PRESENT EXPERIENCE OF NRI REZ WITH PREPARATION OF SPENT NUCLEAR FUEL SHIPMENT TO RUSSIAN FEDERATION

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ABSTRACT

The Nuclear Research Institute Řež plc (NRI) jointed the Russian Research Reactor Fuel Return (RRRFR) programme under the US-Russian Global Threat Reduction Initiative (GTRI) initiative and started the preparation of the spent nuclear fuel (SNF) shipment from the LVR-15 research reactor back to the Russian Federation (RF). The transport of 16 ŠKODA VPVR/M casks with EK-10, IRT-2M 80 %, and IRT-2M 36% fuel types is planned for the autumn of 2007. The paper describes the experience gained so far during the preparatory works for the SNF shipment (facility equipment modification, cask licenses) and the actual preparation of the SNF for transport, in particular its checking, repacking in a hot cell, loading into the VPVR/M casks, drying, manipulation, completion of the transport documentation, etc., including its transport to the SNF storage facility at the NRI before it is shipped to the RF. The paper also briefly describes a regulatory framework for these activities with a focus on legislative and methodological aspects of the return of vitrified waste back to the Czech Republic.

1. INTRODUCTION

The VVR-S reactor started its operation in 1957. The original EK-10 fuel was made up of rods of a 10 % enriched uranium dioxide-magnesium alloy in aluminium cladding. The fuel assembly (FA) consisted of 16 rods in an aluminium casing.

In 1974, the IRT-2M fuel with 80 % enrichment was introduced. This consisted of 4 or 3 concentric square rings of uranium/aluminium alloy fuel/metal clad on either side with aluminium. In 1996, the IRT-2M fuel with 36 % enrichment and used uranium dioxide was introduced.

2. HISTORY OF SNF MANAGEMENT

In the years 1969 – 1975, EK-10 SNF was transferred from the reactor site to the Reloading Site. SNF was held in dry storage drums. The SNF was then transferred to the High Level Waste Storage Facility (HLWSF) between the years 1996-7 (see Fig. 1, Fig. 2). According to the period of storage, the character of construction materials of drums (carbon steel drum filled with concrete, carbon steel liner) and the possible interaction of the drum material with aluminium cladding, corrosion of the cladding had to be taken into consideration. It was decided to repack all EK-10 SNF into canisters.

Fig. 1: Temporary storage of drums with EK-10 SNF in the HLWSF

Fig. 2: View inside one EK-10 storage drum after plug removal

The new hot cell had been constructed in the HLWSF and EK-10 SNF was repacked into stainless steel canisters, hermetically sealed (welded) (see Fig. 3), put into a cask basket and then stored in a special storage facility located close to the hot cell. SNF repacking started in 2006 and was completed this year. Additionally, some leaked IRT-2M FAs were repacked in the hot cell.

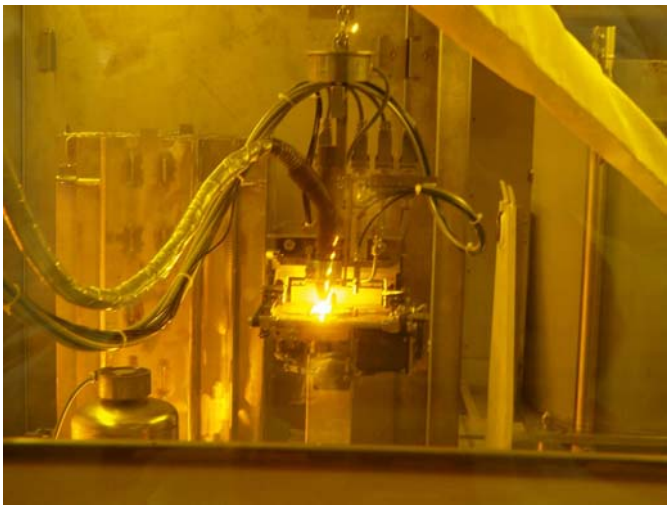

Fig. 3: Welding of the canister with the EK-10 FA inside the hot cell

The most of IRT-2M fuel was moved out of the initial AFR pool in the reactor building into the HLWSF pool between the years 1996 – 2003. The ŠKODA 1xIRTM transport cask for one FA was used. This cask was also used for the transport of 2 leaky FAs from the reactor site to the HLWSF facility.

