Nuclear Perspective for the Future

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Introduction

Is mankind destined to choose nuclear energy in the 21st century? If the answer is yes, nuclear system must be in harmony with nature and human civilization.

Nuclear system, which is based on light(γ -ray), charged particles, and neutral particles, is an outcome of human efforts in science and technology. Accelerators, lasers, and reactors have been developed as technology that liberates their potential power. Quantum theory serves as a common language in these domains. Nuclear energy in the 20th century has made great strides in nuclear power generation and usage of radiation. Without the understanding and support of society, no such developments could have been made.

Nuclear development is now undergoing an era of change. Society is not seeking the same kind of answers along the same tracks. We must identify what is wanted by a society suffering from a civilization based on mass consumption and mass disposal and forge a path into the new century. We must have a firm vision for the development of well-balanced science and technology that provides energy, materials, technologies and information. How should our capabilities in the microscopic world be converted into energy, materials, technologies and information? A change in thinking in our R&D efforts, from “utilization” to “harmony,” is what we need to achieve the needed change.

Most significant are the expectations and anxieties we hold concerning the capabilities of nuclear energy as an energy source. The Self-Consistent Nuclear Energy Systems (SCNES) is indeed an important R&D subject in our pursuit of energy systems that fulfill the goals of full utilization of resources, isolation of radioactive wastes from the environment, and annihilation of radioactivity for a preferable society in the 21st century.

Further, use of radiation has been a leading issue in non-energy applications, beginning with isotopes and developing outward to accelerators and reactors. Applications of nuclear science and technology in daily life are sought in the areas of medical care, food, and the environment.

Taking a global view of nuclear energy, the international community desires the promotion of international collaboration for the peaceful use of nuclear energy as well as efforts for nuclear

nonproliferation and nuclear disarmament. A positive perspective toward the 21st century will only be feasible when mankind concentrates on the peaceful use of nuclear energy. It is in this context that Japan's past efforts can be properly evaluated. The world is moving toward the common utilization of information, and a more globalization is called for the research and development in science and technology. In the nuclear energy field, a more international vision is called for in the promotion of peaceful utilization. Thus Japan has entered a stage in which building a nation of creative science is one of our foremost goals.

1. Nuclear Selection by Japan

Opposition to the Atomic Bomb and Peaceful Use of Nuclear Energy

When Japan's nuclear policy is considered, it seems there are two basic points of view at the starting point.

The first, most important issue is based on the fact that Japan is the only nation that has been attacked by nuclear weapons, not only once, but twice, in Hiroshima and Nagasaki. The tragedy of the atomic bombings caused the Japanese people to hold a deep-rooted antagonism against nuclear weapons. The abolition of nuclear arms is their earnest wish. The sincere desire of every Japanese person as a human being is that nuclear weapons should not exist. On the other hand, we cannot deny that the underlying cause of the atomic bombings was the past war. Our mentality of opposition to war must include the idea that Japan's past attempts to advance into Asian countries seeking natural resources caused trouble for those nations. There is concern in Asia even today, over half a century since World War II ended, that Japan has not completely come to terms with this.

Secondly, the antagonism against the misery of war has been the impetus of the Japanese nation to promote the peaceful use of nuclear energy in order to peacefully secure natural resources and obtain technology-based energy that will not be restricted by lack of natural resources and will have no adverse effect on other nations. This has been the choice of Japan owing to our small land area and insufficient natural resources and based on reflection on our past mistakes. These two issues have the same common goal - the hope of enjoying an affluent way of life in peace. In this sense, in Japan opposition to the atomic bomb and the peaceful use of nuclear energy are interlocked at their very roots. As stipulated in the Atomic Energy Basic Law, nuclear development efforts in Japan are allowed only for peaceful purposes, and those involved in its development have thus far held fast to this principle.

