RESUMPTION OF TRANSPORT OF KUR SPENT FUEL FROM JAPAN TO USA

------ Very Long-term Storage and Public Acceptance for Transport ------

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ABSTRACT

The Research Reactor Institute, Kyoto University (KURRI) has more than 250 MTR-type HEU spent fuel elements. They have been stored in water pools after irradiation in the Kyoto University Research Reactor (KUR) core. The longest pool residence time is 25 years. In accordance with the Foreign Research Reactor Spent Nuclear Fuel Receipt Program of the United States, sixty KUR spent fuel elements were shipped from KURRI to the Savannah River Site of the USDOE in August, 1999. This shipment was done successfully through a public port in Osaka Prefecture, Japan. This is the first shipment in the past twenty-six years after the last shipment through the Yokohama Port. Concerning the use of a public port, we had to solve many issues for public acceptance. In this paper, we describe how we have stored the spent fuels for a long time with high integrity and how we have obtained public acceptance for the transport.

INTRODUCTION

The Kyoto University Reactor (KUR) has been operated at the maximum thermal power of 5MW using high enriched uranium fuel (HEU: enrichment of 93%) since 1968. The first criticality was attained in 1964 and KUR was operated at 1MW nominal power using 90% enriched uranium fuel until 1968. In 1991 two low enriched uranium (LEU) silicide fuel elements were fabricated and loaded in the KUR core for a demonstration of core conversion. The KUR operation with HEU will continue until the end of March, 2004.

The KUR spent fuel elements (SFs) were returned to the United States under the HEU Lease Contract from 1968 to 1973. The total number of the KUR SFs shipped to US is 153 by nine shipments. All of them were shipped through the Yokohama Port together with JAERI's spent fuels. In 1973, concurrently with the termination of the lease contract, the mayor of Yokohama city denied the use of Yokohama Port for the spent fuel shipment. After the termination of the lease contract, Kyoto University concluded the HEU spent fuel reprocessing contract with US on April, 1977, which was interrupted at the end of 1988 in accordance with the start of Environmental Assessment by the US Government. After the US Record of Decision for Environmental Impact Statement on May 13, 1996, Kyoto University concluded the contract

(No. DE-AC09-97SR18907) with the United States Department of Energy (USDOE) on July 30, 1997 for returning the KUR SFs to US. At that time, KURRI had 256 SFs generated by more than 25 years KUR operation. These SFs are stored in a spent fuel pool under very careful management for a long time. As to the transport cask, two casks were newly manufactured in March, 1999.

In August, 1999, we shipped our spent fuels successfully with two casks through a public port in Osaka Prefecture. This is the first shipment in the past twenty-six years. We intend to return SFs to US one shipment a year using two casks. Consequently, seven shipments in total are expected by the end of March, 2006.

We have been hoping to use a public port for shipment of the KUR SFs, since the Kyoto University is a national university. Therefore the use of public port was a top priority matter on the shipment for us.

This paper describes how we store the KUR SFs with high integrity for very long time and how we have solved sensitive issues to obtain public acceptance for the spent fuel transport.

LONG-TERM STORAGE OF SPENT FUEL

The KUR fuel element is of typical MTR-type. Three kinds of HEU fuel elements, namely standard, special and half-loaded elements, and one kind of LEU fuel element are used in the KUR core. The standard fuel element is prepared for keeping a criticality in the core, which contains 180 gU-235 (about 193 gU) in 18 fuel plates. The special fuel element is prepared for control rod insertion, which contains 90 gU-235 in 9 fuel plates. The half-loaded fuel element is prepared for adjusting reactivity of the core and contains 90 gU-235 in 18 plates (9 fuel plates and 9 aluminum dummy plates). The meat part of fuel plate is U-Al alloy, and the material of clad and structural parts is aluminum alloy. The HEU fuel element and fuel plate are illustrated in Fig. 1.