3. THE CZECH REPUBLIC`S PARTICIPATION WITHIN THE GTRI PROGRAM

The Czech Republic was included into the GTRI program in 2004. In 2005, the contract between US DOE and the NRI was signed. In Fig. 4 there is the structure of the GTRI program and the participation of the Czech Republic.

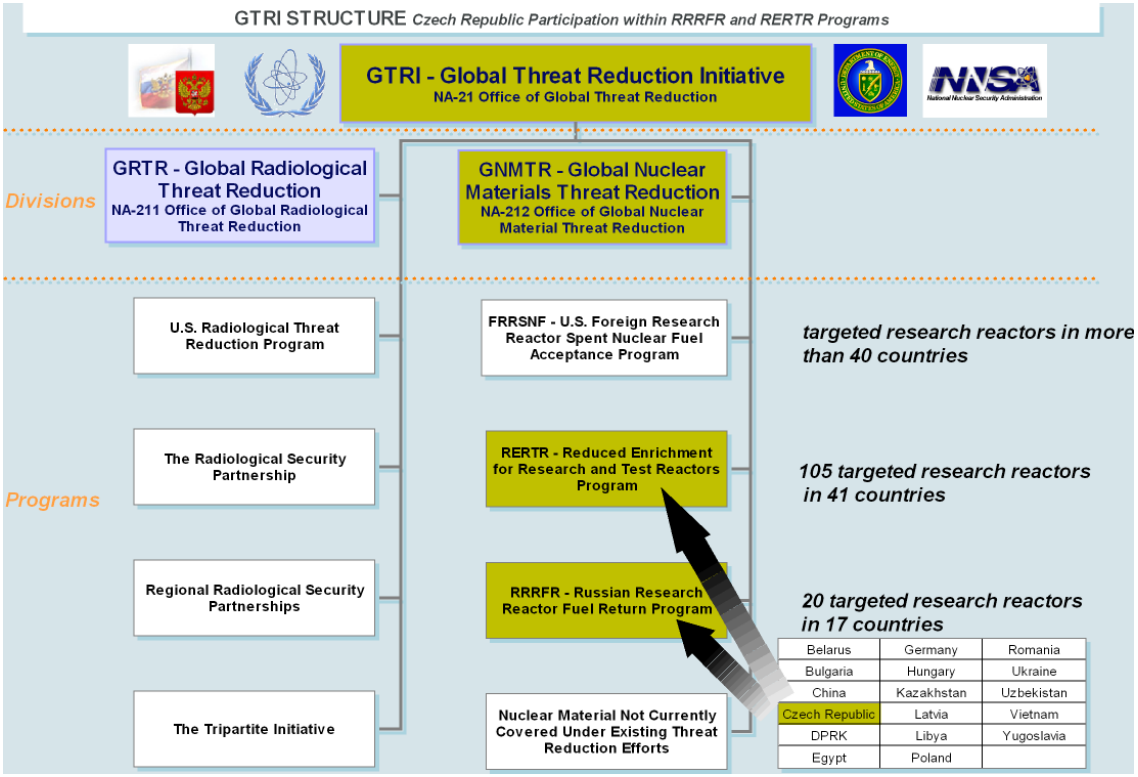

Fig. 4: GTRI structure and participation of the Czech Republic

4. PREPARATION OF THE SHIPMENT

Preparation and implementation of the shipment of HEU SNF are very demanding and highly professional problems requiring cooperation of a number of organizations. With the significant technical and financial aid of the US Administration and the US DOE (total of approximate CZK 450 mil.), the Czech Republic shall become a pilot country, which will carry out such shipment from the NRI to the RF by means of special developed and tested casks, which are compatible with the technology of research reactors of Russian design as well as the technology of the reprocessing plant in the RF.

Tender for such casks took place under the auspices of IAEA. Six famous manufacturers from the USA, RF, Germany, France and the Czech Republic participated therein. The ŠKODA JS a.s., which ensured manufacture of 16 casks, development of which was initiated 10 years ago by ŠKODA JS a.s. and the NRI under the auspices of the Ministry of Industry and Trade of the Czech Republic, was chosen as a supplier. Six ŠKODA VPVR/M casks were purchased by the NRI for shipment of LEU SNF; ten casks for shipment of HEU SNF were purchased by the US Administration (approximately USD 4 mil.) and by gift provided to the NRI provided that the NRI shall provide these as well as its casks for the RRRFR program. Once the shipment of SNF from the NRI is carried out, all 16 casks will be further used for return shipments of SNF from other countries to the RF by agreement between the NRI and the US DOE taking account of experience of the NRI from preparation and implementation of the transport from the Czech Republic to the RF.

