metal drums of low-level radioactive waste are generated. In addition, about 30 150-liter stainless steel containers of vitrified assemblies of high-level radioactive waste, the residue after useful substances such as plutonium and uranium are separated from spent fuel through its chemical reprocessing, result. Other radioactive waste will result when the plant is, in time, decommissioned. Low-level radioactive waste is already disposed of by underground burial. High-level radioactive waste, because its activity level remains high for such a long period of time, must be maintained safely for a long period of time, so that its radioactivity will not have any

significant effect on the environment where people live. For high-level radioactive waste, the leading concept in most countries is disposal several hundred meters deep, in stable geological formations.

In Japan, the Specified Radioactive Waste Final Disposal Act was enacted in 2000, under which basic policies on final disposal have been made and an implementing organization for the disposal business has been established. Hereafter, further steps, including determination of a disposal site, will be taken.

The Nuclear Safety Commission is now addressing various matters, including safety regulation for final disposal.

Toward implementation of this final disposal, relevant parties, including the Japanese government and the implementing body, are required to make efforts to accumulate scientific knowledge on deep geological formations, and to steadily carry out such efforts, which themselves must involve dialog with, and the understanding and cooperation of, the people.

(Economic Efficiency)

Generating costs with various power sources differ from country to country because resources, personnel expenses and capital costs are functions of the social and economic systems and resource-distribution mechanisms in each country. There are countries where fossil-fueled thermal power generation is more economical than nuclear power generation because resource distribution systems have been improved/developed; and, as a result of such distribution, areas that can be assured of a supply of cheaper fuel from large-scale natural gas or coal fields are expanding. In Japan, nuclear power is considered to be as economically efficient as other power sources, based on power cost estimates made on the assumption of 40-year plant operating lives and average capacity factors of 80%.

(Safety)

Given the large amounts of radioactive substances contained in nuclear power plants, multilevel safety designs, including seismic designs based on Japan's natural conditions, and safety management systems are adopted to protect against accidents and other problems. Nonetheless, the general public has considerable apprehension about nuclear power. This is because radiation cannot be perceived with the five senses, because the effects of radiation

on health are uncertain, and because safety arrangements provided in nuclear facilities are unclear to the public. In addition, ordinary people are in no position to foresee the effects and dangers of accidents or problems at a nuclear power plant. The Chernobyl nuclear power plant accident caused immense damage, while, in Japan, a criticality accident occurred at a uranium-processing plant. Based on thorough investigations of the causes, the Japanese government and nuclear operators are required to take measures designed to prevent the occurrence of similar accidents, to continue their efforts toward the development of safety technologies – putting the highest priority on safety – and, most importantly, to take viable precautions against disasters.

(Consideration to Nuclear Non-Proliferation)

In nuclear power development and utilization, consideration to nuclear non-proliferation is essential, because nuclear material, technology and equipment can be used or diverted to make nuclear weapons. Japan, a party to the NPT, has been strictly managing its nuclear materials and facilities under the safeguards of the International Atomic Energy Agency (IAEA), and has thereby gained the understanding of the international community with respect to the practical application of so-called sensitive technologies, such as uranium enrichment and reprocessings, and the use of plutonium. In order to continue to meet its international commitments and to improve the effectiveness of efforts toward nuclear non-proliferation, Japan must endeavor to make both its information and its management of internationally regulated material more transparent, and to make efforts in the development of related technologies.

1-4. Comparative Importance of Nuclear Power Generation in Japan's Energy Supply

In order for Japan to sustain the high quality of life of its people, and to create a recycling-oriented society suitable for the 21st century, it is vitally important that the nation's energy supply-and-demand structure itself be altered. To this end, the Japanese government, by employing various regulatory and incentive means, must make constant efforts to secure a proper level of resource stockpiles, enhance the efficiency of energy-utilization technologies, make reforms in various social systems, bring about shifts in lifestyles, promote energy conservation, and stimulate to the fullest extent possible the use of renewable energy sources according to their specific quantity and quality characteristics.

At the same time, it is a wise and rational policy for the Japanese government to continue making the fullest possible use of nuclear power generation as one of the mainstays

of the nation's energy supply, considering the geographical and resource conditions of Japan, a nation poor in energy resources, and taking the energy uncertainties of the future into account. Moreover, nuclear power generation already supplies the nation with more than one-third of total domestic power output, thereby contributing to improving energy self-sufficiency and stability of the energy supply, as well as playing an important role in reducing the nation's carbon dioxide emissions.

Thus, the share of nuclear power generation in the power generating mix should be maintained at an appropriate level, from the viewpoint of coping with changing circumstances, and of moving Japan's energy supply system toward one that provides high economic efficiency and supply stability, while producing tolerably small amounts of carbon dioxide emissions.

At that time, disposal of radioactive waste should be implemented safely and steadily, with sufficient consideration given to securing safety and nuclear non-proliferation.

2. Nuclear Fuel Cycle

2-1. Current Status of the Nuclear Fuel Cycle

At present, spent fuel from nuclear power plants in Japan is cooled in storage pools at the plants for a certain period of time, and then reprocessed. So far, most spent fuel from Japanese nuclear power plants has been entrusted to overseas reprocessors. Hereafter, such fuel will be reprocessed at a commercial reprocessing plant now under construction in the village of Rokkasho, in Aomori Prefecture. Spent fuel beyond the capacity of that reprocessing plant will be stored at the power plants, or will be delivered to spent fuel intermediate storage operators, who will store it safely outside the power plant compounds, until it can be reprocessed. High-level radioactive waste remaining after useful substances such as plutonium and uranium are separated from spent fuel during the reprocessing will be vitrified into a stable form, stored for 30 to 50 years for cooling, and then disposed of in deep geological formations. The recovered plutonium will be used in existing light water reactors in a process of MOX fuel utilization, and in research and development on, for example, fast breeder reactor technology.

The most effective way to use uranium resources more efficiently is by burning plutonium as fuel in fast breeder reactors designed mainly for fast neutron reactions. Japan has achieved significant results in its fast breeder reactor research, including validation of

the breeding performance of the experimental reactor "Joyo," recovery of plutonium from its spent fuel, and experimental power generation by the prototype reactor "Monju." "Monju" has been shut down because of a sodium leakage accident during trial operations in December 1995.

Internationally, some countries, for example, France, are reprocessing spent fuel and using the plutonium. Others, including the United States, have made it a policy to directly dispose of spent fuel without reprocessing. Countries have also taken different stances on fast breeder reactor development. Russia and China are enthusiastic about FBR development, whereas, despite some technological achievements, the United States and some European countries have discontinued FBR development projects, or otherwise changed their policies for economic or political reasons.

2-2. Significance of the Nuclear Fuel Cycle for Japan

From the state of the world in general, and the situation in Japan in particular, it is apparent that diverse efforts must be made over the long term to secure a steady supply of energy through technological means.

Nuclear power generation contributes to economic efficiency, supply stability and the environmental acceptability of Japan's energy supply systems. Nuclear fuel cycle technologies have the potential to improve further on these attributes, and to permit the benefits of nuclear power generation to be enjoyed for a longer period of time. Technology for reprocessing spent fuel, rather than directly disposing of it, and recovering plutonium and uranium for use as fuel, require facilities enabling nuclear material control as well as safety control, in light of the nature of such technology, which is to chemically treat material with high radioactivity and separate plutonium and other elements, necessitating, therefore, a great deal of facility investment. On the other had, such technology economizes on uranium resources and improves supply stability. It is, therefore, appropriate to basically reporcess spend fuel and make effective use of plutonium, uranium and other elements, while securing safety and nuclear non-proliferation. Taking economic efficiency into account, Japan should make the reprocessing of spent fuel and the use of recovered plutonium and uranium its basic policy, considering the geographical and resource conditions of the country.

Furthermore, fast breeder reactor and related nuclear fuel cycle technologies (hereinafter referred to as "FBR cycle technologies") can significantly increase the efficiency of uranium utilization, and, when they are commercialized in the future, can make it possible to continue using nuclear power for several hundred years with uranium resources currently known to be both technically and economically available for use, and can reduce the long-term radioactivity of high-level radioactive waste, decreasing the environmental load. In order, therefore, to prepare for an uncertain future and secure promising energy supply options, an important strategy is to devote steady efforts to the development of these FBR cycle technologies. Given that basic research for that development and the putting of the technologies to practical use will both take time, and given further the need to contribute to solving energy problems not merely for Japan, but for the world, Japan should focus on research and development on FBR cycle technologies under a long-term plan.

In the use of plutonium through the reprocessing of spent fuel, there are concerns about safety and nuclear proliferation, and doubts about economy and the economic efficiency of research and development investment. In order, therefore, to promote the use of plutonium, it is important to ensure safety, and to dedicate effort to explaining the concept to the people, focusing on securing a stable supply of energy. It is equally important, at the same time, to actively carry out promotional activities to enhance understanding on the part of the international community of Japan's policy on the use of plutonium, and to reiterate to the world Japan's philosophy of firmly adhering to the peaceful uses of nuclear power and its systems. Research and development of FBR cycle technologies should be carried out with efforts to use funds effectively, with proper evaluations at appropriate times, and with the results released to the public. Through these efforts, understanding on the use of plutonium, both domestically and internationally, will, and must, be sought.

3. Use of Radiation

Radiation is now widely used in medicine, industry and agriculture. But although it greatly contributes to the advancement of science and technology, and is important to people in their daily lives, most of the applications are unknown to the general public. Japan, moreover, lags behind many other countries in some applications, such as food irradiation, because of misgivings on the part of consumers.

Radiation is expected to be even more widely used in the future, in areas such as radiation therapy, where it can minimize the physical burden on the patient; food sanitation;

environmental protection, removing nitrogen and sulfur oxides from flue gases; and material processing, such as the reformation of high molecular compounds in manufacturing industries. The development and utilization of these radiation-applied technologies will further improve the quality of people's lives in the 21st century, help create a recycling-oriented society that is in harmony with the environment, and help sustain and develop vital industries.

