New Nuclear Energy toward the 21st Century

By Yamachika Hidehiko

Since the Tokai power station commenced commercial operations in 1966, the number of nuclear power stations has increased to 46 with a total capacity of around 38,000MW and generating approximately 30% of total electric power in Japan. Nuclear power generation is considered an important electric supply source and, due to increased environmental constraints internationally, is expected to increase in importance in the future.

On the other hand, the reprocessing plant in Rokkasho began construction in April 1993 amid a less than favorable atmosphere in world attitudes toward plutonium utilization.

Taking into account this background, a new nuclear energy policy is required for the coming 21st century. Since last November, the Nuclear Subcommittee of the Advisory Committee for Energy has been conducting a study on Japanese nuclear energy policy for the future, reflecting the present international situation regarding nuclear energy. Its interim report was released in June.

The first chapter of the report concerns future nuclear power generation, taking into account the fact that the light-water reactor is expected to continue to be the mainstay of Japanese nuclear power generation for a substantial period in the 21st century.

The second chapter describes the nuclear fuel cycle for the coming decades reflecting growing international nuclear proliferation concerns and the soft supply and demand of uranium, which is expected to continue for the short- and medium-term. Following is a summary of the report.

I. Nuclear power generation (light-water reactor)

1. Present situation

Since nuclear power generation has merits such as stable supply, economic viability, low environmental impact, and a demonstrated high degree of safety and reliability, it has become a main energy source. In the future, amid the growing need to reduce the burden on the environment, the capacity of nuclear power generation and the number of plants are expected to increase substantially.

2. Changes surrounding nuclear power generation

1) The light-water reactor age is expected to continue for a fairly long period in the 21st century due to the soft supply and demand of uranium which is predicted to continue for the short- and medium-term, and practical usage of plutonium by fast-breeder reactors is not expected until around 2030.

2) The number of aging nuclear reactors will increase.

3) The decommissioning of nuclear power plants will be a fact.

4) With the work force decreasing and the numbers of nuclear reactors increasing, it will be difficult to ensure necessary manpower.

5) Although about 70% of Japanese people recognize the necessity of nuclear power generation, only about 40% believe it is safe. In addition, the public has a low degree of confidence in nuclear power generation information provided by the government and electric utilities.

3. Policy direction

1) The measures hitherto implemented have contributed to: increased safety and reliability; decreased manpower needs; and reduced environmental impact. Therefore, further efforts should be implemented as follow up. This objective is called "Nuclear Power Generation Friendly to Human Beings."

A) Measures for existing nuclear reactors to cope with the aging of facilities and the difficulty in ensuring necessary manpower.

Cf. Improving facility maintenance standards and reviewing periodical inspection.

B) Measures for the decommissioning of nuclear reactors.

Cf. Study of detailed procedures, measures for management and disposal of the waste thereby produced, and development of technology for lowering human/environmental burdens.

C) Development of technology for future light water reactors to cope with the extended light water reactor age.

Cf. Study of the design philosophy and plant concepts of future light-water reactors.

2) It is necessary to increase the public's confidence in nuclear power generation, remove anxieties and enhance harmonization of nuclear power plants with local communities. This is called "Enhanced Confidence and Coexistence between Communities and Plants," as outlined below:

A) Measures to increase the public's confidence and alleviate their anxieties.

•Enhancing public information activities.

•Providing nuclear power plant information to the public, such as nuclear power station application documents.

•Hearing public opinion (installing suggestion boxes and holding symposiums, etc.)

B) Measures to facilitate the location of nuclear power plants.

3) In order to build a foundation for facilitating the above-mentioned measures, it is important that technology is improved to evaluate safety and coordinate domestic and international networks between industries, academia and governments.

II. Nuclear fuel cycle

1. Present situation

Various conditions related to the nuclear fuel cycle have greatly changed. It is necessary to establish a nuclear fuel cycle taking into account such changes.

•Environmental limitations have raised

increased expectations for nuclear power generation.

•Japan's nuclear fuel cycle development is being undertaken by private enterprises.

•The supply and demand of uranium on the short- to medium-term basis is not expected to become tight, though the situation in the mid-21st century is uncertain.

