

Challenges and strategies for nuclear energy policy in Japan

BY TADAO YANASE

THE WORLDWIDE NUCLEAR energy industry has been undergoing structural changes. In the 1980s, the industry was dominated by individual corporations that built nuclear power plants with little cross-border cooperation. In Europe, there were four plant manufacturers—Brown Boveri & Cie, ASEA, Framatome, and Siemens—and the United States also had four such manufacturers—Westinghouse, Combustion Engineering, General Electric, and Babcock & Wilcox. Japan was home to three nuclear plant vendors: Mitsubishi Heavy Industries (MHI), Hitachi, and Toshiba Corporation.

It has become necessary, however, for reactor vendors to form international alliances in order to survive. For example, Areva, of France, has teamed up with MHI, Toshiba has acquired Westinghouse, and General Electric and Hitachi have combined their nuclear energy divisions. Given this trend toward international alliances among plant manufacturers and the globalization of the market, it is becoming important to coordinate nuclear energy policies across borders.

Japan has cooperated with the United States in efforts to maintain energy security. In January 2007, Akira Amari, Japan's minister of Economy, Trade and Industry, and U.S. Energy Secretary Samuel Bodman agreed to jointly develop a civil nuclear energy action plan that would provide a framework for collaboration. The two countries worked out the United States–Japan Joint Nuclear Energy Action Plan, which was signed in late April 2007 by Bodman and Amari, along with Bunmei Ibuki, minister of Education, Culture, Sports, Science and Technology (MEXT), and Taro Aso, minister of Foreign Affairs.

The Japan–U.S. action plan comes at a time when the United States is looking into the possibility of constructing new nuclear power plants for the first time in 30 years

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Japan's Nuclear Energy National Plan sets forth guidelines and policies for continuing nuclear's development.

and as a series of alliances has been formed between Japanese and U.S. plant manufacturers. The United States' revisiting the possibility of new nuclear plant construction is also in line with a policy shift to readdress the nuclear fuel cycle through the establishment of the Global Nuclear Energy Partnership (GNEP), announced by the U.S. government in 2006.

The United States–Japan Joint Nuclear Energy Action Plan features support measures for consortia of Japanese and U.S. companies that participate in the construction of new nuclear power plants in the United States. For example, Japan will provide public financing, such as trade insurance, in coordination with loan guarantees and other measures that are to be provided by the U.S. government. The action plan also calls for cooperative activities under the GNEP initiative, such as research and development collaboration on fast reactors and advanced technology for reprocessing spent nuclear fuel, and an exchange of opinions on international nuclear fuel supply assurance mechanisms.

History of Japan's nuclear plan

Under the Framework for Nuclear Energy Policy, which was approved in a cabinet resolution in October 2005, Japan adopted the following three basic policy goals:

- To maintain the ratio of nuclear power to overall power generation at around 30 to 40 percent (or higher) beyond 2030.
- To promote the nuclear fuel cycle.
- To commercialize fast-breeder reactors.

In order to achieve these basic goals, the Nuclear Energy Subcommittee of the Advisory Committee for the Ministry of Economy, Trade and Industry (METI) in August 2006 formulated the Nuclear Energy National Plan, which set forth specific policy packages. The Nuclear Energy National Plan forms part of the revised Basic Energy

Plan, which was adopted in a cabinet resolution at the end of fiscal year 2006.

The three-way standoff

Japan's Nuclear Energy National Plan represents a step toward resolving the "three-way standoff" among the national government, the electric power utilities, and plant manufacturers that has plagued the country's nuclear energy industry since the deregulation of its electricity market in the 1990s, leading to the stagnation of long-term, strategic investments.

As part of its efforts to promote deregulation, the national government decided to respect the independence of the utilities and adopted the stance of leaving decisions concerning long-term investments largely to them. From the viewpoint of the utilities, however, this stance created the impression that the government was avoiding taking a leadership role in the development of a nuclear energy strategy.