Nevertheless, beyond, even, the legacy of the atomic bombs – because of events such as the Chernobyl accident and the criticality accident at a uranium-processing plant – the Japanese public today has greater concern about radiation than it had before. Important, then, in promoting the use of radiation is an effort to help people gain a correct understanding of the benefits of the use of radiation, the characteristics of radiation, and the effects of radiation on the human body. Needed, too, is research on the effects of low-level radiation on the human body, and on the treatment of radiation injuries. Results of that research should be disseminated widely to the general public.

4. Nuclear Science and Technology

As it enters the 21st century, Japan should focus greater effort on basic research, generating intellectual capital for the common benefit of people everywhere, and endeavor to create original, innovative technologies.

Fields such as information technology and life science, where such rapid progress is being seen today, are expected to play central roles in socio-economic development and in improving the quality of people's lives. The promotion of other basic science and technology, including energy research, is, of course, equally important to support various social activities and attain broad social development. It should be noted that today's "fields" of science and technology extend far beyond their original domains and are intricately intertwined. Active, on-going commitments must therefore be made to research and development in the field of nuclear energy, with its enormous potential, described below.

Nuclear science and technology not only form the basis for development of new energy technologies, including nuclear fusion; they also provide effective tools – lasers, accelerators, nuclear reactors – with which to challenge new frontiers. Using various forms of radiation produced by these devices, for example, the microscopic structure of DNA and

proteins can be observed. With radiation, new elements and materials can be created. The internal structure of the atomic nucleus can be ascertained in our quest to know the ultimate constituent elements of all matter. Thus, nuclear science and technology bring new knowledge to physics and other fields of basic science, while providing cutting-edge research tools in life science, materials science, and more. Nuclear science and technology offer enormous possibilities.

Combined with the progress of research in the fields of material science and life science, where even more innovative technologies are expected to arise, the advance of nuclear science and technology is predicted to contribute to extending the intellectual frontiers of humankind in the 21st century, and to give rise to new industries in Japan. Accelerators, nuclear reactors and nuclear fusion represent gigantic systems that combine advanced technologies from multiple fields. As such, the development of these technologies is expected to produce spin-off effects in other areas of science and technology.

Japan, while enjoying the advantage of running second place, watching and learning from the successes and missteps in Europe and the United States, has so far made encouraging strides thanks to research and development in the fields of nuclear science and technology. In consequence, as has been pointed out, Japan has been rather negligent in creating new ideas and has clearly fallen behind other countries in basic research. It is true that the nation has been inclined to be quite rigid in many of its marketing efforts. Now that Japan has become a front-runner in global nuclear science and technology, and considering that there is a growing uncertainty about the future, it is essential for Japan to give priority to creative research and to take a flexible approach, properly reflecting the latest expertise and the needs of a changing society in its plans.

Chapter 4: Promoting a New Nuclear Power Policy

People in nuclear fields must attach greater importance than they have so far to its relationships with the general public, society as a whole, and the international community. Thus, the new nuclear power policy should be promoted with a primary focus on nuclear safety, disaster prevention, public trust, coexistence with local siting communities, adherence to the peaceful use of nuclear energy, and international understanding.

1. General Public, Society and Nuclear Power

The Japanese nuclear industry is confronted by a number of problems in its relations

with the general public and society. Public trust in nuclear power has been eroded by a succession of nuclear accidents and scandals, including a sodium leakage at the fast breeder reactor "Monju," a fire and explosion at the bituminization facility in the Tokai reprocessing plant, and a criticality accident at a uranium-processing plant. In order for nuclear power to play its expected roles in energy supply and the advancement of science and technology, the nuclear industry should further improve technologies for controlling nuclear energy safely, in order to gain public acceptance. In addition, efforts should be made to secure transparency in all aspects of nuclear energy, from policy to utilization, thereby bringing nuclear energy closer to the people.

To this end, it is essential for the Japanese nuclear industry to achieve satisfactory safety results under the safety-first principle. At the same time, efforts should be made to promote information disclosure more positively, and thereby further enhance transparency in nuclear administration and the activities of nuclear operators. What is more important than ever before is to encourage the providing of accurate information to the general public, and to promote dialogue between regulatory authorities and people in all walks of life. In order to site nuclear facilities smoothly and operate them steadily, it is essential for the nuclear power industry to gain the understanding and cooperation of residents in local siting communities. Of vital importance is the recognition that the relationship between a nuclear operator and the local community is one of interdependence.

1-1. Nuclear Safety and Disaster Prevention

To insure nuclear safety, the government must carry out its regulatory responsibilities, and the nuclear power industry must carry out its operational responsibilities, including facility maintenance and attention to safety. A disaster prevention program should be put in place for emergencies. The central and local governments, and nuclear operators, must fully discharge their respective duties to secure the effectiveness of this disaster prevention program. The central government must effectively administer safety regulation from the viewpoint of the general public. It is important, moreover, to ensure that the activities of those responsible parties are transparent and can be relied upon by the general public.

The criticality accident at a uranium-processing plant affords instructive lessons on what is required in the areas of government regulation and disaster management. In addition, it highlights the importance of establishing a safety management structure, based on enhanced safety consciousness of all the parties concerned with the nuclear industry, and

of rigorously promoting safety education. Already the government has, among other actions taken, amended to the Nuclear Reactor Regulation Law, to provide for inspection on the compliance by nuclear operators with safety regulations; enacted the Special Law of Emergency Preparedness for Nuclear Disaster; and reinforced the secretariat functions of the Nuclear Safety Commission. The government and nuclear operators must ensure effective follow-through on these measures. Moreover, it is of crucial importance for nuclear operators to establish and spread the safety-first culture, not only in individual organizations, but in the nuclear industry as a whole. Members of the nuclear industry must be aware of their duty to secure safety on the front line and to act with a strong sense of responsibility for safety, in order to gain public trust.

Furthermore, greater efforts should be directed to research into the effects of radiation on the human body and on the treatment of radiation injuries. In order to be prepared for emergencies, improvements should be made in systems for minimizing adverse health effects, and for providing necessary medical treatment.

1-2. Building Public Trust

In order to build public trust in nuclear energy, the first consideration should be for the nuclear industry to achieve satisfactory safety results in the operation of nuclear facilities. It is also essential for members of the nuclear industry to make constant efforts to gain an understanding from the public. In addition, it is of critical importance to promote – in normal times – the candid disclosure of information on nuclear power, thereby further improving transparency in nuclear administration and the activities of nuclear operators. What is equally important is that the government encourages public participation in the policy-making process. Measures to help the general public gain a better understanding of nuclear power include providing information, promoting various forms of dialogue with the people, and enriching the content of education. In these ways, an environment can be created that enables each and every citizen to think about energy and nuclear power, and to come to their own conclusions about them.

(Information Disclosure)

Information is the basis on which people form judgments on the nuclear energy issue. Thus, it is important to ensure that the information people need is disclosed properly. The government has already made it a rule to disclose all information related to nuclear energy, except that pertaining to nuclear material safeguards or physical protection. The

government should still, of course, ensure that the information provided is clear, complete and easy to understand. The government and nuclear operators should make continued efforts to disclose accurate and reliable information on both normal operations and accidents in a timely fashion, in accordance with well-defined information disclosure standards.

(Public Participation in the Policy-Making Process)

With the "Monju" fast breeder reactor accident as the stimulus, the Atomic Energy Commission of Japan has been promoting public participation in the policy-making process, taking the initiative in this regard among all government agencies. The government must make continued efforts to encourage citizens to take part in the policy-making process by holding public hearings on policy options, and take advantage of opportunities to demonstrate its accountability. These processes should be reviewed in a flexible manner to meet changes in the social situation. The Round-Table Conference on Nuclear Policy made policy proposals after compiling the views of people in all walks of life. In order to continue to hear what citizens have to say and to reflect that in nuclear energy policy, a study should be made on creating a new forum for listening to the people, similar to that of the Round-Table Conference.

(Creation of an Environment for Gaining Public Understanding)

In order to help the people deepen their understanding of the government's nuclear policy and the activities of the private sector, it is of vital importance to create an environment in which each citizen can think about energy generally, and nuclear energy specifically, and form his or her own judgment. To this end, important strategies are to provide information in intelligible terms to answer questions the people have; to engage in two-way communications with the public; and to foster proper education on energy and nuclear issues at schools and social institutions.

1-3. Coexistence with Local Siting Communities

The siting of nuclear facilities is not just a matter for the single area or nuclear operator, but is vitally important to the government's overall energy policy. In carrying out energy policy decided at the national level, therefore, an important consideration is gaining the understanding and cooperation of residents in local siting communities, while, at the same time, developing similar understanding on the part of the people who are the consumers of the electricity.

In projects to construct nuclear power plants, procedures have so far been followed to reflect the voices of the inhabitants of plant-site areas in various forms. As time goes on, it will become even more important to create opportunities for local residents to directly express their views on the particular nuclear power plant project.

After nuclear facilities have been constructed, nuclear operators should naturally do their utmost to ensure that they are operated safely. In order to gain the understanding and cooperation of local residents, it is important to try to alleviate residents' concerns about safety through proper disclosure and the providing of information, and to recognize that the central and local governments, and nuclear operators, must play their respective roles properly, and work together to achieve coexistence between nuclear operators and local siting communities, so that both develop and prosper together, while, for the sake of regional development, respecting the autonomy of local municipalities.

Most of the electric power generated by power plants is transmitted to metropolitan areas to meet the needs of urbanites and industry. In order to facilitate the siting of nuclear facilities, it needs to be emphasized that efforts are required to develop authentic understanding on the part of the people who are the electricity consumers.

