Main Results of Feasibility Study of Lepse Remediation. Plans of Future Work

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The Lepse service ship is one of the most nuclear and radiation hazardous ship in the North-West of Russia. Currently, the ship is laid up at the Atomflot facility. The Atomflot facility is located 1.8 km outside city of Murmansk.

639 spent fuel assemblies are stored in the storage compartments of the ship (in canisters and in caissons). Some of spent fuel assemblies are damaged. Liquid and solid radwaste is also stored on this ship.

Radiation environment on the Lepse does not allow that the crew members stay onboard, and her safety is ensured by an onshore watch which regularly make their rounds of the ship and continuously conduct the radiation monitoring of the ship with the help of sensors mounted on the ship and connected to an onshore monitoring station.

In 1999 it was decided to converse the Lepse to a non-propelled floating temporary spent fuel storage ship. To this end the hull of the ship was surveyed in the dock of the Nerpa ship repair yard. The wear of the ship's hull and structures was nearly 16-30 %.

The Lepse is been maintained in good technical condition. Taking into account the results of the last technical inspection and natural process of the hull and the hull structures wear, the amount of financing to maintain working order will only grow in time.

In 2005 the Rosatom and Rosmorrechflot made up a decision to contract Aspect-Conversion Company to develop a design for the overall remediation of the Lepse service ship. According to the Contract TACIS 2003/007-254 between Aspect-Conversion and the European Commission a package of design and organizational documentation (PDOD) for overall Lepse ship remediation have been developed from December 2005 to April 2007. The following organizations participated in the project under the leadership and coordination of the Aspect-Conversion: OKBM, VNIIPIET, Onega NIITB, TsNIITS, Krylova TsNII, Atomflot, Nerpa Shipyard, NII PMM, and MSCO.

In June 2006 the conceptual studies of the Lepse remediation options were completed and a single work plan was selected and approved by the group of international experts. In choosing the most appropriate options of Lepse remediation the earlier developed solutions were used for bringing the Lepse into an environmentally safe condition, including the engineering concepts suggested by the French company SGN and the British AEA/T within the TACIS Programme in 1997.

The option for Lepse remediation was selected based on the following criteria:

1. Applicability
2. Personnel safety, safety of population and the environment.
3. Cost and completion date.

In the course of conceptual studies of the option for SNF management at Lepse ship, the results of relevant Western and Russian researchers have been evaluated, and the experience

gained from remediation activities at similar facilities in Russia has been used. The review of normal working conditions and consequences of the most severe accidents occurred during SNF recovery from the Lepse storage compartments has shown that the safest place for the work to be performed taking into account environmental impact and population safety would be the Nerpa shipyard site. This provides for the following:

1. Probability of radioactive contamination and radiation exposure to Murmansk inhabitants is completely ruled out.
2. Necessity to maintain the Lepse buoyancy is completely ruled out, which is a quite complicated task considering very close location of the ship (about 400 meters) by the navigable waterway of the Kola Bay.
3. Conditions and the safety of defuelling operations improve as Lepse rests on a solid basement (neither pitching, nor listing occur).
4. Necessity to carry out huge amount of repair works in order to replace outer casing and hull structures in the area of nuclear fuel storage is eliminated.

Organizational technological schedule of the project implementation developed as a part of PDOD for comprehensive dismantlement of the Lepse ship consists of the following main phases:

1. Development of a detailed design (working and design documentation).
2. Preparation of the ship for towing to Nerpa shipyard, decontamination of the SNF storage compartments and repairing the SNF handling equipment.
3. Preparation of a special-purpose auxiliary infrastructure at Nerpa shipyard (controlled area, sanitary passes, lifting cranes, power supply, etc.). Procurement of standard equipment, design, development and fabrication of specialised equipment intended to unloading and transportation of SNF and radwaste.
4. Design and construction of an annex to a land-based spent fuel storage facility (Building # 5)at Atomflot site for storing non-reprocessable spent fuel.

Note: Building # 5 is an SNF cask storage facility refurbished at Atomflot base in 2006 under the UK funding within the frame of the Global Partnership Programme. This facility is a vivid example of successful implementation of an international project.

5. Towing the Lepse service ship to Nerpa shipyard and position on to the open slipway.
6. Dismantlement of the hall structures and equipment, forming the SNF storage block and a station for cask loading; construction of a protection shelter.
7. Discharge of spent fuel from the Lepse storage compartment with the use of the TV equipped remotely controlled equipment at the extend possible. Loading of spent fuel assemblies (SFA) and canisters with SFA into TUK-18 or TUK-120 casks at the cask loading station.
8. Shipment of casks from Nerpa shipyard to Atomflot base on board of the Lotta service ship.
9. Placement of casks for interim storage in the annex to Building # 5 or shipment of spent fuel to Mayak Reprocessing Plant.
10. Treatment of liquid and solid radwaste and its placement for long term storage.
11. Forming two large-scale block-packages out of the Lepse service ship (SNF storage compartment and a liquid radwaste storage compartment).
12. Shipment of the waste block-packages to the Sayda Bay long-term storage facility.