Unfortunately, however, these two basic ways of looking at nuclear energy are not necessarily interlocked in the mind of the average Japanese citizen. The hatred of nuclear weapons and dread of radioactivity tend to make people reject nuclear energy regardless of its mode and

form. The nation has an inertia against nuclear energy, no matter what is said about its peaceful use. A great number of people and non-governmental organizations participating in the anti-nuclear weapons movement seem to be concurrently opposed to the peaceful use of nuclear energy. Similarly, no one can deny the fact that discussing the two subjects at the same table has been regarded as taboo. This means that while loving peace and seeking an affluent way of life, people show discrepancies in their specific decisions and actions.

While the role of Japan in the world and in Asia is becoming increasingly important, nuclear energy concurrently has great potential for growth in the 21st century. Facing an era of change, the times demand that we describe the total picture of the nuclear science and engineering and propose a future image for the nuclear energy system. To achieve this end, we should remember that the movement to oppose the Bomb and the movement toward peaceful use of nuclear energy originated from the same motives and should review the essence of nuclear energy. We should engage in dialog with every nation of the world about working together to realize a peaceful, affluent future without fear of atomic bomb. This is the way Japan chooses to tackle nuclear issues. We will strive to convince the people of the world of the importance of nuclear development, strictly limited to its peaceful use, and of the need for cooperation in order to make strides together toward a bright future.

Peaceful Use of Nuclear Energy in the Past and the Future

The understanding and support of the people have made the construction and operation of fifty nuclear power plants possible during the past thirty years. They now supply one third of electric power demand in the country. Owing to the efforts in the industry and the severe watch by society, the nuclear industry has developed without any radiation disasters, although a few minor troubles have occurred. Light-water reactor technology has phased into the mature stage. Additionally, radiation has successfully found a wide range of applications. Radiation was first incorporated into the field of medical care for health examination and diagnosis in the form of X-rays, but isotopes are now broadly used and reactors and accelerators have been utilized for high-performance examination, diagnosis, and treatment.

However, changes in the times have enlarged the area of individual participation in society, and a new era has arrived that allows individuals to participate in decision-making in society with the help of expert observations. The gigantic characteristics of nuclear energy system and the radioactive waste issues have come forward as major subjects of controversy. The lack of commonality, marketability and openness as well as the difficulty in obtaining a general understanding of nuclear energy should be overcome.

However, peoples' fears of the destructive power of nuclear weapons cannot be denied. In reality, the nuclear tests in India and Pakistan prevent people from feeling free of the nuclear

threat. Under these circumstances, and particularly after the Monju incident, Japanese society has come to embrace anxiety and distrust against nuclear development policy. Society is demanding that past nuclear energy development efforts should not be carried forward into the new century, but should be reviewed before the turn of the century. Review efforts should mainly be directed to nuclear system as an energy source. And, the principal tasks facing us seem to involve safety and radioactive waste. To gain national consensus on the form for the nuclear fuel cycle as well as on the nuclear power plant safety, further profound discussion is needed and efforts to promote talks between the government and people are continuing.

From Hiroshima and Nagasaki to the World

Ever since the Japanese nation encountered the unprecedented disaster of the atomic bombings, examination and study of the health hazards as well as medical treatment for the victims of Hiroshima and Nagasaki have steadily continued.

In health hazard studies in particular, efforts have been carried out with the following objectives:

1. Results of studies must be utilized for protection and medical care of victims.
2. Knowledge of the influence of radiation on the human body should be utilized for the welfare of all mankind.

The results have helped those concerned clarify the medical influence of radiation on the human body and thus have not only contributed to the development of medical care services for radiation hazards and the progress of radiology, but also have built a foundation for a broad range of peaceful uses of nuclear energy. One memorable aspect of this is that professionals at universities in Hiroshima and Nagasaki have made volunteer efforts contributing to treatment and health hazard examination of victims of nuclear tests in the USSR and the USA.

The cooperative efforts of specialists from Hiroshima and Nagasaki have been highly praised in Semipalatinsk in the Republic of Kazakhstan, where atomic bomb tests were carried out by the USSR. A number of Japanese specialists participated in the epidemiological investigations conducted in Ukraina and Belarus after the accident at the Chernobyl nuclear power station. This included extensive examination of radiation hazards, especially leukemia, thyroid carcinomas and other malignant tumors. Medical institutions in Hiroshima and Nagasaki have also trained medical practitioners from abroad.