For their part, the utilities tended to put off drafting long-term investment strategies involving high risks because they were preoccupied with dealing with their immediate problems and adapting their operations to market deregulation.

Meanwhile, plant manufacturers cut back on investments in technology development and focused merely on how to survive the competition as both the national government and the power utilities failed to indicate a future direction. As a result, there was no leadership regarding long-term energy strategy, and decisions on difficult issues were put off. In order to resolve the situation, the three parties had to engage in frank communications with one another about Japan's medium- and long-term nuclear energy policy and share visions for the future. Therefore, the national government took the first step and set a future direction for Japan's nuclear energy policy.

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Enhanced interagency collaboration

The Framework for Nuclear Energy Policy was the first long-term plan drawn up following the government reorganization in which the Atomic Energy Commission was incorporated into the Cabinet Office. The process of drafting the framework helped the Cabinet Office, the Ministry of Education, Culture, Sports, Science and Technology (MEXT), and METI share policy goals and form a solid, united front.

Meanwhile, the Nuclear Energy National Plan, which mapped out concrete measures for achieving the basic principles enshrined in the framework, was worked out by the Nuclear Energy Subcommittee (the advisory body to METI and the Agency for Natural Resources and Energy), with the support of the Cabinet Office, MEXT, and the Ministry of Foreign Affairs (MOFA). The ministries and agencies concerned are now ready to take prompt action in a coordinated manner to promote the implementation of the plan. They are also ready to respond promptly to the GNEP initiative as they did at the U.S. government's first announcement of the initiative in February 2006.

There is also interagency cooperation in making budget requests. For fiscal year 2007, MEXT and METI have requested funds for the launch of their joint projects for the commercialization of a fast-breeder reactor cycle and for human resource development in the nuclear energy field.

In addition, MOFA and METI jointly drafted the Concept for a Multilateral Mechanism for Reliable Access to Nuclear Fuel, which was announced as a Japanese proposal by the chairman of the Atomic En-

Key points of the nuclear plan

The Nuclear Energy National Plan sets forth five basic guidelines, as follows:

1. Establish a firm national strategy and policy framework that does not waver over time.
2. For individual policy measures and time frames, maintain a "strategic flexibility" to adjust to global realities and technology trends.
3. Break down the three-way standoff among government, electric power utilities, and plant manufacturers to achieve true communication and a shared vision. The government has taken the first step by indicating the overall direction.
4. Place importance on the policy measures of individual regions along the lines of national strategy.
5. Ensure policy stability by basing strategy decisions on open and even-handed discussions.

The Nuclear Energy National Plan also includes policy packages for specific actions. For example, it seeks to facilitate the replacement of nuclear plants by reducing and leveling out investment risks specific to nuclear plants, among other measures. Also, it calls for more efficient use of existing nuclear plants, taking into consideration the fact that the capacity utilization at nuclear plants in Japan is conspicuously low compared with that in other countries. In order to increase the capacity utilization, the plan stresses the importance of introducing on-line maintenance technology, which allows the implementation of integrated maintenance work when the plants are in operation.

In addition, the plan calls for firmly establishing the nuclear fuel cycle by promoting the use of plutonium extracted from spent fuel, with a goal of using such plutonium in 16 to 18 light-water reactors. It also stresses the need to secure its supply of uranium by strengthening strategic cooperation with producer nations such as Kazakhstan,

and envisions the commercial launch by 2050 of fast-breeder reactors (FBR), which produce more fissile material than is consumed and therefore enhance energy security, as well as the startup of a reprocessing facility to begin operation in about 2045, around the time that the Rokkasho reprocessing plant will be closed.

The plan refers to the need for efforts to maintain the level of technology and to secure human resources for technology development and for the operation of nuclear plants. An example of such efforts is a joint project of the public and private sectors to develop a next-generation LWR, which is the first national project in Japan's nuclear industry in 20 years.

