

Arrangement of Russian Research Reactors SNF Shipment (Pilot Shipment of SNF from RF SSC – IPPE, FSUE RR)

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Introduction

The Rosatom State Corporation Concept of the spent nuclear fuel (SNF) handling provides for the SNF shipment from the sites of the operating companies for the purpose of its environmentally-friendly treatment at the centralized infrastructure entities of FSUE Mayak PA and FSUE Mining & Chemical Combine.

When implementing the Federal Target Programme “Russia’s Nuclear and Radiation Safety Assurance in 2008 and in Period to 2015” actions in respect to the Federal State Unitary Enterprise State Scientific Centre of the Russian Federation - A.I. Leipunsky Institute of Physics and Power Engineering (hereinafter referred to as IPPE), the mentioned policy is realized by means of the SNF stored at IPPE preparation for shipment and its further transportation to the FSUE Mayak PA for reprocessing. The Russian companies (Rosatom State Corporation, FSUE RF SSC – IPPE, FSUE Mayak PA, R&D Company Sosny Ltd) started the actual work in this direction in 2008.

1. Description of Storage Facility and SNF

The spent nuclear fuel at IPPE is put for dry storage in a detached building, namely the SNF storage facility. The single-storey building that includes Class 3 nuclear materials storage was designed and built in the 60s of the last century for the temporary storage of the fuel assemblies and experimental fuel elements following the irradiation in research reactors.

The SNF is stored in the basement part of the structure made of the cast-in-situ reinforced concrete in stainless steel canisters of different length (from 500 to 2,400 mm) and 200 mm in diameter. The SNF dry storage canisters are placed into the storage facility cells, which are located at the same distance from each other, thus forming the square lattice spacing 800×800 mm. At the time being the authorized time of the SNF storage facility operation is coming to an end, so early actions shall be taken to empty the storage completely and to transfer its contents to reprocessing plants.

Over many years of operation of IPPE research reactors, critical experimental facilities and hot chambers a considerable amount of the spent nuclear fuel of different composition and various degree of enrichment has accumulated in the storage facility. Since many of the installations were research ones, the fuel was operated under strict process mode conditions. The SNF is mostly leaky and it requires to be handled using the approach corresponding to the off-grade fuel treatment.

Due to the radiation-induced swelling over the long storage time (up to 50 years in some cases) the fuel cannot be removed from many canisters with no damage made to the canister structure. Another problem lies in the fact that the most part of SNF is not included into the branch standard of supply to the reprocessing plants mostly because of the lack of its reprocessing technique. It is necessary that the adequate production preparation should be performed and the licensing documentation should be finalized prior to the SNF shipment from IPPE.

2. Tasks That Demand Solution

In view of the storage facility immediate vicinity to the city of Obninsk, the most urgent task is to reduce the radiation danger from the spent nuclear fuel accumulated over the years by means of this fuel shipment to the processing plant (Mayak PA). The following actions are necessary to arrange the SNF transportation:

- 1) comprehensive engineering and radiation survey of the storage facility;
- 2) fuel preparation for shipment;
- 3) elaboration of the transport-technological scheme of empty TUK casks delivery, SNF loading and loaded TUK casks shipment;
- 4) transportation of the treated fuel to the processing plant.

3. Main Concerns

The SNF inventory items in the IPPE storage facility are canisters arranged in the cells having individual sequential number. All the documents including the information about the mass and the contents of the canister are maintained as applied to the inventory item, which can contain the SNF of different types. Moreover, most often the SNF type is impossible to be identified by means of its visual inspection. Thereby there appears the danger of delivering to the reprocessing plant of the fuel, for which no processing technique exists for the time being. For the purpose of the SNF certification firstly accounting records (canister-containing cell certificate, loading logbook, the map of the canister arrangement in the storage facility, documents for the previous SNF activities etc.) shall be analyzed. Secondly, a distance photography of the cell shall be performed followed by the visual assessment of the canister contents. Thirdly, non-destructive methods of the fuel composition and fuel matrix identification under shielding chamber

conditions shall be developed for the canisters, in which the SNF cannot be certified by the above-mentioned ways. The destructive methods of analysis are not desirable in view of the hard constraints for radioactive aerosol release within the Obninsk-city boundaries.