In the following table, there is a list of all contracts, agreement and licenses necessary for SNF transport and reprocessing (as of the middle of September 2007). Some activities have not been concluded yet (blue and yellow coloured).

Tab. 1: List of activities (documentation, contracts, licences)

	US DOE	Czech Republic	Russian Federation	Slovakia	Ukraine	ESA
USA - RF GTRI Agreement	27-May-04 (valid)		27-May-04 (valid)			
NRI-DOE(NNSA) Contract	7-Mar-05 (valid)	7-Mar-05 (valid)				
CR-USA DipNote exchange	27-Apr-07 (valid)	27-Apr-07 (valid)				
CR-USA Min-to-Min Agreement	17-Sep-07 (valid)	17-Sep-07 (valid)				
Gov-to-Gov Agreement		04-Dec-94 (valid)	04-Dec-94 (valid)			
Gov-to-Gov Transport Agreement		14-Mar-98 (valid)	14-Mar-98 (valid)	14-Mar-98 (valid)	14-Mar-98 (valid)	
NRI - MAYAK Unified Project Contract		13-Jun-06 (valid)	13-Jun-06 (valid)			
Technical Conditions (MT, RB)		14-Sep-07 (valid)	***? (RB, MT)***	17-Sep-07 (valid)	***? (RB, MT)***	
NRI-TENEX Foreign Trade Contract		08-Aug-07 (valid)	08-Aug-07 (valid)			27-Aug-07 (valid)
Package Design License		16-Feb-07 (valid)	22-Dec-05 (valid)	02-May-07 (valid)	07-Aug-07 (valid)	
Transport Permission		28-Jun-07 (valid)	03-Aug-07 (valid)	10-Aug-07 (valid)	***? (SNRCU, Exp. Con.)***	
SK-UA border physical protection exchange				08-Aug-07 (valid)	***? (MI)***	
UA-RF border physical protection exchange			***? (MI)***		***? (MI)***	
Agreement with Carrier		24-May-07 (valid)	08-Aug-07 (valid)	24-May-07 (valid)	14-Aug-07 (valid)	
Insurance for Nuclear Damage		28-Jun-07 (valid)	08-Aug-07 (valid)	28-Jun-07 (valid)	28-Jun-07 (valid)	
Czech Export License		28-Aug-07 (valid)				
Russian Import License			30-Aug-07 (valid)			
RF Prime Minister`s Decree			***? (Gov)***			
Czech guarantee letter (RW return)		28-Aug-07 (valid)				
Russian guarantee letter (non-proliferation)		21-Aug-07 (valid)				
Transport documentation completed		***expected 5-Oct-07 (NRI+DMS)***	***expected 5-Oct-07 (NRI+MAYAK)***	***expected 5-Oct-07 (NRI+DMS)***	***expected 5-Oct-07 (NRI+IZOTOP)***	
Shipment		***30 days before the shipment, MAYAK is informed that all documentation is complete***				

5. ŠKODA VPVR/M TRANSPORT AND STORAGE CASK

The ŠKODA VPVR/M cask (see Fig. 5) is a type B(U) and S cask system designed and licensed for the transport and storage of SNF of Russian origin research reactors.

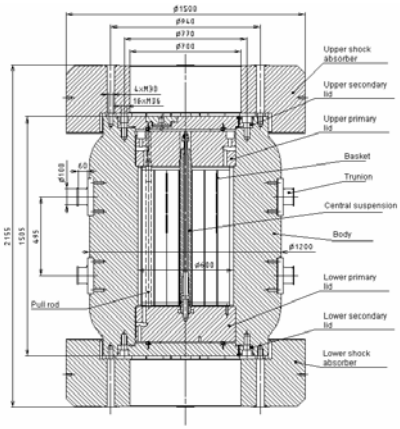

Fig. 5: Scheme of the VPVR/M transport and storage cask.

