Present Status of Development and Utilization of Nuclear Energy in Japan[1]

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Thank you, Mr. Chairman for your kind introduction.

Distinguished delegates, Ladies and gentlemen, let me first heartily congratulate Korean Nuclear Society for hosting this excellent Congress of ICAPP in beautiful city Seoul that encompasses both the old and the modern. It is a great honor and pleasure for me to be given this opportunity of presenting my view on the present status of development and utilization of nuclear energy in Japan.

1. Introduction

In Japan, 53 nuclear power plants, 30 BWRs and 23 PWRs, are currently in operation. Their total capacity is about 47GWe and they are supplying about one-third of the country's electricity, as a safe, reliable and competitive electric power source. They contribute to the energy security, as Japan's degree of self-sufficiency in primary energy supply increases to 20% from 4% owing to their contribution. Nuclear power is recognized as a practical and effective mean to cope with the request to reduce CO2 emission to prevent the disastrous climate change in future and to observe the Kyoto Protocol in particular. Being committed to the further reduction of carbon dioxide emission intensity of electricity generation, Japanese electric utility companies continue the construction of three nuclear power units and prepare to apply the construction permit of eight additional units in five to ten years.

Japan Atomic Energy Commission (AEC) has proposed the people of Japan to share a vision that safe, economical, and reliable nuclear energy technology will contribute as a mainstay of electricity and heat generation technologies to the enhancement of environmental quality as well as to the fostering of economic growth and energy security in many parts of the world. With this vision, the AEC is asking relevant government organizations and industries to make coordinated efforts for using nuclear energy in a manner that protects public health and safety and the environment, promotes the security of our nation and the world, and in a manner compatible with the needs of the society where the facilities and activities necessary for nuclear power generation are located. The AEC believes it important to make these efforts in a way to pursue a set of actions across three different time frames; short term, mid-term and long-term, in parallel.

2. Short-term actions

The short term actions are those aiming at using existing assets as long as practicable. Important actions for this purpose are those to; 1) restore and maintain the public confidence in the safety management of existing nuclear power plants and related facilities; 2) take measures to reduce the

[1] Presented at 2005 International Conference on Advances in Nuclear Power Plants (ICAPP05), held at Seoul, Korea, May, 16, 2005.

risk of cost recovery that is increased due to the deregulation of electricity market, 3) improve the performance of existing plants incessantly; 4) promote the utilization of the plutonium recovered from the spent fuel in LWRs, 5) secure adequate interim storage capacity for spent fuel waiting for reprocessing; and 6) make progress in the search for the site for geological disposal of vitrified high-level radioactive wastes separated in reprocessing.

The reason why we put the restoration of the public confidence on the top of the list is because we have experienced the deterioration of the public confidence in both the plant operator's safety management and the effectiveness of regulator's activities due to the occurrence of a series of operators' misconducts, and, owing to the deterioration, the plant availability has dropped and the loading of MOX fuel in LWRs has delayed at all units.

As for the effects of deregulation of the electricity market, which is inevitable in the age of globalization of economy, government took such measures to reduce the financial risk specific to nuclear power as a) the establishment of legal frameworks to assure the fund for decommissioning of both nuclear power plants and fuel cycle facilities including high-level radioactive waste disposal activities, b) the establishment of provisions to give priority in electricity generation and transmission to such capital-intensive power sources as nuclear power, and c) the improvement of the provision of grants-in-aid for municipalities which accept nuclear facilities.

Actions for the improvement of the performance of existing plants are centered on the increase in the output of existing units, the assurance of reliable operation up to 60 years, and the economical management of dismantling of the nuclear facilities and radioactive waste generated in the process, in addition to the introduction of accountability-conscious quality management system in the plant. Also considered important are the development of higher burn-up fuel and the improvement of the economy of the operation of fuel cycle facilities by the reduction of the amount of wastes generated in these facilities.

It is also an important task of government in this time frame to facilitate the understanding on the health and safety aspect of high-level radioactive waste disposal by residents living in potential areas for the site as the delay in the determination of the site is a major source of uncertainty in the promotion of nuclear energy use. The company to carry out the disposal activity, NUMO, started in 2002 the open solicitation of area of preliminary investigation for HLW disposal site. Although a group of people in several towns showed interest in proposing to accept the investigation, the town assemblies rejected the proposal in each case. This indicates that we are requested to increase the efforts for improving the public understanding of the safety and acceptability of the repository in their backyard.