How should we further develop these results and activities in the medical care field? There are numerous things in this area that may serve as a reference for the peaceful use of nuclear

energy. In that sense, we must strive to arrive at a consensus in Japanese society, and further in the world, about the consistency and compatibility of opposition to nuclear weapons and the peaceful utilization of nuclear energy.

2. Requirements on Science and Technology in the 21st Century

Civilization has so far required to the science and technology four major elements, those of energy, materials, information, and technology.

A civilization based on fossil fuel energy came into full bloom during the industrial revolution, accelerating the use of natural resources. This has diversified the resources used, such as coal, petroleum, and natural gas, and has brought forth an era of mass consumption and mass disposal. The result has been a number of crucial environmental issues, most typically global warming by CO_2, to say nothing of by-products such as NOx and SOx. Thus, our civilization based on petroleum has come to a turning point. However, the industrial revolution, which accelerated the progress of science and technology, has also allowed human civilization to extend itself both in quality and quantity, and has upgraded living standards to a remarkably high level. Mankind cannot possibly renounce such affluence.

While frankly acknowledging the broad range of scientific and technological achievements after the industrial revolution, we must develop a recycling-based civilization that will put restrictions on unlimited use of resources in the 21st century. To achieve this, we need to establish an ethics in which we regard harmony at a higher philosophical level than mere utilization. We must establish social institutions that back up such an ethics, and develop technical measures for their realization. I believe a transformation in thinking must be carried out so that mere utilization will be superseded by harmony as a higher concept. Discussion must be stimulated to win understanding in society, in the Diet and other government assemblies, as well as in a variety of forums in society. The Conference of the Parties of the Intergovernmental Panel on Climate Change was one such event of discussions in pursuit of harmony at an international level.

What is now required for nuclear energy is for us to display the total picture and to gain a perspective for the future. In order for nuclear energy to be developed in a way that integrates science and technology in harmony with nature and human civilization in the 21st century, the following questions must be answered:

a. Is it science that can provide new knowledge and information for society?
b. Can it lead to a new world of science and technology using methods specific to nuclear energy?
c. Can it encompass the whole of science and technology that already exist?

d. What measures are there for ensuring harmony with the natural environment and human civilization?

These queries should provide a development direction toward a well-balanced nuclear science and technology, in which much is expected of the role of particles representing the microscopic world, such as high-performance light, charged particles, and neutral particles. Accelerators, lasers, and reactors will bring these quanta to play in human society and quantum theory will serve as a common language in these domains. Thus nuclear science and technology has vast space for potential development and many regions to be cultivated. This suggests that we may have great dreams for the future.

Nuclear applications are a world of science and technology that will be developed in the areas of high-performance particles such as light charged particles and neutral particles. Nuclear energy is expected to substantially contribute to science and technology in the 21st century. Nuclear power generation has so far been regarded as the representative role of nuclear energy. In the future, our expectations for the role of high-performance quanta suggests that they will contribute to information science and will also contribute to the material sciences such as in creation of substances and control of properties. These uses will also widen the realm in which civilization is elevated in the form of leading-edge technologies in the microscopic world. However, it is medical uses and applications in food science where nuclear energy will advance into the regions of human life and individual activity, and will be the most conspicuous area of application in the near future. The medical use of radiation has a long history, beginning with the use of X-rays in diagnosis. A recent example is diagnosis using positrons and treatment of cancer, the final disease facing mankind, using high-performance particles obtained from reactors and accelerators. In the next century cancer treatment with the use of heavy particles will further contribute to human life at medical facilities constructed in a number of areas, not only in Japan, but also in other parts of the world. Thus radiology has been gaining a substantial position in the world of medicine.

3. What Type of Nuclear Energy System Should Be Built?

What is Self-Consistency in a Nuclear Energy System?

One of the central areas of nuclear development is represented by nuclear power generation. From now on, I will focus on nuclear energy system.

