Present Status of Nuclear Fuel Material Transportation in Japan

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Introduction

On June 24, 1994, the Atomic Energy Commission (AEC) of Japan formulated a new long-term plan, "Long-Term Program for Research, Development and Utilization of Nuclear Energy," for the first time in 7 years. In this long-term program, AEC stated that the third fundamental policy of nuclear development and utilization was the "steady development of nuclear fuel recycle taking the future into consideration." It is essential, it also said, to ensure the stable supply of energy while looking into the future so that Japan with limited resources can maintain and develop its economic and social activities in the future.

To establish such nuclear fuel recycle policy, it is critical to transport nuclear fuel material smoothly between nuclear facilities both in Japan and abroad. Thus, safe transportation of nuclear fuel material has become more and more important.

Present Status of Nuclear Power Generation and Nuclear Fuel Cycle Facilities in Japan

Present Status of Nuclear Power Generation

As of the end of September 1994, nuclear power generating capacity totaled 39,476 MW

in Japan, with 47 commercial power reactors in operation, and nuclear power accounted for about 30% of total generated electricity. If the commercial power reactors under construction or under preparation are included, Japan has 53 units in all and generating capacity of 46,733 MW.

Present Status of Nuclear Fuel Cycle Facilities

Japan Nuclear Fuel, Ltd. (JNFL), is in charge of establishing a uranium enrichment plant and a reprocessing plant as nuclear fuel cycle facilities, and a repository for low- level radioactive waste (LLW) and a storage for high- level waste (HLW) as back-end facilities, in Rokkasho Village in Aomori Prefecture. The uranium enrichment plant has already been in operation since 1992, and the reprocessing plant is now under construction aiming at starting operation sometime after the year 2000. Meanwhile, the repository for LLW has been in operation since 1992 (as of March 1994, it stored 26,600 drums), and the storage facility for HLW has received since 1995 the vitrified waste returned from France.

Nuclear Fuel Cycle and Nuclear Fuel Material Transportation

Transportation of Nuclear Fuel Material

Table 1 shows the nuclear fuel material transported within Japan between 1989 and 1993.

Table 1. Transportation of nuclear fuel material used for nuclear power generation

Year		1990		1991		1992		1993		1994	
Item		T	Q	T	Q	T	Q	T	Q	T	Q
Fresh Fuel	UF_6	43	765	48	761	47	748	52	790	52	752
	UO_2	80	655	102	802	86	760	95	749	87	713
	Fuel Assembly	56	941	61	915	66	1112	59	1090	56	869
Spent Fuel		45	469	46	494	41	478	33	433	31	281

(T: Number of Times Q: Total Amount in tons of uranium)

Note: This table shows the transportation of nuclear fuel material subject to confirmation.

Transportation of Natural Uranium, Enriched Uranium, and Fuel Assembly

Japan imports low-level enriched uranium used for power generation, mainly from the United States, France, and Germany. Imported natural uranium hexafluoride is transported to the uranium enrichment plant operated by JNFL in Rokkasho Village, and enriched uranium hexafluoride and enriched dioxide are transported to the uranium fuel processing plant. After the uranium dioxide is processed into fuel assembly, it is transported from the uranium fuel processing plant to nuclear power plants throughout Japan. Such nuclear fuel material is carried within Japan mainly by land using trucks or trailers.

Transportation of LLW

LLW, which is produced in the course of operation and regular inspection of nuclear power plants, is mixed with cement and asphalt to solidify and is put into drums. These drums are stored temporarily in the special storage space located in nuclear power plants. Then they are transported by sea to Mutsu-Ogawara Port in Rokkasho Village with eight drums put into each especially made transportation container. From this port, the drums are transported by land to JNFL's LLW repository site by land.

Transportation of Spent Fuel

In Japan, spent fuel is transported from nuclear power plants to the Power Reactor and Nuclear Fuel Development Corporation's Tokai Reprocessing Plant by sea through special- purpose-built ships. Japan entrusts reprocessing of spent fuel to some foreign countries. In transporting spent fuel from Japan to these countries, it is sent from Japanese nuclear power plants to BNFL or COGEMA by sea using special- purpose-built ships.

Transportation of Plutonium by the Akatsuki-maru

Plutonium, which is produced during the spent- fuel reprocessing in foreign countries, is to be returned to Japan to use it as nuclear fuel. Plutonium, which is to be used to fabricate replacement fuel for a fast breeder reactor, Monju, was transported from France to Japan by a special- purpose-built ship, the Akatsuki-maru. The ship left France in early November 1992 and arrived at Japan Atomic Power Company's Tokai Port on January 5, 1993.

To ensure safety, the ship was equipped with the devices necessary to prevent collisions, such as a satellite navigation system and anti-collision radar. The ship had also double hull and double bottom structure and fire-protected construction to prevent fires. It was

also equipped with a device to flood the cargo space with water should an accident occur.

Transportation of HLW

Radioactive waste, which is generated during the reprocessing of spent fuel in foreign countries, is also to be returned to Japan. Of such waste returned to Japan, high-level waste liquid was melted with glass to make the solid vitrified residue, which left France in late February 1995 and arrived at JNFL's waste storage center in Rokkasho Village on April 26, 1995 . The solid vitrified residue was contained in the transport container conforming to IAEA safety standards, and was transported using a ship which complied with IMO's SOLAS Convention and the INF code.

Safety Study

To ensure safety of transportation, it is necessary not only to establish strict standards, but also to promote a systematic safety study based on the progress in technology and the study results achieved so far. For this purpose, the safety studies shown in Table 2 are being conducted in research institutes throughout Japan.

Commitment to 1996's Revision of IAEA Standard

IAEA Radioactive Material Safety Regulation (1985 edition), which constitutes an international standard for transportation of radioactive material, was published in February 1985. Japan incorporated this IAEA regulation into the domestic law after deliberation by the Atomic Energy Commission, and the law has been enforced since January 1, 1991. At present, International Atomic Energy Agency(IAEA) is working to revise the regulation in 1996, and the experts' meetings are being held several times a year to discuss the matter. Japan has actively participated in this revision work and is committed to a positive contribution to this work.

Table 2. Safety study on radioactive material transportation

Area of Study	Theme of Study(Example)	Research Institute
(1) Study on Structure and Material	Study on impact strength at the screw connection of packagings	Mechanical Engineering Research Institute
(2) Study on Heat and Fire Resistance	Study on UF_6 thermal characteristics	Power Reactor and Nuclear Fuel Development Corporation
(3) Study on Sealing	Study on sealing performance at the time of sealing device deformation	Mechanical Engineering Research Institute
(4) Study on Shielding and Criticality	Study on radiation safety during the transportation of low- level radioactive materials	Ship Research Institute
(5) Study on the Safety Analysis Code	Development of the code for thermal structure safety analysis of packagings	Japan Atomic Energy Research Institute