Nuclear Policy and the Long-term Program of Japan

Yoichi Fujiie
Japan Atomic Energy Commission
2-2-1 Kasumigaseki, Chiyoda-ku, Tokyo, 100-8966 Japan
Phone: +81-3-3581-2585

I. Nuclear Science and Engineering in Civilization

The Total Picture of Nuclear Science and Engineering (Centuries and Millennia)

Civilization gives rise to science and engineering while science and engineering supports civilization; throughout the history of civilization, this inseparable relationship has been maintained.

What civilization has been seeking from science and engineering are specifically four items: energy, material, information, and technology. Science and engineering have been offering these items in various forms since ancient times and they have tried to expand the volume and improve the quality of these items as times changed. Modern science and engineering started during the Industrial Revolution and nuclear science and engineering originated at the end of the 19th century as a new form of science and engineering. It seems improper to connect nuclear science and engineering to that history merely from a technological viewpoint.

Nuclear science and engineering exists in a quantum world and it basically deals with a broad area of science and engineering related to light, charged particles, and neutral particles. Particle accelerators, lasers, and nuclear reactors are devices designed to bring the quantum world into civilization. There seem to be three kinds of spans for the consideration of nuclear science and engineering: a span of decades from political and economic viewpoints, a span of centuries for the research and development of monumental science and engineering to practical use such as fast reactors and fusion reactors, and a span of millennia for the continuation of civilization and the half-life of radioactivity. Therefore, significant factors to discuss are obtaining a clear perspective of the roles these spans play, clarifying realistic goals to reach with a long-term perspective that includes social concerns, and working to reach these goals. We also need to deal with the purposes flexibly and prepare for technological

alternatives to solve technological issues. Nuclear science and engineering has thus far focused on the use of nuclear energy and radiation. While looking at civilization as a whole, the scope of their applications should be broadened in terms of comprehensive nuclear science and engineering.

Long-term Perspective for Civilization in the 21st Century based on Deep Insight (Centuries)

Nuclear science and engineering is now at its turning point, which we can see in most nations around the world. Nuclear science and engineering as well as science and engineering as a whole and civilization itself are also at turning points; civilization is striving to depart from mass consumption and mass disposal. Amid an international environment where the Cold War paradigm has collapsed and nuclear disarmament is underway, the 20th century, with its violent changes, is shifting to a new century and a new millennium.

To establish nuclear science and engineering that contribute to a new civilization, the concept that harmony should take precedence over utilization must be understood and confirmed. Fears and aversions that people display with regard to the enormity and the high energy density of nuclear energy must be readily acknowledged; it is important to formulate a system of nuclear science and engineering that can be accepted and supported by society.

Nuclear energy systems for the 21st century should work toward the efficient use of natural resources and the reduction of environmental burdens by putting the highest priority on assuring safety. The closure of the nuclear fuel cycle would agree with this direction. It is also necessary to perform research and development while seeking to develop a nuclear energy system that is highly proliferation-resistant. In other words, an advanced nuclear fuel cycle that does not handle strategic nuclear materials such as uranium, plutonium, and other transuranic elements in their pure forms must be studied and developed. It is also highly recommended for international cooperation in such research and development to be reached, now more so than ever.

Japan, which would talk of the tragedy of Hiroshima and Nagasaki together with the inhumanity of nuclear weapons and the wish to abolish those weapons as the ultimate goal, must collaborate in nuclear disarmament more actively by making full use of the accumulated nuclear technology it has developed purely for peaceful purposes.

For the non-energy area, the provision of information and technology is expected in addition to developments such as the current industrial and medical use of radiation, and this data can be obtained by exploring the world of fundamental science and engineering such as cosmic science, material science, and life science. It is crucial to craft a long-term perspective in the pursuit of comprehensive science and engineering that will contribute to the creation of a civilization with an emphasis on recycling to support peaceful and open-minded lifestyles.

Balanced Coexistence of Idealism and Realism in Nuclear Policy (Decades)

In a highly democratic society, it is not at all easy to continuously develop nuclear technology that requires enormous investment, and thus people's understanding and support are essential. At the turn of the century, people want the development of nuclear science and engineering reviewed and reconfirmed. There have been clear changes from the absolute to the relative in the sense of values during the history of Japan's nuclear development that spans more than 40 years, and thus it must respond to the changing times. However, there are geopolitical destiny in terms of natural resources that have never been resolved, at least not from the viewpoint of energy security; there has been no motivation to abandon nuclear energy, but it seems that its importance has increased. On the other hand, the development of new forms of energy that should be able to compete with nuclear energy is expected as we search for better forms of energy that will be attuned to environments.