2. International Community and Nuclear Power

According to overseas media accounts, there is suspicion that Japan intends to develop nuclear weapons, and some express concern that the use of plutonium by Japan may lead to international nuclear proliferation. In order to proceed smoothly with the development and utilization of nuclear energy, Japan should dispel such concerns by making the principles of its nuclear power policy clear to the rest of the world. Equally important in gaining the understanding and trust of the international community is for Japan to use its technologies and experience, working together voluntarily with other nations, to solve nuclear safety and waste-disposal problems, which are common concerns for countries pressing ahead with the use of nuclear energy.

2-1. Making Japan's Policy and System of Adherence to the Peaceful Use of Nuclear Energy Clear to the Rest of the World

From the very beginning of its effort, Japan has pushed forward with its research, development and utilization of nuclear energy solely for peaceful purposes in accordance with the Atomic Energy Basic Law, and on the principles of democracy, independence and

openness. Japan should make clear to the rest of the world that it is committed to the peaceful use of nuclear energy. Japan should make greater efforts to show the international community that it is upholding the three non-nuclear principles - not possessing nuclear weapons, not producing them and not permitting their introduction in Japan - and fully discharging its duties in accordance with the NPT; that nuclear armament is not recognized as serving its national interests; and that transparency in its nuclear administration is assured through the international regime.

2-2. Promotion of Activities to Gain International Understanding on Japan's Plutonium Use Policy

In order for Japan to proceed with the use of plutonium, it should not only strictly maintain the principle of peaceful use, but also make continued efforts to obtain the understanding and trust of the international community, including efforts to actively disseminate information on the measures it is taking to insure that peaceful use. Japan, as one of the leading nuclear power nations and a non-nuclear-weapon state, should make clear the necessity, safety and economic aspects of its plutonium use policy. Moreover, based on the principle of not holding surplus plutonium, i.e. plutonium for no specific purpose, Japan should consider and implement specific policy measures to further improve transparency in its use of plutonium.

In pushing forward with nuclear power generation, it is necessary to transport nuclear fuel materials and radioactive waste domestically and internationally. Regarding international transport now used for returning nuclear waste packages and fabricated MOX fuel from overseas spent fuel reprocessing companies, concern about the safety of the transport is growing among countries whose coasts lie along the transport routes. To dispel those concerns, the central government and nuclear operators should make continuous efforts to promote understanding in those countries, by explaining to them the necessity of transport, future plans, safety, and the availability of damage compensation. In the future, too, in pursuing its nuclear fuel cycle policy, Japan must be mindful of the concerns of other nations in regard to its transport of nuclear materials.

Chapter 5: Toward the 21st Century

(Response to Problems of Nuclear Power in the 20th Century)

In the 20th century, nuclear energy has made many and varied contributions to people everywhere, even as it has sometimes threatened our very existence. We have witnessed

nuclear energy applied to horrific military weapons, radiation injuries in peaceful projects, and nuclear power plant accidents that have spread radioactive materials far and wide. And we carry the problem of radioactive waste disposal – not yet solved – with us into the 21st century.

Looking ahead, Japan should reflect seriously on the history of research, development and utilization of nuclear energy, and make efforts toward nuclear non-proliferation in cooperation with other members of the international community. At the same time, Japan should step up efforts to secure safety, achieve steady and safe operations of nuclear facilities, and make continued efforts to properly treat and dispose of radioactive waste, thereby steadily performing the expected functions of nuclear power, such as energy supply. Japan should make ceaseless efforts to increase safety and reliability by incorporating the results of technological developments in a timely and appropriate fashion, and, at the same time, make nuclear power something that is open and accessible to society. This should be made to build public trust in nuclear power.

(Efforts to Develop the Potential of Nuclear Energy from a Long-Term Perspective)

Our distant ancestors learned to use fire. In the 20th century, science and technology harnessed the "fire" of the atomic nuclei. With huge quantities of energy from small amounts of matter comes radiation, dangerous if not properly handled. Humankind has not yet seen the full potential of nuclear energy.

As an energy source, nuclear power could fuel and warm the people of our planet for a long time to come, and with a relatively small environmental load. Exploiting this potential over the long-term, and being prepared for an uncertain future, are of great importance. It is one of many efforts being made to achieve sustainable development for the global community and to change from a consumption-oriented society to a recycling-oriented one in the 21st century.

In other fields than energy, nuclear science and technology have great potential to advance broad areas of science and technology, from basic to applied technologies, improving the quality of life, and contributing to the industrial sector. Materializing this potential with imagination and an adventurous spirit is a key challenge for humankind.

(Toward the 21st Century)

Nuclear energy was discovered in the 20th century. It is the primary responsibility of the present generation to establish technology and a social system to safely control and manage it wisely, in a manner socially acceptable in the 21st century. Research and development must be carried out on the diverse potential of nuclear energy to the fullest possible extent, in order to achieve a stable, long-term supply of energy, advance cutting-edge scientific and technologies for using nuclear energy, and improve the quality of life. The results must then, without fail, be passed on to the next generation.

It must be emphasized that the fruits of such investments in the future will not only benefit Japan, but contribute also to solving the world's energy and environmental problems, and will create intellectual assets valuable for the future. Many nuclear technologies were developed or refined for military purposes during the Cold War. Now that that period in history is over, Japan, as a non-nuclear-weapon state, should promote the peaceful use of nuclear energy and develop universally valid technologies for harnessing nuclear energy for peaceful purposes that can be used by the global community. Offering such technologies to the rest of the world is of critical importance for Japan in its role as a member of the international community.

Part II : Future Prospects for Research, Development and Utilization of Nuclear Energy

Chapter 1: Major Considerations in Research, Development and Utilization of Nuclear Energy

(Fundamental Roles of the Government and the Private Sector)

Research, development and utilization of nuclear energy are characterized by several conditions: Activities are related to basic government policies on energy supply for the nation's people and economic infrastructure, and on the promotion of science and technology; strict measures are required to secure safety because energy sources with very high energy density, as well as radiation, are involved; diplomatic considerations attach, including issues of nuclear non-proliferation; and long-term research and development commitments are required. Accordingly, a fundamental role of the government is to clearly set forth its basic policy on the research, development and utilization of nuclear energy, enact legislation, such as safety regulations, and take exhaustive measures to ensure that all such legislation and rules are fully complied with. The role of the government also includes improving the international framework for smooth promotion of nuclear energy utilization, based on the security of peaceful use; actions to provide a crisis management system covering the prevention of disasters, in cooperation with local governments and other interested parties, as preparation for contingencies such as accidents; and the implementation of necessary measures for the promotion of basic and generic research and development activities, and for the development of required human resources from a long-term point of view.

Many operations in nuclear power generation, nuclear fuel cycle services and the use of radiation have already been undertaken by private business operators, based on the results of past technological development efforts in the public and private sectors. It is strongly hoped that highly-motivated private business operators will take positive measures for investment and technological development activities, so that the business operations stated above will continue to be smoothly promoted in the years ahead, on the basic principle of securing safety while effectively using the advantages of private businesses.

In the energy sector, the government should seek public understanding of its actions by clearly setting forth its policy on necessary measures to secure a stable supply of energy from a long-term point of view, and on fulfilling its international commitments related to

global environmental problems. In addition, the government should provide private nuclear operators with proper guidance, depending on circumstances, to ensure that the nuclear power generation resulting from their voluntary activities is sufficient to attain the targets set on the basis of the role nuclear power is to play. In the area of nuclear fuel cycle projects as well, the government should take necessary measures to facilitate smooth implementation.

(Promotion of Research and Development)

In promoting the research and development of nuclear energy, the government should play a leading role in implementing research and development projects that require long-term commitments, specifically those aimed at identifying and commercializing potential capabilities of nuclear power as a promising energy option in the years ahead; and basic and generic research and development activities to acquire diverse knowledge and information as the intellectual assets of humankind. When any research and development project achieves results that should be put to practical use, it is important for the government to assist highly-motivated private corporations in carrying on their activities for the commercialization of such results. Another important task of the government is to jointly work with private corporations - prospective users of new technologies in future markets - from the viewpoint of efficiently promoting research and development projects and smoothly implementing the transfer of technologies in the years ahead.

In leading the world in the area of nuclear energy research and development through these projects, it is important for Japan to promote creative research and development in a competitive research climate and to steadily carry out these projects with diverse options and sufficient flexibility to properly respond to the latest information and ever-changing social requirements. For this purpose, the government should timely and properly assess research activities and have its findings properly reflected in subsequent research and development programs and in the allocation of available research resources. Concerning, in particular, research and development projects that are closely related to social needs, it is important to undertake these projects with the specific users in mind.

A primary consideration in gaining public understanding of investment in the research and development of nuclear energy is the assessing of these research activities with sufficient transparency.

Chapter 2: Harmony between People, Society and Nuclear Energy

1. Securing of Safety and Prevention of Disasters

(Commitment to Secure Safety)

From the standpoint of protecting lives and property, the government is responsible for implementing strict safety regulations. Under the Nuclear Reactor Regulation Law, which was amended following the criticality accident at a uranium-processing plant in 1999, the government is responsible for conducting inspections, etc., on how nuclear operators comply with the applicable safety rules. The Nuclear Safety Commission is in charge of strengthening safety regulations, as necessary, mainly based on the results of investigations carried on by competent authorities after approval of nuclear facilities, to ascertain the actual state and effectiveness of the regulations. In fulfilling their respective responsibilities, the government and the Nuclear Safety Commission should do their utmost to ensure that a sound relationship of positive tension is established and maintained between the regulating and regulated sides.

Nuclear operators, who are licensed to carry out otherwise prohibited activities, bear the primary and heavy responsibility for securing the safety of their business operations. Nuclear operators should effectively secure safety on their own initiative through voluntary activities to maintain safety, and their executives are expected to make every effort to see that a safety-first operation policy permeates throughout their organizations. In training researchers, technicians and engineers, steps should be taken to enhance educational programs related to safety. Following the criticality accident at a uranium-processing plant in 1999, the Nuclear Safety Network and certain other organizations were established by parties involved with nuclear energy. It is strongly hoped that efforts will be exerted to promote safety consciousness and to share relevant information and experience among all members of various industrial circles in general, and to upgrade the ethics of the entire nuclear power industry in particular, through these networks and organizations.