The leak-tightness barrier availability shall be provided for the purpose of the safe SNF placement in the cask when shipping the fuel for reprocessing as well as during its temporary storage at the reprocessing plant. So prior to the shipment for processing, the most part of the SNF from the storage facility shall be arranged in leak-tight casks.

According to the normative documentation in force at IPPE, the canister contents activities directly in the storage facility itself are prohibited. On completion of the entities at the IPPE territory analysis it was determined that the most fit for the SNF treatment and packaging activities is the physical research complex building (hereinafter referred to as PRC) after its shielded chamber equipment has been substantially upgraded.

The main concern indeed that impedes the implementation of the large-scale shipment of SNF from IPPE is the extremely unsatisfactory condition of access railroads from the Obninskoye station to the site area. The railway has been out of operation for many years and thus has fallen into complete disrepair. The situation is accentuated even more by the railway going through the areas being the property of different companies, which are not interested in the railway recovery.

4. Solutions in the Framework of the Pilot Project

For the purpose of the SNF pilot shipment from the IPPE storage facility a specific procedure has been developed, which provides for the following activities:

- 1) SNF inspection in the storage facility to specify the fuel suitable for delivery to Mayak PA;
- 2) SNF-containing canisters extraction out of the storage facility cells;
- 3) SNF-containing canister loading into the in-house transport container and its delivery to the PRC;
- 4) SNF-containing canister supply to the shielded chamber using the transfer cask;
- 5) SNF repackaging activities;
- 6) SNF-containing casks loading into TUK containers.

The existing transport-technological scheme was made actual for the first (pilot) SNF removal. The results of the analysis made, routes and possible transshipment sites studies showed that the SNF can only be shipped from the IPPE territory now by motor transport. Since the considerable distance between the cities of Obninsk and Ozersk makes it impossible to transport all the SNF by trucks, the suitable site of the fuel transshipment onto the rail cars had to be found, necessary licensing documents had to be finalized, empty TUK casks had to be delivered to the IPPE, SNF had to be loaded and the transportation to the reprocessing plant had to be arranged.

5. Pilot SNF Shipment Implementation

Considerable results have been achieved in the course of the pilot SNF shipment from the IPPE site activities envisaged by the Federal Target Programme "Russia's Nuclear and Radiation Safety Assurance in 2008 and in Period to 2015" within the period from 2009 to 2011. In the first place a list of SNF, which Mayak PA can accept and reprocess with no correction made of the standard technique, has been specified. Of the whole amount of the SNF kept in the storage facility part of SFAs of BM type and all SFAs of EK-10 type were selected to be shipped per the first run. Due to the fact that BM-type SFAs overall dimensions were too large for them to be placed in TUK-19 casks specific equipment was developed, produced and supplied to IPPE including the following items:

- receiving rotary device (Fig. 1);
- canister adapter;
- safety device;
- elevating table;
- clamping device;
- cutoff device;
- casks for the BM SFA fuel component packaging.



Fig. 1. Receiving rotary device

Additionally the required accompanying and licensing documentation has been finalized. The procedure of the TUK-19 casks leak-tightness test prior to their shipment has been developed in respect of the IPPE PRC conditions.

The route of empty TUK-19 casks delivery to IPPE included the railroad section, the transshipment site and the motor road section. On completion of the required preparatory work SFAs EK-10 and BM-type SFA-containing casks were loaded into sixteen TUK-19 containers (Fig. 2). SFA-containing TUK-19 casks were placed into the dedicated freight large-capacity containers (DFLCC). DFLCC is an upgraded 20 feet ISO-container, which can accommodate up to three TUK-19 casks. The transportation was made using two haulers of MAN TGA19.390 kind and two semi-trailers SW240GRKR, one DFLCC on each of them (Fig.3).



Fig. 2. TUK-19 in the PRC central hall



Fig. 3. SNF-containing casks shipment from the PRC territory

After the containers have been delivered to the transshipment site area, they were reloaded onto the rail flatcars using the autocrane (Fig. 4).



Fig. 4. CFKK loading onto the rail flatcars

Then the dedicated railway train was made up and the rail cars were sent to the consignee address.

Thus, for the first time in the last 15 years part of SNF was shipped from the IPPE to the reprocessing plant (FSUE Mayak PA) using the combined motor and railway route.