•The suspicion of nuclear weapons development in North Korea and other countries, and generation of a large volume of fissionable materials from dismantled weapons in the former USSR have raised increased international concern about nuclear proliferation.

•Overseas nuclear fuel cycle projects are not active.

•There is increased interest among the public regarding radioactive waste management and disposal.

2. Reasons for a nuclear fuel cycle from an energy viewpoint

Japan, which lacks energy resources and requires a large amount of energy, should maintain a nuclear fuel cycle for the following reasons:

1) In order to secure a stable supply of nuclear energy on a long-term basis, the development of technology for utilization of plutonium and establishment of related legal and organizational systems should be implemented steadily and continuously for the future.

2) Reprocessing contributes to more adequate management and disposal of high-level radioactive waste, which is considered indispensable to the public acceptance of nuclear power generation. Reprocessing reduces the environmental impact caused by radioactive waste disposal because of the smaller volume and shorter half-life of the resultant radioactive waste.

III. Policy Direction

Taking into account changing circumstances, individual nuclear fuel cycle projects should be developed, under an adequate and reasonable development schedule, with the aim of fast-breeding reactors becoming technically feasible around 2030 in order to supply energy in case of shortages of uranium after the mid-21st century. The projects also should be effective with respect to improvement of the nuclear fuel cycle economy and nuclear nonproliferation measures.

As to the use of plutonium, there should be a system whereby careful attention is paid to ensure that only the amount of plutonium that is necessary is recovered in Japan. The recovered plutonium and that returned from abroad should by all means be securely used without holding any excessive stockpile.

Uranium enrichment

The capacity of uranium enrichment facilities should be extended to about 1500 + SWU/y after 2000.

Reprocessing

At present the reprocessing project should be limited to the Rokkasho reprocessing plant (800t-U/y) which is

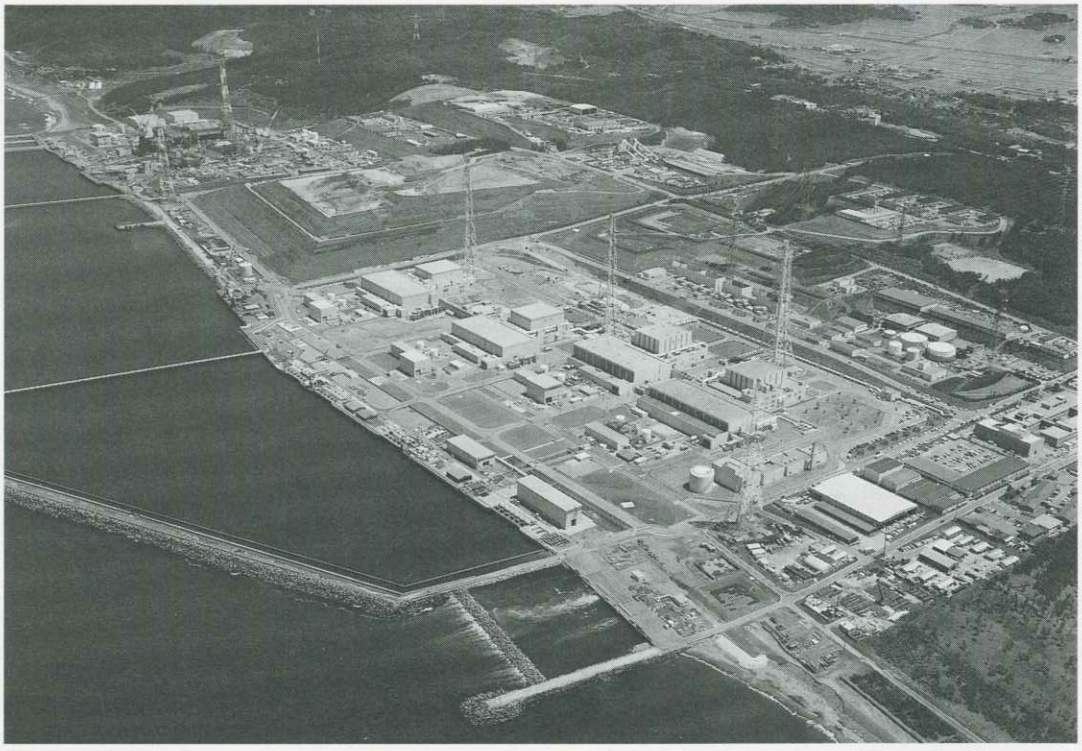

Photo: Tokyo Electric Power Co., Ltd.