It is important for the government and nuclear operators to ensure that lessons learned from problems, as well as the latest information from domestic and overseas sources, are timely and properly reflected in their safety measures. While reflecting the latest scientific and technological knowledge in safety regulations, the government should endeavor to maintain at a high level the scientific and technological foundation necessary to secure safety. For this purpose, it is necessary for the government to steadily promote studies, in cooperation with interested organizations, under an annual safety research program to be

formulated by the Nuclear Safety Commission, in such areas as environmental radioactivity, radioactive waste and nuclear power facilities.

Efforts are needed also to push forward with fundamental studies on the effects of radiation on the human body, and the migration and circulation of radioactive substances in the environment. The results of these studies must be incorporated into such activities as the assessment of the health risks of radiation and the formulation of reasonable protection standards.

(Commitment to Prevention of Nuclear Disasters)

Based on the recognition that the possibility of an accident cannot be totally eliminated, no matter what commitments are made to securing safety, sufficient disaster prevention measures should be provided to minimize harm to life, health, etc., of local residents in the event of an accident. Hereafter, the government, local governments and nuclear operators should, while gaining local residents' understanding, combine their efforts to ensure that the Special Law of Emergency Preparedness for Nuclear Disaster functions effectively as intended.

2. Disclosure and Offer of Information

(Desirable Way of Disclosure)

Relevant information provides criteria by which the general public can assess the reliability of nuclear regulatory authorities and nuclear operators. Accordingly, the government and the operators should make clear where various information can be found, and where responsibilities lie in their organizations, so that timely, accurate, reliable information necessary to the public can be disclosed both at normal times and at times of accidents, under clearly-defined disclosure standards.

In order to gain further confidence from the people in the disclosure and providing of information, continuous efforts to review them are required.

(Desirable Way of Offering Information)

In offering information aimed at promoting public understanding of nuclear energy, the government and the nuclear operators should follow the basic principle that such information be: (a) timely; (b) easy to understand to those who are not experts; and (c) sufficient to meet diverse needs of recipients. In addition, it is essential for the government

and the operators to promptly offer necessary information at the time of an accident. Such disclosures of information should systematically combine grass-roots dissemination networks, interactive media, and other new media such as the Internet. The government and the operators should endeavor to widely disseminate explanations concerning risks involved in nuclear operations, the existence of natural radiation, other sources of personal risk, and the benefits and significance of nuclear operations. Such communication with the general public should be based on the concept of "risk communication," which calls for exchanges of information and opinions and peer reviews among all interested parties, and for upgrading their understanding through such processes.

Today, in our information-saturated times, it is the mass media that primarily supply people with the information they need to make judgments on important issues. For that information to be accurate and easy to understand, the government and the nuclear operators must, on their part, make certain that the information and materials they provide to the media are themselves correct and clear.

3. Education on Nuclear Energy

It is essential that education on nuclear energy be systematically and comprehensively dealt with as part of issues of energy and the environment, as well as from the viewpoint of science and technology, radiation, etc. For this will be useful to make good use of "Periods for Integrated Study" which each school is free to develop and establish under new guidelines on courses of study in schools. The teaching of each subject individually should also be improved. The following should be done to support such efforts: Systematic curriculums on nuclear power and energy should be developed; accurate data and information on nuclear energy should be provided to teachers; teacher-training programs should be improved; and linkages among teachers, science and other museums, nuclear-related institutes, and academic institutions. Programs such as tours of facilities, which promote understanding of science and technology among the general public, should also be strengthened.

4. Coexistence with Local Siting Communities

Smoothly siting nuclear facilities requires deepening the understanding of power-source-siting and energy issues on the part of people generally, but specifically the urban consumers of most of the generated electricity. This involves efforts by the government and the nuclear operators to promote communication between residents of electricity-

consuming areas and the local communities where the nuclear plants are located.

To gain sufficient understanding and cooperation from residents of siting communities, it is important that, in addition to proper measures to secure safety and prevent disasters, and proper information disclosure, steps be taken to implement the principle of "coexistence," whereby the nuclear operators and local communities develop and prosper together. Up to now, nuclear facilities have had favorable effects on the financial positions of the local governments and employment. To expand those effects to the wider regional area as the next step following siting, the local communities themselves should play a leading role in formulating a future vision for their own development. At the same time, the central government must consider promotion measures that can effectively and actively support such new directions in regional development. From this point of view, the government's measures for promotion of power source siting, including grants under the Three Electric Power-Source Siting Laws, should be continually reviewed in such a way that they are made more helpful for the development of the local siting communities. Nuclear operators, as private-sector enterprises, are expected to actively participate in such efforts as the drawing up of the future vision of each host community, making use of their corporate resources and know-how.

Chapter 3: Nuclear Power Generation and the Nuclear Fuel Cycle

1. Basic Policy

Nuclear power generation already supplies more than one third of the total electricity produced in Japan, contributing much to the improvement of the nation's self-sufficiency rate for energy, stability of supply, and reduction of carbon dioxide emissions per unit of energy production. Accordingly, Japan's basic policy is to retain nuclear power as one of its principal power sources, and to maximize its utilization.

Nuclear fuel cycle technologies help improve the characteristics of nuclear power generation, especially in terms of supply stability, and enable it to continue supplying energy over a longer period of time. Commercialization of these technologies in Japan is expected to more firmly secure nuclear power's contribution to the nation's energy supply system. The basic policy of the government thus calls for effective use of such materials as plutonium and uranium recovered from spent fuel, while seeking public acceptance of the nuclear fuel cycle. It is hoped, therefore, that nuclear operators will continue their activities under this basic policy.

The present generation, which enjoys the benefits of nuclear power, has the obligation to do its utmost for the safe disposal of radioactive waste resulting from the research, development and utilization of this energy source. Accordingly, continued efforts will be exerted to achieve steady progress in the proper disposal of such waste.

A long-term look at future energy supply indicates that it is important not only for Japan, but for the entire global community, to search for diverse technological options and to carry on research and development activities to bring out their materialization, in order to secure a stable supply of non-fossil energy sources low in carbon dioxide emissions, and of greater environmental acceptability. In this connection, fast-breeder-reactor-based cycle technology is considered a promising future option because of its ability to dramatically improve the utilization factor of uranium resources over the present level, and probably to reduce the long-term radioactivity of high-level radioactive waste. Efforts will be continued, therefore, to steadily carry out research and development projects on this technology, based on timely and appropriate assessment of all factors involved.

In promoting the use of plutonium, exhaustive measures should be taken to maintain transparency with respect to the peaceful use of this material, under the basic principle of securing safety. More specifically, along with diplomatic efforts to gain the international community's understanding of, and trust in, Japan's policy for the peaceful use of plutonium, steps will be taken to attain full transparency mainly by enhancing the management and disclosure of information on plutonium inventories, from the viewpoint of further clarifying the nation's long-standing principle of not holding surplus plutonium, i.e. plutonium for no specific purpose. In Japan, plutonium recovered from spent fuel reprocessed by overseas contractors and domestic plants is, for the time being, used for MOX fuel utilization in light water reactors and for research and development of fast breeder reactors, etc. Plutonium demand for research and development purposes may vary according to the projects and their progress; in all cases, however, proper measures will be taken for flexible, transparent use of the plutonium, based on the total supply-and-demand picture for this material.

2. Steady Development of Nuclear Power Generation

Some existing nuclear power plants have already been in service for many years; nevertheless, maintaining stable operation of those older plants is important for securing a stable supply of energy. It is important that there be early detection of any age-related

degradation of components or materials, and that proper preventive maintenance be taken. Inspection for such detection should be carried out during periodic reviews at 10-year intervals, taking into account experience with older plants at home and abroad.

Taking into account the progress of risk assessment techniques, the government should be always mindful of the latest views on what constitutes effective and efficient safety regulations, and should keep its regulations up to date. Major topics in such a study should include the introduction of a more flexible implementation of periodic inspections, extended operation cycles, and a change in the regulatory parameter from electricity generated to thermal output. Efforts are also needed to boost studies to provide new technical information and methodologies necessary to carry out these tasks.

The government should consider using special, private, third-party certification bodies to audit and assess licensed nuclear operators in the operation, management and quality assurance of their nuclear facilities, so that regulations can be implemented effectively and efficiently. In these days of globalization, the government should also investigate how to coordinate Japanese technical standards with international ones.

In addition, the government and private sector should, while developing necessary technologies and actively introducing technical achievements conducive to the improvement of the energy supply system in Japan, endeavor to prepare for a new sense of values and new environmental constraints, so that nuclear power generation can continue to play the role expected of it.

3. Nuclear Fuel Cycle Projects

3-1. Securing of Natural Uranium

It appears that Japanese electric utilities can procure natural uranium at a reasonable cost for the time being. Considering the importance of securing such a supply in the years ahead, however, steps should be taken to build up appropriate uranium stockpiles while securing fresh supplies mainly under long-term contracts, as in the past. Consideration should be given to the diversification of supply sources, with careful attention paid to the current trends toward longer lead times for mine development and toward oligopoly in the uranium industry.

3-2. Uranium Enrichment

The worldwide uranium enrichment service market is expected to remain in a state of overcapacity for at least some time to come. From a mid-to-long-term point of view, however, it is important for Japan to anticipate a shift in the supply-and-demand situation toward instability, and, therefore, to act to counter that shift and increase the independence of the nation's nuclear fuel cycle program. In that respect, it is strongly hoped that every effort will be made to maintain operation of the Rokkasho-mura Uranium Enrichment Plant, now in service, to improve its economic efficiency, and to steadily increase its production capacity to 1,500 tons SWU/year by developing, based on past experience, and introducing, a new, highly economic centrifuge.