An irradiated HEU fuel element of average burn-up of 23% (for LEU fuel, average burn-up 34%) is discharged from the core as a spent fuel element. Eleven SFs in average are generated annually through the KUR operation.

The SFs are stored in a water pool. The pool liner and floor are made from stainless steel. Each spent fuel element is inserted into a storage rack made from stainless steel. The pool water is purified by an ion-exchange system and its electric conductivity is kept around 0.3 S/cm. The pH-value of water is about 6.3. Further, an aluminum shutter is installed on the top of the pool to prevent decrease of water level by evaporation and degradation of pool water by mixture with falling dust.

As of August, 1999, the longest pool residence time of SFs is 25 years. In order to confirm the integrity of each spent fuel element stored in the pool, we perform a visual inspection and a sipping test every year. Up to now, the appearance of each fuel element is good and no visible corrosion or chemical change has been observed on the surface of the fuel plate. Also, any questionable leakage radioactivity has not been measured by sipping test. From these results, we can conclude that keeping the quality of pool water is indispensable for a very long-term storage of SFs in a pool.

SHIPMENT OF SPENT FUEL

Preparation of Package

In the fiscal year 1998, two casks for the transport of the KUR SFs were designed and manufactured. The cask is named JMS-87Y-18.5T type and shown in Fig. 2. The package type is B(U). The maximum capacity of one cask is 30 of MTR-type SFs and total radioactivity 25 PBq. The total weight including tie-down equipment is approximately 20 ton. The design of our cask is just the same as the JAERI's cask and is certified already by the competent authorities of Japan, US and UK.

For the first shipment in this August, the preparation of loading the SFs into the casks began in June, 1999. Prior to loading, a nozzle part of the element was cropped as shown in Fig. 1, which did not contain any fissile material. The weight of one fuel element after cropping was approximately 4.5 kg. Sixty oldest spent fuel elements were loaded into two casks by mid-July, 1999. After several KURRI's inspections for the integrity of loaded elements, the external radiation level and surface contamination of package, the leak-tightness, etc., the legally regulated pre-shipment inspection for package was carried out by the Science and Technology Agency (STA) according to the IAEA safe transport regulations.

Before shipment, all of the SFs was recognized as an Authorized Material by the Savannah River Site (SRS) pursuant to the contract. This means that the KUR SFs shipment has been approved by USDOE.

Land and Sea Transport

KURRI lies in Osaka Prefecture which has a coastline. But we have not own sea port in our site because KURRI is located inland. Therefore, a land transport using a public road is unavoidable between the KURRI site and the shipment port. The shipment was carried out in August, 1999 and the distance of transport by road covered approximately 10 km.

For the land transport, truck trailers licensed by the Ministry of Transport (MOT) were used. For the sea transport, a vessel which meets the requirements of the INF-code of the International Maritime Organization (IMO) has been used. In order to confirm the integrity of loading to a truck trailer, the tie-down condition between the package and the loading platform of the trailer was inspected by MOT. Also the tie-down condition in the vessel's hold was confirmed by the MOT inspector. The transport route was approved by the Public Safety Commission of the Osaka Prefectural Police Department for land transport and by the District Maritime Safe Agency for sea transport.

Prior to the shipment, the Transport Head Office (THO) was organized in KURRI to carry out the first shipment safely and smoothly. Under the control of the chief of THO, four groups, namely, transport watching group, radiation surveillance group, guard group and communication/ contact group, were provided in THO. The member of each group accompanied with the convoy from KURRI to the shipment port.

The KUR spent fuel packages were transported very securely with strict guard by police on the public road and the pier. In the port, several guard ships of the Maritime Safe Agency and the Osaka Water Police Station watched and guarded the vessel. No trouble and accidents during the transport is happened up to the present.