Every type of energy in the universe can be defined as nuclear energy. Mankind seeks to use solar energy and its variations as natural nuclear energy sources and also strives to use artificial nuclear energy such as nuclear fission and nuclear fusion. Accordingly, when we think of harmony with nature, we must recognize the history of the universe and the earth as

well as that of naturally available energy sources.

Science and technology begin with learning about nature and simulating natural phenomena.

In discussing energy resources, it is essential to recognize the fact that, historically in nature on the earth, carbon dioxide in the atmosphere decreases over time and natural radioactivity attenuates.

In the ecological sphere in which living creatures are mutually dependent, solar energy can be converted into the circulation of principal elements, typically carbon, through the coexistence of plants and animals. While energy enters and leaves the ecological sphere, substances circulate within the sphere. That is, this sphere has the potential to circulate substances, and the principle of recycling and "zero-release" (or zero-emission) can be effected.

However, in our modern energy systems, in which great quantities of fossil fuels are burned, carbon dioxide is generated in quantities that exceed the circulation potential to have closed circulation, resulting in a state far from that of zero emissions. Consequently, the carbon dioxide is discharged into the environment. That is like letting a monster loose in a field. The monster is devouring the "canned" forms of solar energy that have been steadily conserved in nature.

At the present stage, can we envision the future state of nuclear energy system? Conversely, what sort of expectations and hopes does society have for nuclear energy system in the future?

What is called for is a conversion from the society of the 20th century, which is characterized by mass consumption and mass disposal, to a society based on recycling or circulation, in which resources are fully utilized and waste is reduced through recycling.

I believe that the future of nuclear energy system should satisfy the expectations and hopes of society for 21st century and should concurrently resolve the present issues we face. Also, I am of the firm opinion that the future picture of nuclear energy systems should transcend the age and should be substantiated by the innate potential of nuclear energy.

The following four requirements must be met by the kind of future nuclear energy system that will replace present fossil fuel energy sources such as oil and other underground resources:

1) It must be usable as a general-purpose energy source and must exhibit high performance and high efficiency in utilization.
2) It must satisfy the energy demands of mankind for a long period of time.
3) It must have environmental adaptability.
4) It must be safe.

We define a nuclear energy system that satisfies these four requirements simultaneously as a "Self-Consistent Nuclear Energy System" (SCNES). The ultimate goals of this system are full utilization of resources (recycling) and no emission of harmful waste (zero-release).

SCNES can be explained in a simple manner as follows. While liberating the energy contained in atomic nuclei to the maximum extent and utilizing it at high efficiency, the system contains harmful radioactive wastes and annihilate the radioactivity within itself. Thus it is based on the philosophy of putting "harmony with the natural environment" and "harmony with human society" above mere "utilization."

In the nuclear energy system that is our ultimate goal, energy is liberated by nuclear fission while at the same time the nuclear fuel made up of transuranium elements such as plutonium is generated, and complete burning is achieved through recycling. Further, the zero-release of radioactive waste is pursued through containment and radioactivity annihilation and by ensuring plant safety.

Present Significance of Fast Reactor Development

The marked performance of light water reactors in the present century indicates that nuclear energy can steadily supply electricity with excellent safety, reliability, and economy.

It is well known that when nuclear fuel recycling technology with fast reactors is achieved, the utilization ratio of natural uranium will be drastically raised and the energy demands of mankind can be satisfied with our present uranium reserves for a sufficiently long period of time. Thus technologically it can serve as an energy source that is not affected by the nonuniform distribution of uranium resources, and it thus meets the requirements of Japan. That is, recycling will satisfy our fuel resource requirements.

The advantage of nuclear fission lies in the fact that a large amount of energy can be extracted from a significantly small volume of fuel. Consequently, in addition to the fact that the amount of waste generated is far less than with any type of fossil fuel, it has also the advantage that radioactivity attenuates over time.

The feasibility of whether or not such an ultimate energy system as SCNES could exist in principle can be checked by ascertaining the neutron balance and energy balance of a system that annihilates radioactivity of fission products with long lives concurrently with fuel production. Studies to date indicate that a recycling system with fast reactors as the main system element would satisfy these requirements. Examination of the engineering features such a recycling system has begun in several nations.