In particular, the phenomenon of global warming has become serious worldwide, and thus it is necessary to work to fulfill the international promises made at COP3. There is a growing tendency to utilize non-fossil energy sources. It is also recommended that the use of radiation for medical care and food science in the future be examined as science and engineering ensure convenience and lifestyles in an aging society.

To form nuclear policy, it is necessary to recognize that both leadership and accountability are sought when nuclear science and engineering are introduced into society and then take hold. Economic benefits available or technological achievements underway cannot be ignored when crafting actual policy. Although these two points are important factors, it seems unwise to determine actual policy without taking future prospects into account. In crafting nuclear policy that can contribute to the construction of well-balanced forms of nuclear science and engineering, the coexistence of idealism that transcends the times and realism that seeks solutions to present issues

should be encouraged. Formation of realistic policy after taking future perspectives into account is significant.

II. Japan's Nuclear Policy and Long-term Nuclear Program

Though nuclear science and engineering in the 20th century has been contributing to the existence of mankind in many respects, they also have been threatening the existence of mankind because of their use for military purposes and through accidents with radiation or radioactivity that were used for peaceful purposes. The problem of radioactive waste disposal will be carried over into the 21st century. While society draws upon the wisdom of man to establish technology and social systems to control and manage nuclear science and engineering that were created in the 20th century, our generation should conduct research and development to derive the most of various possibilities in nuclear science and engineering while working toward the long-term and stable supply of energy, the development of leading-edge nuclear technology, and the improvement of the quality of people's lives. Surely, we will hand down the results to future generations.

Therefore, we do not consider the formulation of a long-term program at this time to be a mere continuation of those programs that have been reviewed about every five years. In a corner of Asia, Japan has striven to overcome its geopolitical destiny, devoted itself to the peaceful use of nuclear science and engineering, and has become an advanced nation in the field of nuclear science and engineering. In the new long-term nuclear program that will be announced by the end of 20th century, we would like to clarify the concept of nuclear science and engineering for coming centuries and also present Japan's nuclear policy while squarely looking at Japan's current status. We also hope to deliver a message requesting the understanding and support of people in Japan and around the world.

In May 1999 the Atomic Energy Commission established the Long-term Program Planning Council to conduct surveys and discuss various matters regarding the "Long-term Program for Research, Development, and Utilization of Nuclear Energy" so that the basic philosophy needed to determine nuclear policy in the 21st century would be confirmed and that the total picture and long-term perspective regarding nuclear research, development, and utilization would be clarified. Six subcommittees were

established under this council to conduct studies in detail:

1) Nuclear science and engineering for the nation and society
2) Use of nuclear energy as an energy supply
3) Future prospects for fast reactors and related technology
4) Leading-edge research and development projects for the future
5) Use of radiation in daily life
6) International development with a new vision

We recently (on August 22nd) drew up a proposed long-term nuclear program. We are now asking for people's opinions about the program, which will be taken into account. Within this year, the long-term nuclear program will be published both domestically and overseas.

The long-term nuclear program drafted is summarized as follows:

Nuclear power generation

・Nuclear power generation should be continuously and fully utilized as a basic power source because it already supplies more than one-third of the gross power generation in Japan, it contributes to improving Japan's self-sufficiency for energy, it offers a stable supply of energy, and it helps to considerably reduce carbon dioxide emissions per energy produced.

Nuclear fuel cycle

・Nuclear fuel cycle technology will allow further improvements to the characteristics of nuclear energy as an excellent and stable supply of energy through the saving of uranium so that mankind can utilize nuclear energy for a long time. Therefore, we will make it Japan's basic policy to reprocess spent fuels and utilize recovered plutonium and uranium efficiently. We will steadily promote the policy by providing for the intermediate storage of spent fuels while taking a flexible attitude to the management of the entire nuclear fuel cycle.

Fast reactor and related cycle technologies

・Fast reactor cycle technology should be considered as a great potential for uncertain and future energy sources in terms of the drastic improvement of the efficient use of uranium and the reduction of environmental burdens. We will continuously promote the "Feasibility Study on Commercialized Fast Reactor Cycle Systems" as to various choices such as reactor type selection, reprocessing, and fuel fabrication methods. We will also propose a proper perspective on commercial fast reactor cycle systems

and clarify research and development programs to develop these promising systems.