ON THE PUBLIC ACCEPTANCE

On this shipment, the most important and delicate issue was to find a shipment port. After the denial of using the Yokohama Port, we have endeavored to find an appropriate public port of shipment. However, the ports outside Osaka Prefecture mostly denied to offer the port for the shipment of SFs as very dangerous material. We suppose that the main reason of denial is why the SFs produced in the Osaka area should be shipped from the port outside the area. Also, the background such that a long distance transport of spent fuels by road has not been done recently in Japan is supposed to be one of the reasons.

Several years ago, we began to negotiate with the Osaka Prefectural Government to solve the issue of shipment port, since the prefectural government manages the Osaka Prefectural Council of Nuclear Issues which has been organized at the same time of the establishment of KURRI, 1964. The aim of the Council is to watch the KURRI's management conditions for the research reactor KUR and the critical assembly KUCA. The Council consists of the mayors concerned and the delegations of many kinds of parties or organizations such as prefectural council, related city councils, related residents, women's society, agriculture union, fishermen's cooperative association, etc. In principle, all issues reported to and discussed by the Council are completely opened to the public. This means that all issues or items decided by the Council are basically accepted by the public. The KUR spent fuel return program which includes the use of a public port in Osaka Prefecture was discussed by the Council. In 1998 October, the program was approved by the Council on the condition that KURRI should obtain each consent of the neighboring cities and town.

KURRI has already concluded the nuclear safety agreement with each of the neighboring two cities and one town when KURRI was established. According to the agreement, any information concerning reactor safety and nuclear material should be reported to each municipal authority. This municipal authority's officer is point of contact to the public. In order to obtain a consent concerning the return program, we prepared pamphlets to explain safe transport and distributed them to the public and the related organizations. We opened the KUR facilities including the spent fuel pool and the casks to the authorities' officers and the public. Furthermore, we went to any place at anytime to answer the questions, if the public desired. We promised to give any information, especially land transport information, to the municipal authorities and communicate carefully each other. As the result, the both of KURRI and the municipal authorities held all transport information in common. We believe that such transport information has been well controlled by the municipal authorities and KURRI. Furthermore, to ask the public to feel easy for the present transport, we proposed to measure the radiation level and the radioactivity of environmental samples along the transport route before and after the transport. All of these results were reported to the public through the municipal authorities. By the promise and the proposal mentioned above, we were successful to obtain each consent of the neighboring two cities and one town.

CONCLUDING REMARKS

Since 1974, KURRI has stored the MTR-type KUR spent fuel elements in a pool. In spite of long-term storage, they are kept in good condition without corrosion or crack under the control of highly purified pool water. The electric conductivity of the water is around 0.3 S/cm and the pH-value is about 6.3. Accordingly, it is concluded that the quality of an aluminum-based MTR-type fuel element is kept at least for twenty-five years in wet storage by controlling the pool water being highly pure.

After the ROD of US Government on May, 1996 and successive conclusion of the contract between Kyoto University and USDOE on July, 1997, KURRI resumed to ship the KUR spent fuel elements to US this August after an interval of twenty-six years. This shipment has been done successfully through a public port in Osaka Prefecture by the cooperation and understanding of many organizations and the public. Especially, the role of the Osaka Prefectural Council of Nuclear Issues was important for us to obtain the public acceptance for the spent fuel transport by using a public port in Osaka Prefecture, since the members of the Council were the delegations of variety groups or organizations. Furthermore, the close communication between the site and the local government was severely required in order to carry out such program effectively and obtain the public acceptance.

From this experience, it has become clear that feeling easy is different from feeling safe for the public. The public people can understand the safety of the nuclear material transport, but cannot always feel easy. In order to relieve the public, it is very important to show actually that circumstance is not change before and after transportation by measuring radiation level, etc. An easy to understand and practical explanation is required to the persons concerning nuclear energy.

