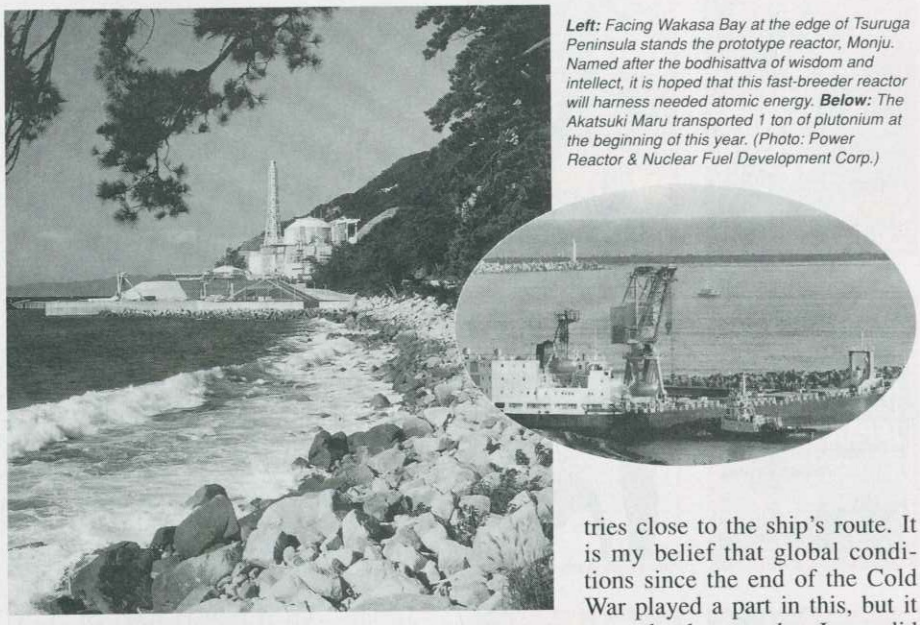
Japan's Nuclear Fuel Recycling Program

By Dr. Akira Oyama



Left: *Facing Wakasa Bay at the edge of Tsuruga Peninsula stands the prototype reactor, Monju. Named after the bodhisattva of wisdom and intellect, it is hoped that this fast-breeder reactor will harness needed atomic energy.* ***Below:*** *The Akatsuki Maru transported 1 ton of plutonium at the beginning of this year. (Photo: Power Reactor & Nuclear Fuel Development Corp.)*

Plutonium shipments

Late last year and into the beginning of this, Japan transported a batch of extracted plutonium from France by ship. For many years now, Japan's power companies have consigned spent fuel from nuclear power stations to France for reprocessing with the contract stipulating that plutonium and the wastes derived from the reprocessing process be returned to Japan. Further, after many years of research and development Japan has succeeded in constructing a prototype fast-breeder reactor and plutonium is required to fuel it.

Japan has previous experience with plutonium shipments from France. For this most recent transport, technical standards adopted in accordance with strict International Atomic Energy Agency (IAEA) guidelines ensured the safety of the transport and the U.S. and France contributed regarding safety of the escort. Every imaginable precaution had been taken and the shipment went as planned. However, Japanese authorities had not envisioned the extensive international media coverage this shipment received which gave rise to apprehension in countries close to the ship's route. It is my belief that global conditions since the end of the Cold War played a part in this, but it may also be true that Japan did not do enough to explain its plans.

Peaceful applications of atomic energy

I will briefly touch upon Japan's current peaceful uses of atomic energy and her policies.

Japan is a heavily populated and crowded country which lacks natural resources. The majority of the nation's energy sources and food supplies are imported, making Japan, among advanced nations, the most dependent upon other countries for energy sources. As such, Japan cannot maintain and improve the living standards of its people without promoting industries based upon the highest levels of science and technology. In order to reduce fossil fuel imports, Japan has placed heavy emphasis on the promotion of nuclear power generation as an energy source and nuclear power use has steadily increased since Japan's first nuclear power plant went into operation in 1965.

At the time of the first oil crisis in 1973, oil made up 77% of Japan's primary energy supply, but with the introduction of natural gas and continuing efforts to cut energy consumption, combined with the introduction of nuclear power, the level of dependence on oil has now been reduced to 57%. There are currently 43 nuclear power plants in operation, with a total capacity of 34.6 million kilowatts, producing 9.8% of the primary energy supply. Atomic energy furnishes 27.1% of the overall electric power generating capacity and has become firmly established as an important source of electrical power. The chart illustrates the transition that has occurred in the types of fuel used by Japan for the production of electric power.

Nuclear power is different from other fuels in that a large amount of energy can be drawn from a small amount of fuel. Furthermore, recycling of nuclear fuel permits very efficient use of resources. Because Japan does not possess coal or oil resources nor are there uranium reserves, since the inception of the atomic energy program she has proceeded with plans to reprocess spent fuel and recycle the recovered uranium and plutonium as nuclear fuel, and has developed the technology to do so.

Japan's fundamental positions regarding nuclear fuel recycling are summarized below:

1. Preservation of natural resources and recycling

The term nuclear fuel recycling means the reuse of the useful portion of spent fuel that would end up as waste material. This contributes to the preservation of resources. For a country like Japan, with no energy sources yet high energy demands, initiatives must be taken to deal with this issue.