Furthermore, the Nuclear Energy National Plan highlights Japan's efforts to use its nuclear industry to contribute to the stabilization of the global energy supply-and-demand balance and to the prevention of global warming by promoting nuclear energy abroad while supporting the establishment of a solid framework for nuclear nonproliferation. It also emphasizes the importance of the national government's role in promoting dialogue with the residents in the vicinity of nuclear facilities, as well as with the general public, to seek their understanding of Japan's need to pursue nuclear energy.

The details of the policy packages included in the Nuclear Energy National Plan are available on the Web site of Japan's Agency for Natural Resources and Energy at <www.enecho.meti.go.jp/english/report/rikkokugai.pdf>.

The nuclear fuel cycle

Study of existing policy and alternatives

The Framework for Nuclear Energy Policy was drawn up after deliberations—total-

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ing 45 hours in 18 sessions, all open to the public—by the New Nuclear Policy Planning Council, including an evaluation of the existing policy of reprocessing all spent fuel and three alternative options, as follows:

- Reprocessing some spent fuel and directly disposing of the remainder after storing it for a certain period.

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- Directly disposing of all spent fuel.
- Storing all spent fuel as a provisional measure for 40 to 50 years before deciding whether to reprocess or directly dispose of it.

The evaluation of the existing policy and the alternatives was conducted according to the following criteria: safety, energy security, environmental compatibility, economics, nuclear nonproliferation, technological feasibility, social acceptability, adaptability to future uncertainty, problems that may arise in the case of policy change, and overseas trends.

The cost estimates calculated by the Atomic Energy Commission showed that based on current uranium prices, the direct disposal method would reduce the fuel cycle cost by about 40 percent compared with reprocessing. Japan has decided to continue reprocessing under the Framework for Nuclear Energy Policy despite its higher costs, for the following three major reasons:

1. Reprocessing helps provide a stable energy supply, reduces the volume of radioactive waste, and allows for the ability to respond to future uncertainty.
2. The social assets that have been built up over many years—technologies, bonds of trust with communities where nuclear power plants are located, and the various international agreements secured in order to enable Japan to engage in spent fuel reprocessing—are too valuable to abandon.

3. A policy shift from reprocessing to direct disposal could make it difficult to transport spent fuel from nuclear power plants and could lead to a series of nuclear power plant closures, and it could also stall the selection of interim storage and permanent disposal sites.

Utilization of recovered plutonium

Japan's Basic Energy Plan and the Framework for Nuclear Energy Policy stipulate that plutonium utilization in LWRs should be promoted, as it is the key to Japan's plan to secure the use of plutonium recovered through the reprocessing of spent fuel, which is vital to the nuclear fuel cycle. The basic plan and the framework also call for the national government to take the lead in activities that will help gain the understanding of the general public and the communities that host nuclear facilities regarding the safety and importance of plutonium utilization. Plutonium utilization in as many as 18 LWRs is expected to lead to the saving of approximately 10 to 20 percent of Japan's uranium resources, and, consequently, to further improve the advantages of nuclear power in terms of stable supply. Utilities making steady progress toward implementing plutonium utilization in LWRs include Kyushu Electric Power, Shikoku Electric Power, and Chubu Electric Power.

Some countries commenced plutonium utilization in LWRs in the 1960s, and subsequently mixed-oxide (MOX) fuel was used on a commercial basis. (MOX fuel has been introduced in a total of 57 reactors worldwide over the years.) In Japan, MOX fuel has been used in pilot demonstrations, most frequently in the Fugen reactor, which is similar to an LWR.

Based on past records of reactor operations both in Japan and abroad, as well as deliberations by experts, Japan's Atomic Energy Commission issued a report on the safety of plutonium utilization in LWRs, suggesting that MOX fuel can be used safely in existing LWRs.

