PRESENT STATUS OF NUCLEAR FUEL MATERIAL TRANSPORTATION IN JAPAN

T. Nagakura (1), S. Fukuda (1), Y. Tsuritani (2) and H. Kawai (3).

(1) Central Research Institute of Electric Power Industry,
1-6-1 Ohtemachi, Chiyoda-ku, Tokyo 100, Japan
(2) Ministry of Transport, 2-1-3, Kasumigaseki, Chiyoda-ku, Tokyo 100, Japan
(3) Science and Technology Agency, 2-2-1, Kasumigaseki, Chiyoda-ku, Tokyo 100, Japan

INTRODUCTION

To sustain and develop economic and social activities in the future, it is essential for Japan, which is not endowed with rich energy resources, to ensure energy security while looking into the future. In such efforts peaceful use of nuclear power has a vital role. In establishing the nuclear fuel recycle policy to achieve effective use of nuclear energy, it is indispensable to transport safely and smoothly nuclear fuel material between various nuclear facilities in Japan and abroad. Assurance of safe transportation is gaining in importance more than ever.

In the nuclear fuel recycle policy of Japan, "plutonium thermal use," that burns plutonium in the form of a mixed oxide fuel with uranium in a light water reactor, has been positively considered with views to utilize plutonium generated by spent fuel reprocessing and to achieve more effective use of uranium. Up to now Japan has been holding a principle of having no excess plutonium with the view of nuclear nonproliferation, and plutonium thermal use is recognized as the most proper use of plutonium as of today. A plan "On Promotion of Nuclear Fuel Cycle for the Time Being" was acknowledged by the Cabinet on February 4, 1997, and on the basis of it, the Minister of International Trade and Industry and the Director General of the Science and Technology Agency requested the governors of three prefectures (Fukui, Fukushima and Niigata) hosting nuclear power plants to cooperate with the implementation of plutonium thermal use. With such a background, when the Government has the consent of the parties concerned including the local communities, plutonium thermal use will be promoted. This, in turn, will increase the importance of assuring safety of MOX fuel transportation.

In promoting the development and use of nuclear power, it is vital to assure extra safety and to ensure positive and prompt release of information. Japan has made it a principle to release information on nuclear power safety, and has been striving to release information as much as possible except some information of which release would hinder execution of nuclear material protection, nuclear nonproliferation or protection of property right. Regarding nuclear fuel material transportation, it is naturally important to ensure safety of transportation itself. Moreover, as the transportation is done internationally in many cases, it is necessary for the countries concerned in the transportation to supply the countries along the transportation route with full information on the transportation. In the return transportation of high level radioactive waste (vitrified residue) from France to Japan, that was made in January through March in 1997, the countries concerned, the U.K., France and Japan coordinated with each other to positively release information on transportation safety and the like to the countries along the transportation route and news media so as to seek international understanding of the transportation while ensuring safe transportation. In conducting international transportation of nuclear fuel material in the future, it is as important as ever to properly implement the IAEA Radioactive Material Safety Regulation, and, regarding release

of information on transportation, to internationally seek coordination to positively release information except that needs nondisclosure on the ground of protection of nuclear material.

PRESENT STATUS OF NUCLEAR POWER PLANTS AND NUCLEAR FUEL CYCLE FACILITIES IN JAPAN

• Present Status of Nuclear Power Plants

As of the end of November 1996, nuclear power generating capacity totaled 42,712 MW in Japan, with 51 commercial power reactors in operation, and nuclear power accounted for about 34 % of total generated electricity. If the commercial power reactors under construction or under preparation are included, Japan has 57 units in all and generating capacity of 48,278 MW.

• Present Status of Nuclear Fuel Cycle Facilities

Japan Nuclear Fuel, Ltd. (JNFL) constructed 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 radioactive waste (HLW) as back-end facilities, in Rokkasho Village in Aomori Prefecture (the reprocessing plant is under construction).

Of these facilities, the uranium enrichment plant has already been in operation since 1992. Regarding the reprocessing plant, the pool for receiving spent fuel was completed, and the plant is under construction aiming at starting operation sometime after the year 2000. Meanwhile, the repository for LLW has been in operation since 1992, and the storage for HLW has been storing 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 1991 and 1995.