Kashiwazaki-Kariwa nuclear power plant

necessary from the viewpoint of the energy supply policy. The plan for the second private reprocessing plant should be discussed in 2010.

MOX fabrication

To ensure complete usage of the plutonium that is recovered in Japan, plutonium not used for R&D is to be fabricated into MOX fuel and used for plutonium thermal application (application of plutonium to light-water reactors). This application is expected to start in the late 1990s, and extend to more than 10 reactors in the 2000s. Construction and operation of a MOX fuel fabrication plant should correspond to the Rokkasho reprocessing plant.

Essential Projects of Present Nuclear Fuel Cycle

Essential project	Previous plan	Nuclear Subcommittee's interim report
Uranium enrichment	3000tSWU/y after 2000	Currently 1500tSWU/y after 2000
Rokkasho reprocessing plant	Operation to start mid-1990s	Operation to start after 2000
MOX fabrication plant	In progress	In progress
Storage of used fuel	Has secondary importance	Positively viewed
Priv. No. 2 reprocessing	Operation to start app. 2010	Plan to be decided around 2010
Overseas MOX transport	To be implemented mid-1990s to 2010	To be implemented at the necessary time (planned to start from late 1990s)
No. 1 FBR demonstrator	Construction starts planned for second half of 1990s	Start-up of construction planned for early 2000s. Breeding will not necessarily be conducted
Radioactive waste management and disposal	Has been promoted	Should be accelerated
Nuclear nonproliferation R&D	Not mentioned	Should be implemented

Storage of spent fuel

Spent fuels contain uranium and plutonium which are important resources for the future. Therefore, spent fuels exceeding the capacity of the Rokkasho reprocessing plant should be adequately stored until they are reprocessed. More efficient and effective storage methods for the future should be investigated.

Recovered plutonium from abroad

It is our policy to return to Japan the entire amount of plutonium recovered from reprocessing abroad. Plutonium not used for R&D purposes is to be fabricated abroad into MOX fuel and returned at the necessary time. (To start in the late 1990s.)

Fast-breeding reactor demonstrator

The start of construction for the demonstration fast-breeder reactor is being delayed from the previously planned second half of the 1990s to the beginning of the 2000s. Plutonium breeding at the demonstration plant will not necessarily be conducted in its operation.

Research and development

Intensive efforts are to be made in technological development contributing to improved economy of the nuclear fuel cycle, to reduced impact on the environment by the nuclear fuel cycle, and to enhanced resistance to nuclear proliferation.

International framework

Active efforts should be made to establish an international framework to raise transparency regarding peaceful use of plutonium.

Radioactive waste management and disposition

Reinforced measures for management and disposal should be instituted, especially for high-level radioactive wastes.

Conclusion

While Europe and the United States are not actively developing nuclear power generation, in Asia there is high interest, reflecting both the necessity to meet increasing electrical demands in the region and the benefits—such as low CO_2 emissions compared to other electric sources—accompanying this source of energy supply.

Under these conditions some countries expect cooperation from Japan, which has achieved a reliable, high level of technology. At the same time nuclear cooperation with these countries should be pursued, taking into full consideration increasing world concerns about nuclear proliferation.

Moreover, international cooperation is required to maintain the safety of nuclear power stations that were built under the former regimes in eastern Europe and Russia.

The Nuclear Subcommittee will begin another study on international issues, such as nuclear energy cooperation, from this autumn, to be concluded next spring.

As electricity supply is expected to increase by about 20% by the year 2000 compared to present usage, the parties concerned should make concerted efforts to ensure that nuclear power generation plays an important role as one of the major sources of electricity for the coming 21st century. JJTI

Yamachika Hidehiko is deputy director of the Nuclear Energy Industry Division at the Agency of Natural Resources and Energy, Ministry of International Trade and Industry.