In addition to plutonium utilization in LWRs, FBRs will be the future key for stable energy supply. Once they are introduced, Japan will be able to secure a semi-permanent supply of domestic energy. Japan aims to establish a demonstration FBR and related recycling facilities by about 2025 and to start operating its first commercial FBR by 2050 under the Nuclear Energy National Plan. It will be necessary to secure a budget for the development of FBR technology, which is positioned as a core national technology.

Reprocessing activities

Japan has conducted the reprocessing of spent fuel at a plant at the Tokai Research

and Development Center of the Japan Atomic Energy Agency. The plant has been operating for 25 years and has reprocessed a total of 1180 tons of uranium (as of November 16, 2007). A new plant in Rokkasho, Aomori Prefecture, is almost completed, paving the way for Japan to continue reprocessing.

Other countries have chosen either reprocessing or the direct disposal method based on their own assessments of relevant factors, such as geopolitical conditions, resources, the scale of the nuclear power generation program, and cost competitiveness. Countries with relatively small nuclear power generation capacity that have adopted the direct disposal method include Finland, Sweden, Germany, and Belgium. Some countries with abundant energy resources—for example, the United States and Canada—have opted for direct disposal as well.

Other countries—particularly those that

submit an application to the government for a safety review of the Shimane nuclear power plant, and Chubu Electric Power Company and Electric Power Development Company (J-Power) are making steady progress in obtaining approval for plutonium utilization in their LWRs.

■ Also in Rokkasho Village, the construction of a MOX fuel plant will begin by the end of 2007, after a basic agreement was reached in April 2005 between the village and Japan Nuclear Fuel Limited on the siting of the plant. Operation of the plant is expected to begin by the end of 2012.

■ Regarding the use of plutonium in the form of MOX fuel in LWRs, Kyushu Electric Power Company obtained formal approval in March 2006 for plutonium utilization from Saga Prefecture and Genkai Town, and Shikoku Electric Power Company received similar approval in October 2006 from Ehime Prefecture and Ikata Town. Chugoku Electric Power Company

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have large nuclear power generation capacity, plan to continue nuclear power generation in the future, or that are poor in energy resources—have chosen the reprocessing option. Reprocessing facilities have been operating in the United Kingdom, France, and in Russia for many years.

The United States' early 2006 announcement of GNEP, which aims to pursue both the expansion of nuclear power and the nonproliferation of nuclear technologies, was a departure from its longtime favoring of the direct disposal method. Through this announcement, the United States aims to promote the development of advanced reprocessing technology that would be effective in preventing nuclear proliferation and shows its willingness to participate in a nuclear fuel cycle involving reprocessing.

Recent nuclear fuel cycle developments

Following the Atomic Energy Commission's reconfirmation of Japan's policy of promoting the nuclear fuel cycle, Japan has made steady progress toward establishing this cycle, as follows:

■ The Rokkasho reprocessing plant, built at a cost of approximately ¥2.19 trillion (about \$19.7 million), is scheduled to start operation around February 2008. Final (ac-

■ An interim nuclear waste storage facility is to be built in Mutsu City, Aomori Prefecture, by Recyclable-Fuel Storage Company, which was established jointly by Tokyo Electric Power Company and Japan Atomic Power Company. Aomori Prefecture and Mutsu City agreed in October 2005 to the siting of the facility, which is to begin operation by 2010.

■ Concerning the ultimate disposal of nuclear waste, several regions expressed interest in providing a site for an ultimate disposal facility.

■ In February 2005, Fukui Prefecture and Tsuruga City agreed to a plan to remodel the Monju prototype FBR, where operation has been suspended since an accident in 1995. The remodeling work was completed in May 2007, and the reactor is scheduled to resume operation in 2008.

■ Progress has also been made in the area of financing to facilitate the nuclear fuel cycle. In 2005, the Diet (Japan's parliament) passed a law designed to set aside approximately ¥12.6 trillion (about \$113.6 million) as nontaxable reserves to cover the expenses involved in the construction of the Rokkasho reprocessing plant and other facilities. The law became effective in October 2005. ■