For Japan's uranium enrichment technology to be internationally competitive, continued efforts should be made to promote research and development activities at home, taking into account such factors as the sophistication and sensitivity of that technology. It is desired that private nuclear operators carry on research and development activities on their own initiative, with consideration given to possible cooperation with overseas partners, depending on trends in the international market, while effectively using the results of, and human resources employed in, past centrifuge development projects by the Japan Nuclear Cycle Development Institute.

3-3. MOX Fuel Utilization in Light Water Reactors

MOX fuel utilization in light water reactors makes effective use of uranium resources, serves as an alternative method for supplying fuel for nuclear power generation, and helps improve the stability of that fuel supply. In addition, this process is expected to contribute to the development of the industrial infrastructure and social climate needed for full-scale resource-recycling in the nuclear fuel cycle in the future. The process has been used on a commercial scale in other countries since the 1980s, and, based on the results of basic studies carried out at home and demonstration tests conducted with commercial reactors since the second half of the 1980s, Japan is also beginning commercial use. Electric utilities plan to gradually increase the number of light-water reactor plants using MOX fuel to a total of from 16 to 18 by the year 2010.

There is room for further improvement of this process in terms of its economic efficiency. In view of the technical features described above, preparations for its introduction, the past record of its use, and the assessment of its safety at home and abroad,

it is reasonable and appropriate for Japan to steadily carry out the plan for MOX fuel utilization in light water reactors, and the electric utilities are expected to do so.

Important considerations in implementing the MOX fuel utilization plan are that the nuclear operators enhance their quality assurance systems, while the government provide proper regulations in a effort to prevent the occurrence again of anything like the 1999 falsification by a British reprocessor of quality control data on MOX fuel, which led to a loss of public trust in the MOX fuel utilization plan in Japan.

At present, MOX fuel using plutonium recovered from Japanese spent fuel reprocessed by overseas contractors is manufactured in those countries. It is reasonable, of course, that future MOX fuel using plutonium recovered in Japan be manufactured at a domestic fabrication plant. Accordingly, it is hoped that interested private operators will develop a MOX fuel fabrication business in this country, keeping pace with the construction and operation of the Rokkasho-mura Spent Fuel Reprocessing Plant. With additional information obtained from overseas sources as well as from the work of the Japan Nuclear Cycle Development Institute, such operators are expected to do their utmost to quickly establish the MOX fuel processing business as a new sector of the nuclear industry in Japan.

3-4. Reprocessing of Spent Fuel from Light Water Reactors

Spent fuel from light water reactors in Japan, with the exception of a portion contracted out to the Tokai Reprocessing Facility of the Japan Nuclear Cycle Development Institute, has been reprocessed by overseas contractors. Meanwhile, taking into account various relevant factors, specifically the demand for domestic reprocessing, private Japanese nuclear operators conceived the Rokkasho-mura Spent Fuel Reprocessing Plant based on the operational experience accumulated at the Tokai Reprocessing Facility, and on technologies and experience in countries advanced in the reprocessing field. The parties are now pushing forward with construction of the plant in order to have it in commercial operation by 2005.

Mainly from the viewpoint of securing fuel cycle independence, Japan intends in principle to reprocess all spent fuel domestically from now on, and the private nuclear operators are expected to make steady progress with the construction and operation of the Rokkasho-mura facility, the first commercial-scale reprocessing plant in Japan, so that commercial reprocessing technology will be firmly established domestically. As long as

the reprocessing plant and intermediate storage projects progress smoothly and on schedule, it is unlikely that an overseas reprocessing option will be needed. In dealing with this topic, it is also important for Japan to consider reactions in the countries facing the sea lanes used for the transportation of nuclear materials.

In addition to conventional spent fuel reprocessing, the Japan Nuclear Cycle Development Institute is planning to conduct demonstration tests on reprocessing techniques for high-burnup fuel, spent MOX fuel from light water reactors, and certain other fuels, at its Tokai Reprocessing Facility. These tests should include assessments at each stage because results are expected to contribute greatly to future research and development activities in this field.

It appears reasonable that the next reprocessing plant, following the Rokkasho-mura Spent Fuel Reprocessing Plant, have – based on the results of the studies and tests noted above – higher economic efficiency, and include facilities for reprocessing not only spent uranium fuel but also high-burnup fuel and spent MOX fuel from light water reactors. Based on future research and development, the new plant may also be able to reprocess spent fuel from fast breeder reactors. Accordingly, it is important that a construction plan for the plant, covering its capacity and technologies, be decided on the basis of a comprehensive study on the construction and operational record of the Rokkasho-mura facility, the progress of future research and development and intermediate spent fuel storage projects, prospects for the commercialization of FBR technology, and so on. A look at these projects and activities to this point indicates that it is reasonable and appropriate for interested parties to begin studying the next reprocessing plant project in around 2010.

3-5. Intermediate Spent Fuel Storage

Intermediate storage of spent fuel provides an adjustable time period until the fuel is reprocessed and thus lends an element of flexibility to the nuclear fuel cycle as a whole. In Japan, a law concerning intermediate storage was enacted in 1999, and the private sector is now making preparations for commercial operation of storage facilities by 2010. It is expected that an implementing entity capable of properly operating and managing these facilities will carry out the project in the years ahead under the basic principle of securing safety.

For this purpose, it is important for the government and electric utilities to explain to

the general public the necessity and safety of these facilities in a proper, easy-to-understand manner.

4. Treatment/Conditioning and Disposal of Radioactive Wastes

Radioactive waste is generated primarily at nuclear power plants and nuclear fuel cycle facilities (including waste returned from abroad after spent fuel reprocessing under contract), but some does come from universities, research institutes, medical institutions and other facilities. Such waste should be safely treated/conditioned and disposed of by the generators. The government should provide guidance to or regulate the generators to ensure that the treatment/conditioning and disposal are carried out properly and safely.

4-1. Commitment to Waste Disposal

Some low-level radioactive waste from nuclear power plants has already been buried underground. Based on studies of methods of disposal, a basic policy has been presented on the disposal of other radioactive waste, excluding uranium waste, the disposal of which is now under investigation and discussion.

As to radioactive waste for which no specific disposal plan has yet been proposed, it is essential that the generators and other interested parties formulate and implement a specific plan through sufficient consultation and cooperation so that they can promptly start safe, efficient treatment/conditioning and disposal. During the implementation of the plan, the government should support the interested parties' efforts, whenever necessary, to prevent waste disposal problems from adversely affecting the development and utilization of nuclear energy.

Since radioactive waste varies greatly in its level of radioactivity and in the type of radioactive material contained, arrangements should be made to classify the waste by method of disposal, regardless of the facility from which it comes, and take specific measures for its treatment/conditioning and disposal.

① Waste for Geological Disposal

Radioactive waste having relatively high radioactivity and containing large amounts of radioactive materials with a long halflives should be disposed of by a method capable of securing safety for a long period of time, so that the living environment will not be affected. This requires the use of geological disposal, which, after providing engineering barriers to

prevent radioactive materials from leaking out, buries the waste in stable underground zones several hundred meters deep, which serves as a natural barrier.

(High-Level Radioactive Waste)

Japan's policy is that high-level radioactive waste remaining after the recovery of plutonium, uranium and other useful materials from spent fuel by reprocessing should be solidified in a stable form and, after being stored for 30 to 50 years for cooling, buried under the ground by the geological disposal method. Vitrified high-level radioactive waste is already stored at a repository in Rokkasho-mura, Aomori Prefecture. According to the "Final Disposal of Designated Radioactive Waste Program," which was issued on October 2, 2000, under the Law on Final Disposal of Designated Radioactive Waste, "final disposal will start sometime in the latter half of the 2030's."

In selecting disposal sites, an important factor is gaining understanding and support from residents concerned. In order to do so, it is important to ensure transparency through thorough information disclosure. The government, electric utilities and the implementing entity, a leading player in site selection, should perform each duty with proper role sharing and mutual cooperation. For this purpose, the government should clarify the political significance of final disposal and its efforts to secure safety, and endeavor to obtain understanding from residents. It should also provide all necessary systems and setups for coexistence between the planned disposal facility and the local community; while the utilities and others having basic responsibility as the waste generators should carry out activities to gain public understanding of the disposal project, with cooperation from the implementing entity and the government, and should work actively with the implementing entity in selecting disposal sites.

From the geological disposal technologies for high-level radioactive waste, the implementing entity should take charge of developing those consistent with the safe implementation of the final disposal project and with the improvement of its economic performance and efficiency. Meanwhile, the government and related organizations should actively push forward with research and development projects necessary for safety regulation and safety assessment of the final disposal, with fundamental research and development activities, including scientific studies of the deep geological environment, and with development of technologies to enhance the reliability of geological disposal technology. Based on the results of past research and development efforts, the Japan

Nuclear Cycle Development Institute, among others, should steadily carry on research and development activities to verify the reliability of geological disposal technologies and to establish a safety assessment method, using research facilities for deep geological environments and the Quantitative Assessment Radionuclide Migration Experiment Facility in Tokai village. The research facility for deep geological environments will serve not only as a place for scientific investigation, but also as a place for deepening public understanding of research and development activities related to the geological disposal of waste. Accordingly, this research facility project should be clearly distinguished from the disposal facility mentioned above.

In order to win people's trust in the business of radioactive waste final disposal, efforts are also needed to provide full information on the disposal project and to secure its transparency at all stages.

(Radioactive Waste Other than High-Level Waste)

In addition to high-level radioactive waste, some other radioactive waste also requires geological disposal. As that waste varies widely in its chemical and physical properties, it is important for waste generators and other interested parties to closely cooperate with one another in carrying out research and development of waste treatment and disposal technologies to pave the way for reasonable disposal of this waste, taking into consideration the diversity of its properties and making use of the results of research and development efforts for the disposal of high-level radioactive waste.