Fig. 6: Manipulations in the manipulation frame

The VPVR/M cask loading procedure is divided into following activities:

- Cask transport in the ISO container to the SNF loading site
- Dismantling the cask in the manipulation frame (see Fig. 6)
- Transport of the cask to the SNF storage facility (pool, hot cell)
- Putting the basket inside the loading facility (pool, hot cell)
- Loading the SNF into the basket, basket retraction into the cask
- Flushing of the cask with hot air, desiccation of the cask
- Cask completion, helium leaking test
- Cask sealing by IAEA and EURATOM seals

The specially designed basket handling tool is used for lowering the basket from the cask into the storage pool (see Fig. 7, Fig. 8). The basket is filled manually with the FAs by a special manipulation rod.

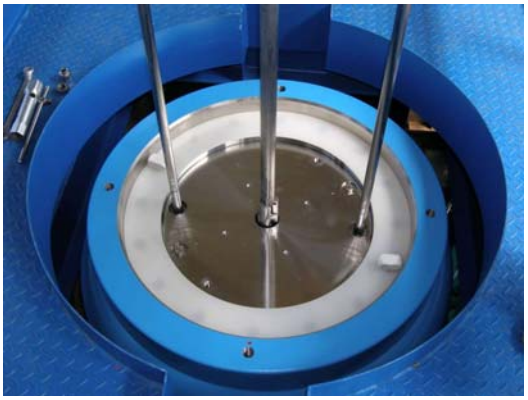

Fig. 7: The attached central suspension/hanger and centring fixture pull rods

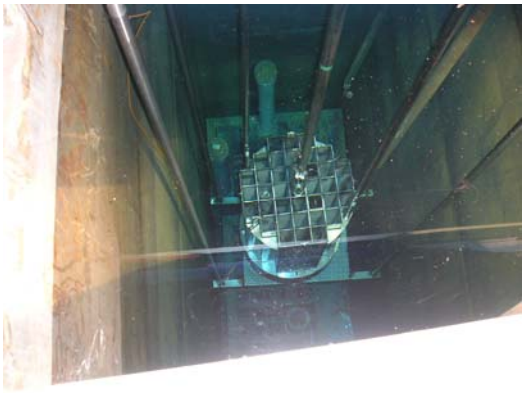

Fig. 8: Basket with lower lid in the storage pool

The crane and lift fixtures are equipped with a digital dynamometer that is used to monitor the weight of the basket during reinstallation into the cask. It prevents the disruption of the central suspension/hanger.

6. DEMONSTRATIONS OF SNF LOADING

The VPVR/M cask underwent three demonstrations to verify that the design was acceptable technically, for handling and loading SNF at the research reactor facilities, and receipt and unloading at the Mayak facilities in RF. The demonstrations were held at the ŠKODA, NRI and Mayak facilities. The following sections provide a summary of those demonstrations.

Demonstration of the VPVR/M cask at ŠKODA Manufacturing Facilities

The first demonstration was required by the DOE technical team to verify that the VPVR/M cask design was technically acceptable for use by the RRRFR Program. The demonstration was conducted in Plzen, the Czech Republic, at the ŠKODA JS company. The demonstration included a leak test, cask manipulation operation, simulating the unloading of the fuel basket at MAYAK (see Fig. 9), loading the SNF, and demonstrating the accidental failure of the central suspension/hanger resulting in the drop of the full basket.

Wet Run in the NRI Rez plc

The purpose of the NRI "wet run" was to: demonstrate that the handling equipment worked properly at the reactor site and at the HLWSF; demonstrate the detailed operating procedures; provide training for the NRI technicians; dry and seal the cask and prepare the cask for transport and loading it into the ISO container. The "wet run" was observed by representatives from the USA, Ukraine, Poland, Russian Federation, Bulgaria, Slovakia, and various organizations from the Czech Republic.

Mayak Dry Run

The third demonstration was performed at the Federal State Unitary Enterprise (FSUE) Mayak Production Association facilities, in Ozyorsk (see Fig. 10). The purpose was to demonstrate the set-up of the cask handling and auxiliary equipment at the Mayak facilities; demonstrate that the detailed operating procedures were complete and operational; training of the Mayak technicians; and performing cask maintenance in preparation for loading the empty cask for transport and loading it into the ISO container, tying it down, and returning it to the originating facility. The dry run was attended by representatives from the Czech Republic (NRI and ŠKODA JS), DOE, FSUE "Mayak", "Sosny" R&D Company, and Rosatom.

Fig. 9: Basket being lifted out of the cask using the central suspension/hanger

Fig. 10: Basket inside the modified Mayak storage pool fuel handling cart

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