It is misleading however, to expect that a nuclear energy system with a complete absence of

radioactive waste could be readily realized. The annihilation of radioactivity by nuclear reactions and the underground disposal of radioactive waste are not mutually incompatible, but the two should rather be viewed as cooperating with and complementing each other. I believe that research and development on annihilation of radioactivity should be promoted in a favorable direction side by side with efforts in underground disposal on the near-term basis. I am of the opinion that the ideal approach for nuclear energy development in the 21st century is to promote R&D efforts by presenting the whole picture to society and thereby obtain the understanding and support of society.

I think that R&D efforts from now on will require a step-wise approach of first describing the flexible development concepts leading to a future nuclear energy system and then achieving the goals of each development stage.

In a Self-Consistent Nuclear Energy System, the coordination of reactors and their nuclear fuel cycles is indispensable.

While nuclear reactions of neutrons take place in a reactor, fast neutrons are superior in performance. In the nuclear fuel cycle, efficient separation (elemental separation and isotope separation) of substances is expected.

In a Self-Consistent Nuclear Energy System, energy is produced by fission and new fuels, mainly the plutonium generated in the reactor, are used as resources. The radioactive waste emerging as a result of fission is efficiently separated and incinerated in a reactor or accelerator in order to annihilate the radioactivity. This is how we can once again verify the current significance and objectives of fast reactor development from the viewpoint of self-consistency.

The requirements for a Self-Consistent Nuclear Energy System do not include any economic goals. However, no one doubts that one of the most indispensable factors in implementation is economy in time of interest. Nuclear systems that lack economy are never implemented. I believe that the aim of a research and development project should be how to convert good ideas into things with high economy. In that process, we should define what are the good ideas and what sort of economy should be achieved. It is conceivable that in the process of creating a recycling-based society and realizing a recycling-based civilization, discussion of the environment will be emphasized together with discussion of resources. Representation of the value of the environment and resources in terms of numerical figures will be required. It would be problematical to determine the capability of a future nuclear energy system merely in terms of economy premised on present use or on short-term economy. Evaluation of economy by incorporating added value is required. Moreover, in parallel with development efforts, we will need to define the capital expenditures for development toward

the implementation of the various functions equipped in a nuclear energy system as well as the cost factors for the overall system configuration.

In today's international community, it is a must to give full consideration to nuclear nonproliferation. Japan should lead the world in demonstrating that the peaceful use of nuclear energy and nuclear nonproliferation can be compatible, through efforts to build nuclear energy systems that are unlikely to lead to nuclear proliferation. In a Self-Consistent Nuclear Energy System, transuranium elements other than plutonium are recycled together with plutonium. Thus, by refraining from attaching special importance to plutonium, the Self-Consistent Nuclear Energy System is considered to have the characteristics of a nuclear energy system with significantly low potential for nuclear proliferation.

R & D in nuclear energy requires both the gathering together of element technologies that perform a wide variety of functions and the capability to integrate these technologies into a single system. As with other massively-scaled areas of science and technology, such systems also require a long period of time for development. Consequently, without constantly clarifying the long-range vision and seeking ultimate goal, one's original direction may be lost or one's efforts may be lost as society changes.

On the other hand it is also essential to straightforwardly examine the current status, to prepare realistic measures for every eventuality, and to cope with changes in situations and delays in progress with flexibility.

The Atomic Energy Commission of Japan is emphasizing the importance of the establishment of the nuclear fuel cycle from the viewpoint of effective use of resources and reduction of environmental load.

This is a realistic representation of the scientific concepts of recycling and zero-release. Each of the concepts involves practical measures toward reaching the goal of nuclear energy development and also serves as a bridge for the future.

Including the underground disposal of radioactive waste, the nuclear fuel cycle is an inevitable issue faced by every nation pursuing nuclear power generation. It will be a common future issue for Asian countries.