3. Mid-term actions

Mid-term actions are those to pursue the improvement of the performance of current designs of nuclear facilities. In the age of technological innovation, the competitive operation of current design units and facilities does by no means guarantee the adoption of the facilities of the same design as existing ones for their replacement or the increase in supply capacity in future. Therefore it is essential for nuclear power plant suppliers to prepare advanced designs with improved performance compared with the current designs in order to win the orders in tomorrow's market. As significant number of plants will start the retirement in 10 - 30 years, such new designs should be prepared in 10 to 20 years.

The goals of improvement to be pursued are to 1) reduce capital cost by shortening licensing and construction time through standardization of design and the development of modular cost-effective construction technologies, 2) improve robustness in maintaining safety and reliability by adoption of passive safety features and enhancing the easiness of inspection, 3) minimize environmental impact by reducing volume of radioactive waste generated during both operation and decommissioning of the facilities, and 4) improve human consciousness by pursuing low occupational exposure; low work-load in operation, maintenance, and emergency situation; and low man-power need for inspection and maintenance.

These improvements can be successfully realized by qualified suppliers of nuclear equipment and components and engineering organizations with the personnel, skill, and experience in design, engineering, and construction of current design. Good examples are the cases of ABWR-II and APWR in Japan. The ABWR-II is under development by the same industrial framework as that of ABWR that is one of the most advanced LWRs introduced in the world, aiming at further improvement in economy and safety.

4. Long-term actions

One of the goals of long-term actions are to develop innovative nuclear energy supply systems which can compete in future energy market so as to make nuclear energy technology sustainable in terms of social acceptability as well as safety, economy and environmental protection. One of the major projects for this purpose is that of developing fast reactor and its fuel cycle systems. The project started in Japan by the construction of experimental fast reactor JOYO and prototype FBR MONJU. JOYO is operating now at the up-rated thermal output of 140 MW. As for MONJU, we have just started works for improving the measure to mitigate the effect of secondary sodium leakage.

In parallel with these activities, JNC is continuing a series of feasibility study to explore and clarify the concepts of fast reactor system fitted for the fourth generation nuclear power plants and its fuel cycle system, which should be commercially available in 2050s. Focal points of study are to explore the way to enhance the economy, safety, and reliability, to achieve the efficient utilization of nuclear fuel resources, to realize sufficient security in terms of proliferation resistance and physical protection, and to minimize the radio-toxicity of the wastes to be disposed of through minor actinide recycling, in consistent with the national goal of pursuing zero emission society through reducing, reusing and recycling of wastes.

We are also promoting generic nuclear science and engineering research as a part of the long-term actions. Included in this category are nuclear safety research, basic nuclear science and technology research including that for partition and transmutation of long-life nuclide in the waste stream of the reprocessing process, and exploratory research for engineering concepts of realizing innovative ideas of nuclear application such as fusion energy and the hydrogen production by nuclear energy.

As for nuclear hydrogen, we believe it wise to focus on basic science and engineering that advances the technologies for electrolysis of water to produce hydrogen and processes of thermo-chemical decomposition of water as it is generally acknowledged that the process of converting the entire economy to hydrogen-based ones will take decades and require numerous discoveries and technological breakthroughs. As these processes require high temperatures, we pursue the

development of both high temperature nuclear reactor and thermo-chemical processes, in parallel with challenging such difficult problems as the discovery of suitable materials which can be used in high temperature and corrosive chemical conditions.

5. Conclusion

Finally I would like to make two remarks in lieu of conclusion. First, nuclear community should ensure transparency of the activities of research, development and utilization of nuclear energy technology to the public and get its feedback on their direction incessantly so as to assure the public understanding and acceptance of the products. This is because the public acceptance of innovation becomes much more frequently driven by the pull of the needs of a wide range of actors in society, than it is by technological push. As pointed out by Abraham Maslow, the needs will expand their scope from physiological and safety to those for belongingness, esteem, and self-actualization depending on the situation of their satisfaction. Therefore it is important to pay close attention to coherence with various needs of diverse actors in society, through incessant risk-and-benefit communication with them.

Secondly, considering that nuclear energy will be one of the most important measures for our world to mitigate the climate change caused by greenhouse effects gas, the social rate of return of the investment into such nuclear energy R&D to the world as a whole is higher than to the individual countries. Therefore I believe that co-ordination of research activities beyond the national prestige to reduce the duplication of effort at the world level must be an absolute priority.

Thank you for your kind attention.