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

Year		1991		1992		1993		1994		1995	
Item		T	Q	T	Q	T	Q	T	Q	T	Q
Fresh fuel	UF_6	48	781	47	748	52	790	52	752	48	807
	UO_2	102	802	86	760	95	749	87	713	81	792
	Fuel assembly	61	915	66	1112	59	1090	56	869	57	937
Spent fuel		46	494	41	478	33	433	31	281	35	394

(T: Number of times Q: Total amount in tons of uranium)
Note: This table shows the transportation of the type A fissile packages and type B packages.

• 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 uranium 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, etc. 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 a land route, mainly comprising a dedicated road, over a short distance (about 9 km) to JNFL's LLW repository site.

• Transportation of Spent Fuel

In Japan, spent fuel is transported from nuclear power plants to Tokai Reprocessing Plant of the Power Reactor and Nuclear Fuel Development Corporation (PNC) 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 of the U.K. or COGEMA of France by sea using special-purpose-built ships.

• Transportation of Plutonium and MOX Fuel

Plutonium, which is produced during the spent fuel reprocessing in foreign countries, and MOX fuel, which is produced by using such plutonium, are to be returned to Japan by sea to use them as nuclear fuel.

In January 1993, plutonium was transported from France to Tokai Port of Japan Atomic Power Company by a special carrier, the Akatsuki-maru. The plutonium was used by PNC to fabricate replacement fuel for a prototype fast breeder reactor, Monju.

To ensure safety, the ship was equipped with the devices necessary to prevent collisions, such as a satellite navigation system and an 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. In short, the transportation was executed under a careful plan.

In future, if plutonium thermal use using MOX fuel is implemented in the domestic light water reactors, MOX fuel fabricated into fuel assemblies overseas will be transported to Japan by sea.

• 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, solid vitrified residue is produced by melting high-level waste liquid with glass and solidifying them. The second transportation of solid vitrified residue to Japan was made in 1997. The carrier ship left the port of Cherbourg in France on January 13, 1997 and entered Mutsu-Ogawara Port in Aomori Prefecture on March 18 of the same year. Two transportation containers holding a total of 40 glass vitrified residue cans were delivered, on the same day, to the JNFL's HLW storage center in Rokkasho Village. Throughout the transportation, the HLW (glass vitrified residue) was contained in the transport containers conforming to IAEA Radioactive Material Safety Regulation, and these transport containers were transported by a ship which complied with IMO's SOLAS Convention and the INF code. To ensure safety, the ship was equipped with the devices necessary to prevent collisions, such as a satellite navigation system and an 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. In short, the transportation was executed under a careful plan.

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, safety studies shown in Table 2 are being conducted in research institutes throughout Japan.

Area of study	Theme of study (example)	Research institute
(1) Study on sealing and criticality	o Study on criticality safety of spent fuel packagings with burnup considered	Japan Atomic Energy Research Institute
	o Development of criticality safety handbook for packagings	Japan Atomic Energy Research Institute
	o Study on neutron sealing for high burnup spent fuel transportation	Ship Research Institute
(2) Study on structure, material, and heat and fire resistance	o Demonstration of high burnup spent fuel casks	Central Research Institute of Electric Power Industry

Table 2. Safety study on radioactive material transportation

INCORPORATION OF THE 1996 EDITION OF IAEA RADIOACTIVE MATERIAL SAFETY REGULATION (ST-1) IN THE DOMESTIC LAW

IAEA Radioactive Material Safety Regulation (1985 edition), which constitutes an international standard for transportation of radioactive material, was published by IAEA in February 1985. Japan incorporated this IAEA regulation into the domestic law, and the law has been enforced since January 1, 1991.

IAEA has been working to revise the 1985 edition of the regulation, and Japan has been actively participating in the work. A proposed revision of the transport regulation was approved by the board of directors of IAEA in September 1996, and the revised regulation will be published as the 1996 edition of the transportation regulation (ST-1). International implementation of this 1996 edition of the transportation regulation (ST-1) is currently under consideration by IAEA, IMO, ICAO, etc. with the target year set at 2001. Japan has started to consider the incorporation of the 1996 edition of the regulation (ST-1). Watching the attitudes of the respective countries and international organizations, Japan will incorporate the new edition of the regulation in the domestic law after full deliberation by the Nuclear Safety Commission and the Council on Radiation.

SESSION 15.2

Sea Transport