(Partitioning and Transmutation Technology)

The technology to separate radioactive materials with long halflives contained in high-level radioactive waste and convert them into short-lived or non-radioactive, stable materials using a reactor or an accelerator is still at an early stage of research and development, but it should be able to contribute to reducing the burden of waste treatment and disposal, and to effective utilization of available resources. Research and development activities for partitioning and transmutation technology should be carried out based on periodic assessments, in coordination with the development of nuclear fuel cycle technology as a whole. It should be borne in mind that commercialization of partitioning and transmutation technology will not eliminate the need for geological disposal of radioactive waste.

② Waste for Disposal with Institutional Control

Radioactive waste whose radioactivity attenuates to a sufficiently low level as to no longer affect the living environment within a period for which institutional management is realistic can be safely disposed of in the ground at a relatively shallow depth, usually by combining engineering and natural barriers, and, after disposal, managing it properly according to its radioactivity. Even waste containing radioactive materials with long halflives can be safely disposed of by the same method and with the same post-disposal management if the concentration of such materials is low enough.

From now on, therefore, specific measures should be taken to pave the way for disposal of low-level radioactive waste, other than that which the nuclear power plants have already begun disposing of it in concrete vaults. In implementing these measures, a study should be conducted not only on the disposing of waste at different sites based on its place of origin, but on disposing of waste by two or more disposal methods at the same site, and on disposing of waste subject to the same disposal method at the same site, regardless of its place of origin.

4-2. Decommissioning of Nuclear Facilities

Such nuclear installations as commercial power reactors, test and research reactors, and nuclear fuel cycle facilities, should be decommissioned when the time comes at the responsibility of their operators, under the basic principle of securing safety while gaining the local community's understanding and support. It is expected that the land, after the decommissioning of commercial power reactors, will serve as sites for new nuclear power plants, again with the understanding of their communities.

4-3. Reduction of Waste Generation and Promotion of its Effective Use

Steps should be taken to reduce the amount of waste generated and to recycle/reuse it. Research and development to those ends should be actively pushed forward. Interested parties and the competent authorities should jointly conduct an extensive study on the uses of such waste and the development of systems for that purpose, including satisfactory safety checks. Waste with a radioactivity concentration below the "clearance level" need not be dealt with as radioactive material, and may be handled in the same way as conventional waste in respect of safety. In principle, it is important to recycle waste to the fullest extent practical and reasonable.

5. Preferred Course and Future Prospects for Research and Development of FBR Cycle Technology

5-1. Importance of FBR Cycle Technology

It is essential that Japan, exceedingly poor in energy resources among the major industrialized nations, endeavor to develop resource-saving energy technologies as a step toward a long-term stable supply of energy, and to secure technological options in a bid to solve future energy problems for the world community as well as for itself. FBR cycle technology has some of the greatest potential among such technological options.

FBR cycle technology can be applied flexibly to diverse fuel types and compositions, including plutonium and minor actinides. This suggests that the technology could contribute to a solution to waste problems by reducing the amounts of transuranic materials that remain in high-level radioactive waste and constitute high potential risks.

5-2. Direction of Research and Development Efforts for FBR Cycle Technology

Against the backdrop of the liberalization of the electricity market and other recent developments, the pursuit of higher economic efficiency has come to be recognized as a modern societal requirement. It is important, therefore, in the research and development of FBR cycle technology, to set the ultimate goal for economic efficiency at the commercialization stage as comparable to that of light water reactors – in addition to the further pursuit of safety.

Anticipating the diversity of future social needs, the research and development of FBR technology should be carried out flexibly based on a study of diverse options, unrestricted as to the size or type of reactor, or the method of spent fuel reprocessing involved. Efforts will also continue on the research and development of partitioning and transmutation technology for long-lived radioactive materials, which is attracting great attention for its potential ability to reduce the environmental burden and to make more effective use of available resources. In carrying out these activities, it is important for all interested parties to work jointly in a competitive climate. In order to make the results of these activities internationally useful, efforts will be exerted to develop those options that are technically unlikely to lead to nuclear proliferation.

The most developed of the FBR cycle technology options is one based on MOX fuel and sodium cooling. This technology should be assessed first because it provides a

reference against which to assess the others.

5-3. Future Deployment of Research and Development of FBR Cycle Technology ("Monju")

The protype fast breeder reactor "Monju," operation of which has been suspended since 1995when the sodium leakage occurred, is the only FRB plant in Japan with a reactor based on the most advanced FRB cycle – i.e., using MOX fuel with sodium cooling, and with power-generation facilities as well.

The Special Committee on Fast Breeder Reactors discussed the significance and role of the prototype fast breeder reactor "Monju." Because attaining Monju's specified objective of demonstrating reliability as an operational power plant and establishing sodium-handling techniques will be the basis for evaluation in comparison with other options, it is particularly important to give priority in technological development hereafter to the attainment of that objective.

As mentioned above, the reactor is considered the core of research and development activities for FBR cycle technology, and steps willbe taken to quickly resume its operation.

In this, following strict examinations by safety regulation agencies and the Nuclear Safety Commission, the Japan Nuclear Cycle Development Institute should resume operation to carry out research and development, ensuring the implementation of measures to preventing sodium leakage and to improve safety at the facility based on the results of its comprehensive safety inspection, in order to obtain understanding from as grate a portion of society as possible, including the siting area.

In carrying out research and development, recognizing that people's distrust in and uneasiness about nuclear power as a result of the accident at Monju, as well as a series of accidents and mishaps thereafter, have significantly increased, the institute should do its utmost in securing safety, being aware that Monju is a reactor still under research and development, and should fully disclose and provide information, paying particular attention to ensuring confidence on the part of the people both nationally and locally.

"Monju" is a valuable facility internationally as well, for the sake of FBR development in the future. With this in mind, arrangements will be made to develop "Monju" and its

auxiliary facilities into an international cooperation base open to researchers from Japan and abroad, with the results of their research and development efforts widely shared internationally.

From a long-term point of view, it is important to effectively use "Monju" as an irradiation bed for generating fast neutrons equivalent to those expected under actual operating conditions. In conjunction with this, fuel production and reprocessing, including the demonstration of elemental technologies and other research and development results, toward the commercialization of FBR technology, will also be pursued.

Another important task of Monju is to accumulate extensive data on the burnup of minor actinides and the transmutation of long-lived fission products.

(Steps toward Commercialization and Assessment of Research and Development)

Research and development projects for FBR cycle technology should be carried out based on a long-term outlook, with an exhaustive survey of the social situation and the trends of research and development activities in Japan and abroad. In view of the technical diversity of FBR cycle technology, therefore, it is important to give these projects sufficient flexibility and to investigate multiple options.

More specifically, the ongoing "Feasibility Study on a Commercialized FBR Cycle System" undertaken by the Japan Nuclear Cycle Development Institute with the cooperation of electric utilities and other interested parties, will be continued to examine such aspects as reactor type selection, spent fuel reprocessing methods, and fuel fabrication technologies, with the objective of presenting an optimal commercialization vision of FBR technology and a research and development program toward that end.

In addition, the Japan Nuclear Cycle Development Institute, the Japan Atomic Energy Research Institute (JAERI), the Central Research Institute of Electric Power Industry (CRIEPI), universities, equipment suppliers and other interested parties will carry out extensive fundamental research and development activities for FBR cycle technology, using their various research and development facilities and inviting expert researchers, both domestically and from abroad.

It is appropriate that a specific program for a demonstration fast breeder reactor be

decided after full assessment of various results attained in the process of research and development activities toward the commercialization of FBR cycle technology. Meanwhile, a development program for that commercialization will be steadily carried out with flexibility including as to the date of commercialization.

For this purpose, the government will review methods of carrying out research and development projects and the degree of their implementation from time to time, as necessary. In evaluating those projects, efforts are needed not only to make technical assessments, but also to review the basic research and development policies, taking into account, whenever necessary, changes in the social situation, and paying special attention to the efficiency of investments in research and development.

Chapter 4: Diversified Deployments of Nuclear Science and Technology

1. Basic Policy

Science and technology have two aspects. One is fundamental research based on intellectual curiosity, to understand the dispensations of Nature and explore their limits. The other is research and development aimed at applications to meet the needs of the economy, society and people. Nuclear science and technology have these same two aspects. Accelerators and high-power lasers are the means to probe the ultimate

competition, and technology development plays a leading role in such programs. Therefore, it is important to reflect the results of immediate evaluations without delay.

(Nuclear Fusion)

Research and development of nuclear fusion should be promoted to expand various energy options and to clarify their feasibility for the future. ITER is a very important project in this regard because the targets of its R&D are the demonstration of burning plasma and the integration and testing of all essential fusion reactor technology and components. The ITER project should be promoted based on the evaluations of the Informal Meeting of the ITER Plan (domestic advisory committee to survey and discuss the method of promoting the ITER project). It is also important to promote other research efforts to explore the possibilities of nuclear fusion science in a well-balanced manner.

(Innovative Nuclear Reactors)

In the 21st century, it is expected that humankind will enjoy, in addition to the next generation of light water reactors, the benefits of innovative nuclear reactors with high economic efficiency and safety, suitable for diversified energy supply applications such as heat utilization, and for other wider reactor uses as well. Therefore, it is necessary for the government, industry and universities to cooperate in examining research and development of innovative nuclear reactors, giving consideration to utilization of a variety of ideas regardless of scale or type of reactor.

(Basic and Generic)

Basic research in nuclear science and technology identifies the various possibilities for nuclear energy, and sows the seeds that may lead to technical innovation in the future. Generic research contributes to development of research projects in the nuclear energy and other science and technology fields. The government will have to promote such research projects, giving consideration to the originality of researchers in the competition for funds, and conduct proper evaluations of the projects.

3. Ways to Promote Research and Development

3-1. Establishment of Research Environment

Inasmuch as applied research to meet social needs creates new fields of basic science, and, conversely, that fundamental research based on intellectual curiosity creates new technology, it is important to reinforce connections and cooperation between the two in the

field of nuclear energy, among others. Amid a growing trend toward interdisciplinary research and development, creative research, innovative technological development, and smooth technology transfers are now required. In such circumstances, it is important to promote sharing and networking in regard to research activities, in order to foster their organic connections, while fully utilizing the originality of individual research institutes and research activities.