2. Ensure long-term, stable supplies of energy sources for nuclear power

Japan depends upon imports for the majority of its energy sources and needs to make efforts to utilize the latent power of uranium resources in the most effective manner possible, as well as improving the stability of its supply.

3. Handle radioactive waste in an appropriate manner

When energy sources such as plutonium and uranium are separated from radioactive waste materials through nuclear fuel recycling, the amount of highly radioactive materials is reduced. This makes it easier to reduce this waste to a stable state.

4. Ensure that nuclear fuel recycling plans are known in order to reduce international anxiety

Japan has proceeded with nuclear energy development for purely peaceful purposes. In order to reduce international anxiety concerning its nuclear fuel recycling plans, Japan has continued to be open about the progress of these schemes. At the same time Japan adheres to the principle that it will not acquire more plutonium than necessary to further these plans.

5. Contribute to the development of safeguards and strengthen the international nuclear nonproliferation system

It is a matter of course that Japan has used the technological know-how and experience accumulated up until now to institute appropriate safeguards in its nuclear fuel recycling program and is making efforts to make them even more stringent. It is important that contributions be made toward the future development of strong IAEA safeguards and a strengthened nuclear nonproliferation system worldwide. Japan also wants to participate actively in international studies related to management of plutonium.

The long-term view

From the standpoint of the short- and mid-term view of Japan's atomic energy usage, guarantees for the safety of today's light-water reactors will be an important issue as we move forward. This also is related to conserving fossil fuels and the global environment.

Looking at energy issues into the mid-21st century, it is estimated that the world's population will reach 10 billion. It goes without saying that living standards in the developing world must be improved and per capita energy consumption will rise. Even if developed nations try to restrain energy consumption, population growth will inevitably lead to great increases in the energy consumption of developing countries. However, continued increases in the consumption of fossil fuels such as oil and coal cannot be permitted.

Bearing this in mind, it is understandable that the scientific development of a long-term, massive supply of non-fossil fuels is indispensable. The choices related to atomic energy can be divided into nuclear fission, derived from recycled fuel used in fast-breeder reactors, or nuclear fusion. The latter is still in the scientific research stage and four parties, the United States, the European Community, Japan and Russia are now conducting joint research. Development related to the former has progressed much further, but fast reactors still are not economically competitive. However, because this is an issue that concerns mankind's future, it would not be wise to abandon development merely because today it is not economical.

Regarding nuclear fuel recycling research and development it is important to take a long-term view and attempt to have flexible planning. This is due to the long-term efforts that are needed to certify one type of system for research and development as well as for facility construction. The prototype reactor Monju was built as the first phase of practical implementation of the fast-breeder reactors that are believed to be required for nuclear fuel recycling in future. Based upon subsequent operation results, design and construction of a demonstration reactor, aiming for actual implementation sometime between the years 2020 and 2030, will proceed. Further, we will steadily and systematically proceed with the use of plutonium in light-water reactors, currently the top of the line in nuclear power plants. While this will play a role in securing a stable energy supply, it will also help us move forward with preparations for the future age of fast-breeder reactors and a practical system for recycling nuclear fuel.

'Atoms for Peace'

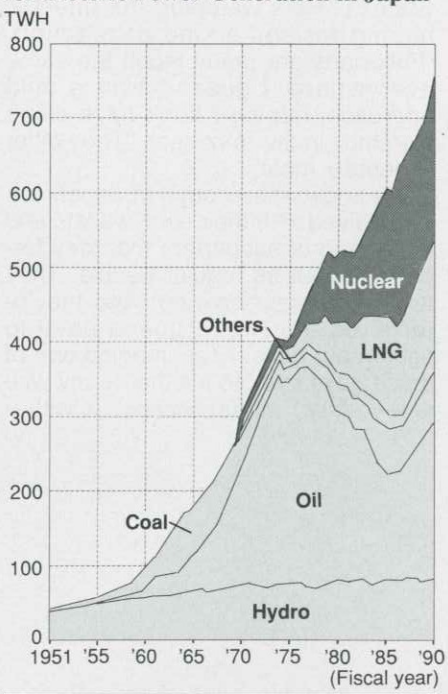
In December 1953 Dwight Eisenhower, then president of the U.S., proposed the "Atoms for Peace" program before the U.N. General Assembly. This opened the way for peaceful use of atomic power in non-nuclear weapon states like Japan. Eisenhower made the following statement in his speech:

"The United States would seek more than the mere reduction or elimination of atomic materials available for military purposes. It is not enough to take this weapon out of the hands of the soldiers. It must be put into the hands of those who will know how to strip its military casing and adapt it to the arts of peace. The United States knows that if the fearful trend of atomic military buildup can be reversed, this greatest of destructive forces can be developed into a great boon, for the benefit of all mankind."

If the Cold War is truly over then the way toward the realization of Eisenhower's dreams of 40 years ago is open. However, there are countries in the world who seek to acquire nuclear armaments, even as they ignore the happiness of their own populace. As such, although I do not believe that it will happen overnight, Japan will continue working together with other nations in order to bring about a world without nuclear weapons, a world which benefits from using atomic power only in peaceful ways.

Fig. 1

Change of Primary Energy Resources for Electric Power Generation in Japan



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