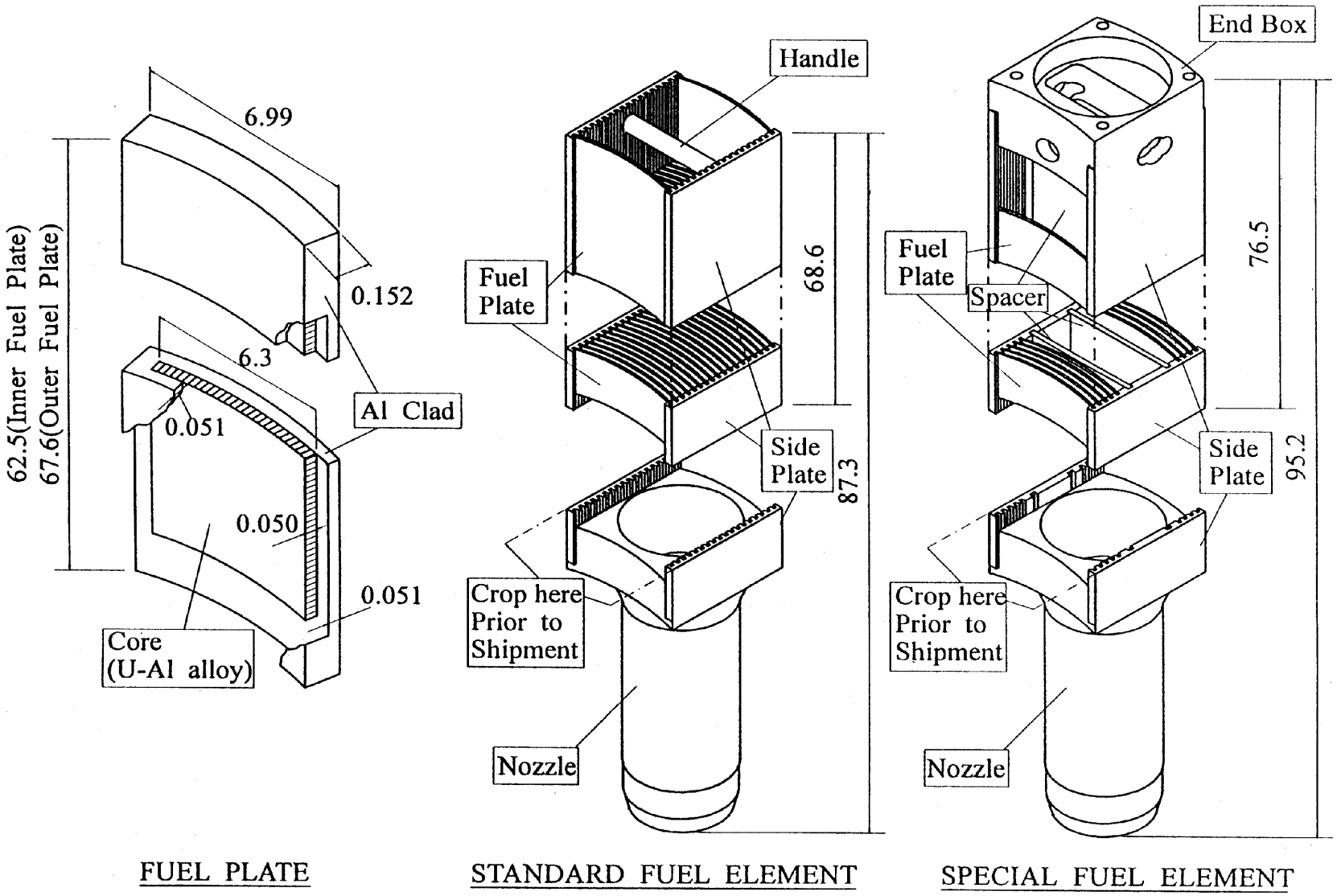

Fig.1. Schematic Illustration of KUR Fuel Plate and Fuel Element (unit:cm)