For this purpose, it is necessary for the government to promote joint use of large research facilities and equipment built by research and development institutes, and joint research among different organizations and different fields, while endeavoring to maintain and enrich the research resources required for the fundamental nuclear research activities of universities, where human resources are developed. The government will also have to promote creation of versatile knowledge-and-information networks designed to enhance mobility of human resources both at home and abroad, and the infrastructure to facilitate smooth distribution of research data and related information. Where the transfer of research findings to the private sector will be important, it is necessary not only to define roles among industry, academia and the government, but also to build flexible research and development systems where researchers can share or concentrate their activities through such networks. The needs of society and the marketplace should be met by aggressively promoting commercialization of research findings through use of technology transfers.

Research reactors have played major roles in scientific research, basic and generic research, medical treatment and the development of human resources. Their future utilization must be determined; at the same time, it is necessary to consider how to deal with the spent fuel, including returning highly enriched uranium fuel to the United States within the prescribed period.

3-2. Evaluation of Research

To further stimulate research and development activities, improve efficiency, and achieve more worthwhile results, it is important for the government to evaluate research and development themes and research institutes in a timely and appropriate manner, and reflect the results of evaluations in the distribution of resources and other decisions on the programs concerned.

For such evaluations, it is important that social criteria be properly selected, including

not only the scientific and technological content of the research, but also the social significance and requirements for implementation. Research projects involving many researchers require strong, effective leadership, and attention must be paid to this aspect as well.

Chapter 5: Utilization of Radiation Contributing to People's Lives

1. Basic Policy

Radiation is a dangerous tool that, if used the wrong way, can have adverse effects on human health. Used the right way, radiation brings many benefits for individuals and society. It is important to carry out research and development as well as promote the wider use of radiation in fields such as medicine, industry and agriculture, while working to win the understanding of the people by providing information that is easy to understand, and actively disclosing it. As the existence of radiation cannot be felt directly by the senses, however, and people have little chance to understand its effects on human health, a vague sense of fear continues to exist. Every effort should therefore be made to help people gain a correct understanding of radiation and its uses.

As the utilization of radiation spreads, facilities and opportunities to handle radioactive substances will increase. It is thus important to promote appropriate control of radiation, including disposal of radioactive waste generated by such utilization, and to improve education and training on radiation protection.

2. Contributions to People's Lives

Japanese society is aging and the birthrate is declining; demand for effective, inexpensive medical treatments using radiation is certain to increase. Radiation use in the production and preservation of foods is also expected to increase, helping to cope with global population growth. Utilization of radiation is expected to expand in various industrial sectors as well, such as the development and use of new materials and manufacturing processes.

In the medical field, while promoting sophisticated diagnostic and treatment methods using radiation, including corpuscular beams, and expanding the scope of radiation-applied care through the development of new medical radiation sources and new radio pharmaceuticals, it is important that industry, academia and the government cooperate in promoting research and development to reduce exposure dose on healthy tissue during such

diagnoses and treatment.

Food irradiation is one of the most effective means of sterilization to ensure sanitary supplies and to prevent loss from spoilage. In promoting practical use of food irradiation, the government must respect the free choices of consumers. It must compare food irradiation with other techniques, and provide easy-to-understand information on the necessity for and safety of food irradiation. It is also necessary to continue to promote research on the healthfulness of irradiated foods and on detection technology.

In agriculture, industry and environmental conservation, it is important to promote radiation breeding, which contributes to a stable food supply and environmental protection; the creation of new, useful, cutting-edge materials and the preservation of resources; and the development of environmental protection technology, such as to remove harmful substances from flue gases and waste water.

In promoting research and development of radiation application technology, it is important for industry, academia and the government to cooperate with each other, giving consideration to social needs and bearing the creation of new industries in mind.

3. Research on the Effect of Radiation on Living Bodies and Radiation Protection

It is necessary to promote basic research on the effects of low-dose radiation on the human body, using various research techniques such as epidemiological studies, animal experiments, and analysis of cells and genes, while fostering cooperation among the various institutes concerned. It is also necessary to promote research on high-dose radiation exposure, focusing on medical treatment. Findings of such research should be incorporated into health-risk assessments and the setting of reasonable radiation protection standards. It is also necessary to actively engage in research on the movement and circulation of radioactive substances in the environment, and on the development of radiation protection technology.

4. Establishment of Environment to Utilize Radiation

The institutes concerned should cooperate with each other for the effective development of human resources, both as to numbers and quality. It is also important to enrich the basic and generic research that supports the utilization of radiation, and to promote practical use of the findings of such research through technology transfers.

Because utilization of radiation has a variety of applications regulated by several different government ministries and agencies, it is important to achieve smooth cooperation among them to the desired ends. Also, in order to facilitate smooth use of radioisotopes, it is essential to establish a system to provide them.

Internationally, in cooperation on radiation utilization, it is important to promote technology transfers in consideration of the characteristics and needs of the country to which the technology is transferred, and to foster the development of human resources and research projects aimed at establishing the technology in that country.

Chapter 6: Harmony between International Society and Nuclear Energy

1. Basic Policy

Nuclear energy is a technology that must essentially be addressed from an international point of view because of the wide range of activities involved and the magnitude of its importance to people everywhere. In order for us to continue to use nuclear power as an energy option in the future, and to continue to contribute to the creation of intellectual capital for all humanity, the various international issues related to nuclear energy must be dealt with properly.

For this purpose, however, it is necessary not only to reactively respond to the needs of partner countries and requests from international organizations, but to proactively take the initiative in independently addressing the issues from a strategic point of view.

2. The International Issue of Nuclear Non-Proliferation

To smoothly carry on with the peaceful use of nuclear energy, safety must be secured and the nuclear non-proliferation regime must be maintained. For the latter purpose, various international frameworks have been created to date, such as the NPT, comprehensive safeguards worked out by the IAEA based on the NPT, and the CTBT. In addition to maintaining these frameworks, Japan will address this issue on its own initiative with its technology and human resources, aiming to reinforce the overall non-proliferation regime.

At the same time with a view to the total elimination of nuclear weapons Japan as a nation using nuclear power only for peaceful purposes will take initiatives on implementing

the practical steps which includes "an unequivocal undertaking by the nuclear-weapon States to accomplish the total elimination of their nuclear arsenals", which were agreed on at the 2000 NPT Revie Conference.

The nuclear-weapon States have the principal responsibility for management and disposition of surplus weapon-grade plutonium, which is extremely important for the promotion of nuclear disarmament and nuclear non-proliferation. Japan will promote diplomatic cooperation on this issue on its own initiative, maintaining the aforementioned responsibility of the nuclear-weapon States but recognizing the value of cooperation by the non-nuclear-weapon States. This, for example, will include cooperation with Russia in the disposition of surplus weapon-grade plutonium from its excess nuclear weapons, using fast-breeder reactor cycle technology.

Japan will actively promote various measures such as efforts to increase the number of the countries concluding the additional protocol to the safeguards agreement, in order to strengthen the effectiveness and improve the efficiency of the IAEA's safeguards; active participation in discussions of "integrated safeguards"; contributions to research and development of safeguards technology; and further improvements to the national safeguards system.

Given the state of nuclear material control in the former Soviet Union and Eastern Europe since the end of the Cold War, concerns about illicit transfer of nuclear materials and nuclear proliferation are being voiced internationally. Japan will also actively deal with these issues.

As for the CTBT, Japan will continue to approach, on its own initiative, the countries concerned, to seek their ratification of the treaty, aiming at its early entry into force. Japan will also continue to focus its efforts on the "Fissile Material Cut-Off Treaty (FMCT)," through formal and informal consultations, aiming at an early start of negotiations.

(Strong Initiative of Japan to Address Nuclear Non-proliferation)

It is important for Japan to actively address nuclear non-proliferation in various forms, such as the development of nuclear reactors and nuclear fuel cycle technology highly resistant to nuclear proliferation, with international cooperation; the study of measures to improve transparency in plutonium utilization; cooperation in the projects of the Korean

Peninsula Energy Development Organization (KEDO); the dissemination of information about Japan's efforts for nuclear non-proliferation; and the enhancement of Japan's ability to develop technology and to identify further policies and majors for nuclear non-proliferation.

Moreover, as export control for nuclear materials, equipment and technology has a major effect on preventing the horizontal proliferation of nuclear weapons, it is necessary to continue strict export control in this field.

3. International Cooperation in Nuclear Safety and R&D

(Promotion of Cooperation in Nuclear Safety)

In the area of nuclear safety, it is important for Japan to take the initiative in establishing international standards. In particular, Japan will have to actively promote international education and training programs to ensure the safety of nuclear power installations. As was learned from the recent criticality accident at a uranium-processing plant in Japan, it is important to disseminate information overseas in a timely, accurate, easy-to-understand manner when accidents or incidents occur, and, thus, it is necessary to build and reinforce systems to facilitate such communication among countries.

With Asian countries, it is important for Japan to promote the improvement of nuclear safety in the region through bilateral cooperation and multilateral frameworks such as the Forum for Nuclear Cooperation in Asia, and the IAEA Extrabudgetary Program on the Safety of Nuclear Installations in the South East Asia, Pacific and Far East Countries, including education and training of personnel engaged in nuclear safety regulation, taking into account the plans of, and other conditions in, the partner countries; and through the sharing of information on nuclear safety regulations.

Through its long experience caring for the survivors of the atomic bombings of Hiroshima and Nagasaki, Japan has accumulated significant understanding and a high level of scientific knowledge in the area of radiation exposure. Japan also has experience in the emergency treatment of radiation victims gained as a result of the recent criticality accident at a uranium-processing plant. It is important for Japan to promote international cooperation in the field of medical treatment for people exposed to radiation, to share internationally the results of its studies and experience, and to contribute to the establishment of international frameworks for radiation protection standards.