・A prototype fast reactor, MONJU, should be considered the core of the research and development of fast reactor cycle technology, and will operate again in early stages.

・Development projects for these promising systems should be dealt with flexibly.

Treatment and disposal of radioactive waste

・Radioactive waste should be classified according to its disposal method, and specific measures should be taken for disposal.

・High-level radioactive waste(HLW) should be solidified into stable forms, stored for about 30 to 50 years to cool down, and then handled by geological disposal. The program for geological disposal of HLW should be steadily promoted.

・Research and development into radioactive waste should be promoted to reduce the amount of its generation and utilize it efficiently.

Nuclear science and engineering

・Because nuclear science and engineering provides new knowledge in the field of basic science and offers possibilities of providing the most advanced methods of research in life science, material science, cosmic science and so on, we will actively promote research and development on accelerators, nuclear fusion, and the innovative nuclear reactors with enhanced economy and safety.

Use of radiation

・Radiation is widely used for medical care, industries, agriculture, etc. and has been contributing to the improvement of people's lives. We promote the use of radiation for its increased use in various fields.

・We will analyze valuable medical data based on the examination of atomic bomb victims in Hiroshima and Nagasaki for research regarding the impact of low radiation doses on humans. In addition, we will make use of our recent experience with an accident at JCO that involved victims exposed to high radiation doses to develop emergency medical measures for those who are exposed to radiation.

III. Japan-U.S. cooperation in the 21st century

Nuclear science and engineering should be fundamentally dealt with from an international viewpoint, since it has wide effects and has a great impact on human

society in general. And it is extremely important to deal with international issues properly in order to continuously make nuclear science and engineering one of the choices for an important form of energy in the future. Therefore, we should clearly propose our philosophy and specific policy, which centering on what Japan should do for the 21st century, with regard to the nation and the world.

Nuclear energy is of great significance for Japan, where there is economic power with few natural resources. It is necessary to confirm a national policy with an emphasis on the importance of the nuclear fuel cycle as the source of our energy and to declare this policy to the world in a timely manner in cooperation with the government and the private sector. The development and use of nuclear energy only for peaceful purposes should prevent us from shifting our attention from the world's present conditions to use of nuclear energy for military purposes. We furthermore aim to bring about worldwide nuclear disarmament and the reinforcement of non-proliferation systems, and we will independently deal with management and disposal projects for nuclear materials generated by dismantled nuclear weapons.

We thought it beneficial for Japan that a new movement in nuclear research and development has been launched to include NERI, GEN-IV, and TOPS. I have been aware of the importance of Japan-U.S. cooperation in nuclear science and engineering. In the past two Santa Fe Energy Seminars, I held discussions as to the energy system that we should aim for under the title of nuclear energy development for the future[1),2)].

I understand that the GEN-IV's purposes of development has many items in common with the content and the period of development that Japan seeks with the Feasibility Study on Commercialized Fast Reactor Cycle Systems and next-generation light-water reactors. Therefore, it is expected that Japan and the U.S. will start specific joint research in these common fields in the future.

Japan started its strategic investigation and research into fast reactor fuel cycles, which are planned for practical use by about 2015, and Japan has been studying future fuel cycles for fast reactors that will satisfactorily provide safety, economical efficiency, reduced environmental burdens, and proliferation-resistance on the condition that safety is ensured. It would be possible for Japan and the U.S. to cooperate to pinpoint and solve problems in common with GEN-IV in terms of the systems for reactors and relevant technology.

Lastly, in the field of research and development of the geological disposal of high-level radioactive waste, it is necessary to promote the verification of performance evaluation models concerning geological disposal and the development of quality assurance systems related to preparation for safety standards. Safety design and evaluation will take place by strengthening cooperation with national institutes in the U.S., which have been accumulating knowledge in order to implement projects for high-level radioactive waste disposal facilities in the WIPP and the Yucca Mountains.

As mentioned above, it is effective to tackle problems solved jointly in order to improve mutual technology and reconfirm the importance of developing nuclear science and engineering. There are expectations for the start of active cooperation in new research in many fields.

Reference

1) Nuclear Energy Development for the Future, Y. Fujiie, JAEC, The first Santa Fe Seminar,1997,

2) Nuclear Energy Development for the Future -Step-by-Step Approach with Practical Measures-, Y. Fujiie, JAEC, The Second Santa Fe Seminar, 1998.