The selected option for comprehensive dismantlement of the Lepse ship and ANF and radwaste management has been agreed with Rostechnadzor, Murmansk Region Administration and Murmansk Shipping Company and approved by Rosmorrechflot, Rosatom, and Rosprom via joint decision of 7 June 2006. This work organisation scheme

would enable to minimize a probable spread of radioactivity outside the containment. Additional transport operations with SNF transfer and transportation casks within the area of operation is also ruled out.

Radiation safety under normal defuelling operations both for personnel and for population is ensured according to the valid radiation safety standards. The maximum effective dose for population due to release of radionuclide into the environment under normal SNF discharge operations at the border of the nearest town (Snezhnogorsk) is less than 0.1 % of the natural radiation background.

For design basis accidents no radiation effect on population takes place during SNF extraction from the storage.

Maximum annual effective dose for population at the border of Snezhnogorsk town (2,7 km away from the point of probable radioactive release) in case of postulated aircraft accident during SNF discharge is 8,0 mSv, which according to NRB-99does not require evacuation of population and taking protective measures that interfere with normal life of population.

Reduction of possible radioactivity releases into the environment during spent fuel unloading is provided by:

- location of the Lepse storage block formed in a special shelter, i.e. building a protective barrier on the radioactivity pathway to the environment;
- air cleaning with high-effect filters before its release into atmosphere (efficiency of air cleaning from radioactive air soles is more than 99.99%);
- local air suction in the working area followed by its cleaning in entire ventilation system of the shelter.

Materials of PDOD have been examined and approved by the following authorities:

1. Federal Medical and Biological Agency – sanitary and epidemiology conclusion No. 77 GU.01.000.T.000049.12.06 of 26 December, 2006.
2. State Projects Review of the Russian Emergency Ministry – expert evaluation No. GEP-03-07/31 of 5 February 2007.
3. Office of safety regulation of research and marine nuclear installations, and radiation-hazardous facilities of Rostechnadzor – letter of 10 January 2007 No. 08-43/4.
4. Federal Water Resources Agency – conclusion of Aquainfoteka of 7 February 2007 No. 46/22-13.
5. Office of nuclear and radiation safety of Rosatom – conclusion No. 07-001 of 12 January 2007.
6. State Fire Service of the Russian Emergency Ministry - letter of 26 November 2006. No. 3126-06.

Public hearings of the Project documents related to environmental impact assessment (EIA) during Lepse defuelling were held on 26 February 2007 in the town of Snezhnogorsk. These EIA documents were approved of by the participants of the hearings (minutes of meeting of March 5, 2007.). All above mentioned authorities confirmed that the PDOD has been developed in compliance with the standards of radiation and environmental safety and are sufficient to launch implementation of industrial phase of the Lepse dismantlement project.

Technical and economical indicators of the project show according to estimates obtained during development of PDOD that the project can be implemented in 48 months with a total contract value of 43,5 million Euro (1500 000, 0 rubles as of 01.10.2006).

On 25 July 2007 a decision was made to accept PDOD as a basis for beginning of the industrial Lepse dismantlement Poject. The decision was agreed with the Governor of the Murmansk Region and with Rostechnadzor of RF and approved by Rosmorrechflot, and Rosprom. It was decided also to continue further cooperation between contractors led by Aspect-Conversion in succeeding phases of the Project.

The technical solutions developed in PDOD:

- comply with Russian regulatory documents and basic international requirements;
- ensure safe spent fuel and radwaste management;
- are feasible with use of infrastructure built in the Murmansk Region for nuclear submarine dismantlement and spent fuel and radwaste management with its minimal upgrading.

Feasibleness of technical solutions of the PDOD is ensured by involvement of organizations having experience in nuclear submarine dismantlement and in spent fuel and radwaste management. The overall remediation of the Lepse service ship is a priority task related to elimination of the most radiation-hazardous facilities in the Russian North-West. This priority is confirmed by the Strategic Master Plan, developed on request of Northern Dimension Environmental Partnership (NDEP) fund.

The Concept Design and the PDOD developed under the contract TACIS 2003/007-254 between Aspect-Conversion and European Commission enable to lunch the industrial phase of the project in compliance with the Russian regulations.

It is suggested to implement the project by individual large subprojects. It is expedient to start the work on the following subprojects during 2007-2008:

1. Develop of detailed design documentation.
2. Prepare Lepse ship to be towed to Nerpa Shipyard.
3. Purchase of process equipment.
4. Prepare relevant infrastructure at Nerpa Shipyard.