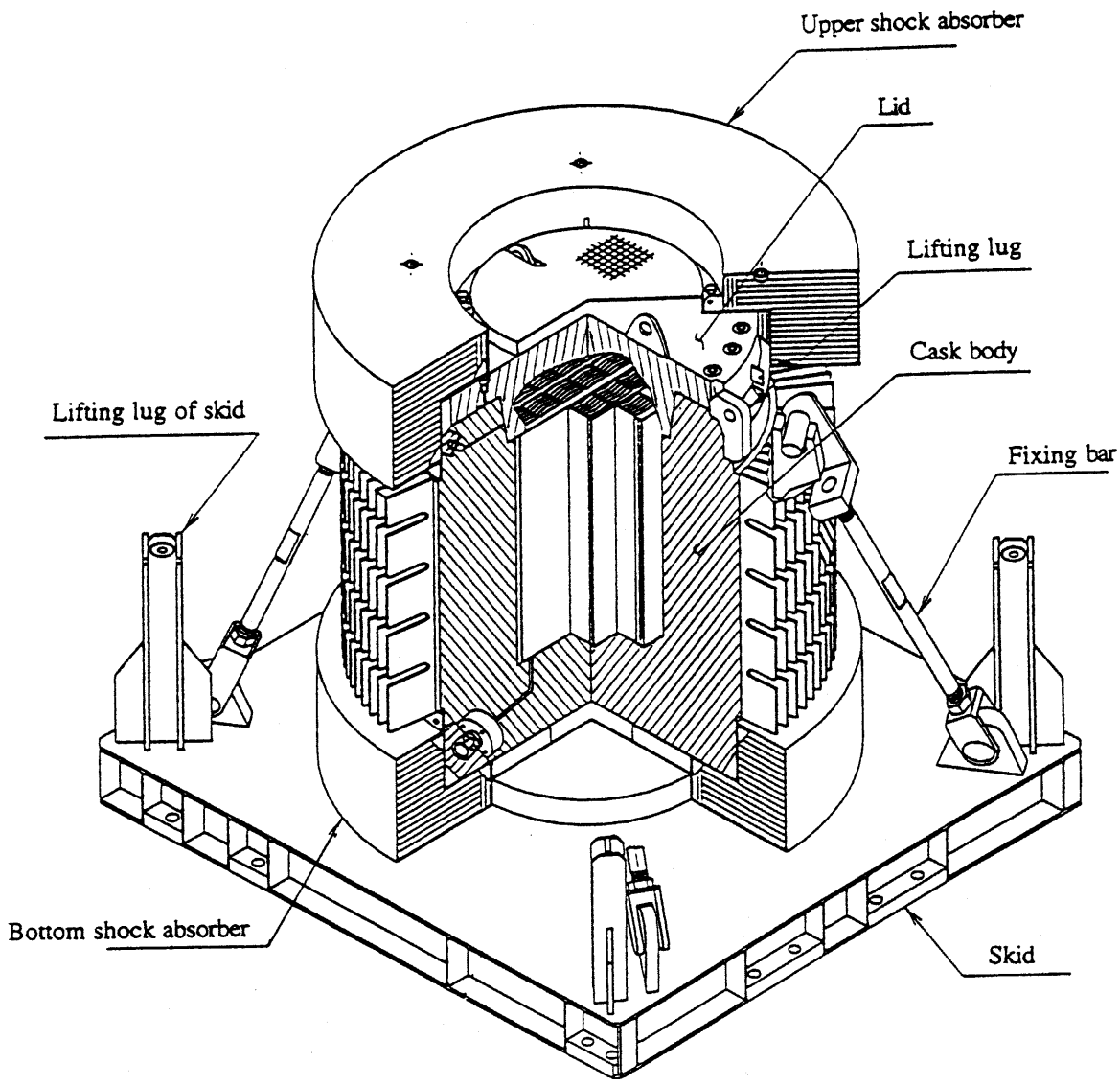

Fig. 2 KUR Spent Fuel Transport Cask – JMS-87Y-18.5T

Dimensions : Height ~ 2 m , Diameter ~ 1.9 m
Total Weight : ~ 20 ton
Material : Stainless Steel