Establishment of the Nuclear Fuel Cycle Development Institute

The Diet, the supreme decision-making body of Japan, has launched a "Nuclear Fuel Cycle Development Institute," a new corporation with an innovative direction for development. The former Power Reactor & Nuclear Fuel Development Corporation (PNC) has thus made a new start under a new name. I believe that the strict expectations of Japanese society

concerning nuclear fuel cycle are included in this new organization. Few nations can directly tackle this problem from the viewpoint of peaceful use of nuclear energy. Japan's nuclear energy community must accept that this bill has been enacted based on the support and expectations for future nuclear energy held by Japanese society and must respond to the expectations of society.

I expect that the Nuclear Fuel Cycle Development Institute(JNC) will fully understand what is needed for the development of fast reactor systems and nuclear fuel cycle, and that as an organization it will be open to the world to promote international cooperation. There are quite a few nations with which cooperation is needed - the USA, the European nations, Russia, the People's Republic of China, and Korea. The new organization must take an active stance in clarifying its fundamental nature as an organization for peace.

4. Nuclear Technologies in Japan for Nuclear Nonproliferation and Disarmament

Collapse of the Cold War Structure and Nuclear Disarmament

One of the ways Japan could contribute to the world is in the process of promoting nuclear energy utilization limited to peaceful use, in the area of cooperation with utilization of weapon plutonium in commercial reactors as fuel.

The world has witnessed a long-term confrontation between East and West, by the two superpowers, the USA and USSR. The immobilized Cold War structure and the balance of power dependent on the nuclear deterrent continued for a long time. However, the limitless competition over nuclear strategies, with its social and economic burdens, led to the disintegration of the Soviet Union. Thus the collapse of the Cold War structure means the world has entered a new era.

This opportunity has been taken advantage of by a nuclear disarmament movement that has spread all over the world, urging the USA and USSR to implement the START plan toward dismantling of nuclear weapons. Unfortunately, however, the START plan has not made the progress that was expected. The underground nuclear tests performed by India and Pakistan last year have shown that the path toward nuclear weapons abolishment will not be smooth.

For the future of mankind, and to create a future for nuclear energy, we must continue our efforts to achieve nuclear disarmament. The USA and Russia have made attempts in the START-1 and START-2 plans. However, the technology for converting redundant plutonium into peaceful purposes is not sufficient. The USA is trying to utilize plutonium by converting it to MOX as reactor fuel and is trying to dispose of it deep underground by vitrifying it. However, the USA gave up reprocessing of plutonium for peaceful uses under

the Carter administration. Consequently, the commercial technology for MOX utilization is not well developed.

While Russia's peaceful use has a number of remarkable points in fundamental respects, in the peaceful use of plutonium her capabilities are insufficient in technical and economic terms. Minister Adamov of MINATOM and Undersecretary Ivanov, who is present, told me that Russia was going to employ MOX combustion mainly in fast reactors rather than in light water reactors.

Under these circumstances, France, Germany, and Canada are willing to cooperate in resolving the problems we face. According to a statement by Senator Domenici of the USA, one approach is the conversion of plutonium into MOX in Europe that will be burned in reactors all over the world (European fabrication and global burning).

The Nuclear Fuel Cycle and Nuclear Nonproliferation

It must be possible to actively take advantage of technology for peaceful utilization as part of our approach to nuclear abolition through nuclear disarmament, which is the fervent wish of Japanese people.

Unlike the USA and Canada, Japan has implemented a policy of recycling from the standpoint of sparingly using uranium resources. Our policy is to fully utilize resources through reprocessing and reuse them from the viewpoint of reducing waste.

The nuclear fuel cycle includes technology that reduces the properties that make uranium or plutonium usable as raw material for atomic bombs. This enables uranium and plutonium obtained from disassembled nuclear weapons to be used as a fuel source in reactors. These are what is known as reprocessing of spent fuel and MOX fabrication technologies. Fast reactors that burn surplus plutonium more efficiently than light-water reactors and CANDU are also included in the nuclear fuel cycle.

The establishment of the nuclear fuel cycle will be a simultaneous requirement for contributing to nuclear nonproliferation and nuclear disarmament. First, a nuclear energy system that cannot directly lead to nuclear proliferation must be created. This has been described already as a system and fuel form that do not place any special importance on plutonium. The research and development of an advanced-cycle system that will simultaneously treat uranium, plutonium and other transuranium elements will be one of the principal topics addressed by the Nuclear Fuel Cycle Development Institute.