(Promotion of Research Cooperation)

In the past, in nuclear energy research and development, Japan was in the position of having to catch up with the United States and various countries in Europe. Now, however, given the comparative declining commitments in the U.S. and Europe, together with strong prospects for the expansion of nuclear research, development and utilization in Asia, Japan has become the front runner in this field, promoting international cooperation on its own initiative.

Specific areas of cooperation may include FBR cycle technology, other cutting-edge technology, disposal of radioactive waste, and nuclear fusion reactors.

Given Japan's geography and resource characteristics, it is expected to play a larger role as the base for research and development of nuclear energy in Asia. As regards the Northeast Asian region, Japan is expected to provide sites and opportunities for research and development in the areas of energy utilization and nuclear safety. For the Southeast Asian region, the focus will be mainly on radiation utilization, radiation safety, and the education and training of personnel.

4. Approach to Regional Issues

(Asian Countries)

Japan will cooperate closely with other Asian countries, taking into account the conditions and levels of development in each. Japan will help its partner countries elevate their own levels of technology in ways that allow them to independently accumulate experience in the research, development and utilization of nuclear energy. For example, the Atomic Energy Commission provides the opportunity to exchange information, opinions and technology at the Forum for Nuclear Cooperation in Asia. Further similar contributions to the improvement of the nuclear-related technology in Asia will be needed in the future.

For the planning and construction of nuclear power plants in other Asian countries, it is most reasonable for Japan to promote cooperation on a commercial basis, in an internationally competitive climate, with the lead taken by the private sector. The government of Japan should take into account the concrete needs of each country and progress in cooperative relationships, And work to establish frameworks to ensure the peaceful use of materials and equipment. The government will work, as well, to create an

appropriate environment, including legal systems, and to support improving the level of basic technology.

(The United States and European Countries)

Japan will endeavor to deepen the United States' understanding of Japan's nuclear fuel cycle policy. At the same time, given recent trends in research and development in the United States, Japan will work to revitalize cooperative relations to include a wider range of nuclear science and technology fields.

Various countries in Europe, for example, France, also possess high levels of nuclear technology. It is important for Japan to continue to promote cooperation with them, such as by mutually opening advanced research facilities, and by promoting international cooperation and specialization in large projects on, for example, nuclear fusion.

(Former Soviet Union and East European Countries)

The Japanese government will continue to promote efficient cooperative activities with the former Soviet Union and the countries of Eastern Europe, based on the international principle that the responsibility for nuclear safety lies essentially with the countries that have jurisdiction over the nuclear power facilities concerned. It is important for Japan to reinforce its close cooperative relations with Russia, where the potential is great in fields such as fast breeder reactor cycle technology.

(Active Utilization of International Organizations)

For the activities of nuclear-related international organizations such as the IAEA and the OECD/NEA, it is important that Japan not only provide financial contributions, but also participate more than ever in their activities, through for example dispatching personnel.

Chapter 7: Foundation to Promote Research, Development and Utilization of Nuclear Energy

1. Development of Human Resources

Research, development and utilization of nuclear energy, while securing safety, requires the nurturing and retention of the best people – the best human resources. But Japan's nuclear industry is entering a mature phase. Not only the numbers of researchers, engineers and technicians, but also nuclear energy research expenditures, have been

declining in recent years. In the field of designing and manufacturing, it will be increasingly difficult to maintain the present levels of technology and human resources in the years ahead.

Japan's universities, which are at the core of human resource development, must therefore take the initiative in this effort, in cooperation with organizations such as research and development institutes and private nuclear operators, and with an international perspective as well. At the same time, hands-on experience can be effectively provided at advanced, cutting-edge research and development facilities.

Developing, maintaining and continuing high levels of technology and human resources is best achieved through on-going manufacturing activities. The nuclear power industry thus makes continual efforts to introduce the latest technology. At the same time, nuclear operators are expected to improve their own education and training, evolve their accumulated technology still further on their own, and pass that technology on steadily to future generations.

It is also important for national research institutes and private nuclear operators to establish methods to facilitate mutual exchanges of personnel and technology, such as joint research and assignments, and to work to strengthen the human-resources and technological positions of Japan as a whole.

In order, moreover, for nuclear energy to attract and inspire promising individuals, it is important to demonstrate to them the importance of nuclear energy to Japan and the role nuclear energy can play toward achieving international peace and stability. It is just as important that research and development activities cover a wide range of possibilities, be challenging, and fire hopes and dreams among the young. Scientists and engineers involved in nuclear energy should take every opportunity to speak enthusiastically to the public.

2. Increase in Competitiveness and International Development of Nuclear Equipment Supply Industry

With the slowdown in construction of nuclear plants in recent years, equipment investments by Japan's electric power utilities have declined, and so, accordingly, have sales by its nuclear equipment suppliers. At the same time, deliveries to Japanese utilities of

equipment from overseas have been increasing as a result of active international procurement efforts animated by globalization of the economy. Japan's nuclear equipment supply industry is now pressed to develop an overall strategy, while endeavoring to cope with such structural market changes and to streamline its management. Those companies will certainly use all of their technical and managerial resources to strengthen quality, improve efficiency, and maintain their international cost competitiveness and technological levels. Even so, the world in which they operate is more and more characterized by business restructurings and industrial reorganizations, international bidding systems and internationalized manufacturing bases, and even cross-border corporate management.

Given the recent changes in the environment for nuclear power – globally but particularly in Asia – Japan's nuclear equipment supply industry is expected to actively promote globalization, focusing on equipment supply, in response to inquiries and orders from Asian countries. Japan's light-water reactor technology will indeed constitute a major contribution to global energy security and the resolution of important environmental issues, and will ensure that the technology is strictly limited to peaceful uses. In terms of responsible international behavior, however, it is not enough to export safe, proven equipment and designs. "Safety" must be exported as well. Japan's nuclear industry thus vigorously promotes the globalization of the nuclear safety culture that has developed – and that is continually being improved – in Japan.

When promoting research and development of technology expected to be of practical use sometime in the future, it is important to consider opportunities for international standardization, based on basic technological concepts created in Japan, in order to give such technology more universal applicability.

As the nuclear equipment supply industry adapts to globalization of its commercial activities, the Japanese government will endeavor to establish an environment that facilitates the development of frameworks for the transfer of materials and equipment under bilateral cooperation agreements, the creation of appropriate regulations in partner countries, technological cooperation, and so on.

January 4, 2001

MEMORANDUM TO: Chairman Meserve
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
Commissioner Merrifield

FROM: Janice Dunn Lee, Director /S/
Office of International Programs

SUBJECT: DEMOCRATIC PEOPLES REPUBLIC OF KOREA (DPRK) REQUEST TO AUDIT AND INSPECT U.S. NUCLEAR MANUFACTURING VENDORS THAT SUPPLY EQUIPMENT FOR TWO LIGHT WATER REACTORS IN NORTH KOREA

This is to inform you of an inquiry (now withdrawn) received from the Korea Electric Power Corporation (KEPCO). It was transferred to the Department of State for response on behalf of the U.S. Government.

KEPCO inquired whether the Democratic People's Republic of Korea (DPRK) can be permitted to audit or inspect U.S. nuclear engineering vendors involved in the supply of equipment for the two light water reactors being built in the DPRK under the Korean Peninsula Energy Development Organization project.

The Department of State has informed us that U.S. policy will not permit the DPRK to participate in the audit and inspection of U.S. nuclear vendors under any circumstances at the present time. It is possible that the question could be revisited later with an agreement for cooperation in the peaceful uses of nuclear energy concluded and in effect, and with the DPRK in full compliance with its IAEA safeguards obligations.

Attachment: KEPCO Letter

cc: SECY
OGC
EDO
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NMSS

DISTRIBUTION:
D Chaney, OIP
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DATE	1/3/01		1/3/01		1/3/01		1/ /01		1/ /01	

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ATTACHMENT

KEPCO
KOREA ELECTRIC POWER CORPORATION
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TELEPHONE : (82)3456-7833

FAX TRANSMITTAL COVER SHEET

Date : 12.09.00

To	: Samuel J. Collins U.S. Nuclear Regulatory Commission Washington, D.C.	**FAX No.** : 301 415 8333 **TEL No.** : 301 415 1270
From	: Korea Electric Power Corp. Att: Mr. Duk Chang Roh or Mr. James A. Sexton	**FAX No.** : 82-2-3456- : 7899 **TEL No.** 82-2-3456- 7830

Dear Sir,

Korea Electric Development Organization (KEDO) is providing The Democratic Peoples Republic of Korea (DPRK) with a Nuclear Power Plant in North Korea. The Korea Electric Power Corporation (KEPCO) is the prime contractor on this project.

KEPCO is investigating the Export Laws and Nuclear Regulatory Inspection laws which may apply to the DPRK nuclear regulatory body. The DPRK desires to participate in auditing and inspecting manufacturing vendors for the equipment provided for this nuclear power plant. At present, the plan is for KEPCO to perform this inspection service.

KEDO is considering three possible cases to resolve this question.
Case 1. DPRK is not allowed to make independent inspections but is allowed to participate as an observer.
Case 2. KEDO and DPRK will make joint inspections.
Case 3. DPRK will carry out its own inspections with the assistance of KEDO.

Given the export control laws of the United States pertaining to the DPRK and the export of sensitive nuclear information, we are interested in the following question. Will the US export control laws inhibit, or otherwise prohibit, the DPRK from auditing or inspecting U.S. nuclear vendors?

KEPCO understands this is a difficult question. However, the answer will provide guidance for us in a number of difficult areas. Is it possible for you to address the question for us or provide guidance on how we may proceed to obtain an answer?

Your kind attention in this matter will be appreciated.

12-09 12:16 SHI FROM:KEPCO KEDO FAX#:821156941169 TO:00115014158333 PAGE:01