Japan has thus far exhibited the attitude that the dismantling of nuclear arms is an issue that should be resolved by the developers of these arms on their own responsibility. Although Japan has called for the nuclear abolition, we have merely opposed nuclear arms from one small corner of Asia. We have not endeavored to directly utilize nuclear technologies developed for peaceful use in nuclear weapons abolition. Japan has been highly restrained in dealing with nuclear energy technologies vis-a-vis other nations.

That was because of the fear of nuclear proliferation and because of the anxiety that action might cause both Japanese society and Asian and other nations to be skeptical that such actions could lead to nuclear armament. Perhaps there was a lack of confidence that Japan would be understood. Excessive fear of nuclear proliferation restricted nuclear energy development under the Cold War structure to domestic development and utilization. This suppressed the initiative to deal with other countries. Japan was in fear of being isolated in Asia and refrained from viewing Asian nations as targets for technology transfer, in order to remove any suspicions related to nuclear armament.

Japan has been concentrating on the peaceful use of nuclear energy in one corner of Asia. Instead of taking the stance of merely being a victim of the atomic bombings, is it possible for Japan to demonstrate that nuclear energy for peaceful use can be implemented to the fullest extent? Is it possible for us to demonstrate that only peaceful use can create the new future needed by civilization?

As seen in the Olympics and World Cup Soccer, each nation of the world is given strong recognition. On the other hand, the world has phased into a borderless stage in the areas of the economy and banking. Here, people cannot be active without mutual solidarity and communication. Japan has also significantly changed its position in the world in the almost half century since the postwar era, when Japan grasped the basics of nuclear energy.

The collapse of the Cold War structure has given Japan an opportunity to make global proposals for cooperation in nuclear energy and has given us the courage to pursue our own nuclear energy development efforts within the trend of globalization. Japan’s standpoint is to actively promote nuclear energy development in the international situation in a manner consistent with national interests. To achieve this end, it is essential that the opposition to nuclear weapons and the peaceful use of nuclear energy become compatible with each other in Japan first.

Japan has the right to call for nuclear abolition internationally. This is because Japan has rejected the nuclear-dependent building of national power and has declared that it will never pursue nuclear armament, even if it has sufficient capability to do so. The critical point is to show that only peaceful use will provide a future for nuclear energy. I think it is also

necessary to make a peaceful contribution to nuclear disarmament in the technology realm by moving beyond single-nation pacifism, in addition to making efforts toward nuclear nonproliferation and appealing for abolition of nuclear arms. Such a movement has already started. Since worldwide discussion on the disposition of the Excess weapons plutonium in U.S. and Russia has been progressed, I think we, Japanese should contribute actively to it, utilizing the technologies for peaceful use fostered so far in Japan.

We must avoid delays in the dismantling of nuclear weapons, since this may be followed by the earth being dominated once again by dark forces premised on a nuclear deterrent.

Conclusion

The fundamental basis of Japan's peaceful use of nuclear energy is grounded in the call for ultimate abolition of nuclear weapons and in enjoying an affluent way of life in peace under the nation's geopolitical position. Also we must realize that Japan must become a nation that creates advanced science and technology in order to contribute to the welfare of the world. Technologies for the peaceful use of nuclear energy should also incorporate consideration for both resource and the environment issues. One of the problems that must be resolved in the 21st century is how to change from our modern civilization of mass consumption and mass disposal to a recycling-oriented civilization with effective use of resources and reduction of refuse. At the roots of people's concern is the issue of whether the science and technology called for in the 21st century will have the potential to enable us to move beyond the civilization of mass consumption and mass disposal. The question is whether nuclear science and technology has this capability. In fact, the question is whether nuclear science and technology will remain a mere energy source, or whether it can provide the energy, materials, information, and technologies required by civilization in a form that maintains harmony with nature and human society. Nuclear science and technology itself does have the capacity to meet this challenge. The issue is if the nuclear community of Japan and the world has the passion and vision to meet this challenge as well.