DRAFT REPORT - REVISION A

Central Spent Fuel Storage Facility Review of Decommissioning Plans

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Acronyms and Abbreviations

CSFSF	Central Spent Fuel Storage Facility
EA	NNEGC EnergoAtom
EIA	Environmental Impact Assessment
HI	Holtec International
MPC	multipurpose container
NPP	nuclear power plant
SFA	Spent Fuel Assembly
SNF	spent nuclear fuel
VVER	water-water energetic reactor

1.0 Introduction

1.1 Project Background and Report Scope

In December 2005, NNEGC EnergoAtom (EA) signed an agreement with the United States (U.S.)-based Holtec International (HI) to implement the Central Spent Fuel Storage Facility (CSFSF) project for Ukraine's water-water energetic reactors (VVERs). HI's scope of work involves design, licensing, construction, and commissioning of the facility, and the supply of transport and vertical ventilated dry storage systems for spent VVER nuclear fuel. In October 2011, parliament passed a law related to management of spent nuclear fuel (SNF), which was approved in the upper house in February 2012. The law provides for construction of the dry storage facility within the Chernobyl-exclusion area, situated between the evacuated villages of Buryakivka, Chystohalivka, and Stechanka in Kiev Region, southeast of Chernobyl. Ukraine requires all spent fuel to be stored in double-wall, multipurpose canisters.

In April 2014, the government approved the 45-hectare site for the facility to take fuel from the Rivne, South Ukraine, and Khmelnytska nuclear power plants (NPPs). Fuel from Zaporizhzhya NPP is currently managed at an onsite dry storage facility and will not be taken to CSFSF. The total storage capacity of the facility will be 16,529 used fuel assemblies, including 12,010 VVER-1000 assemblies and 4,519 VVER-440 assemblies.

The scope of this report is to review the information available regarding decommissioning of equipment and the CSFSF facility with respect to protection of the environment:

- Aging Management: Decommissioning of damaged or aging equipment over the operational life of the CSFSF (expected to be 100 years).
- Post-Closure Decommissioning: Decommissioning of the CSFSF facility in its entirety after operations cease.

The Environmental Impact Assessment (EIA) does not consider the impacts of decommissioning in detail (EnergoProjekt, 2016a); therefore, this report is intended to be a companion document to the EIA.

1.2 Approach and Methodology

The approach taken in this report was to review the available documentation and provide a summary of the information presented regarding decommissioning. The list of documents reviewed can be found in the reference section and the documents themselves are included in Appendix A.

2.0 Results

2.1 Technology

The proposed method for transferring and handling the spent fuel assemblies (SFAs) is similar to what is already in place at the NPPs for both preparing and transporting the SFA to Russia, while the storage system for the SFA at the CSFSF is similar to what is being implemented at the Zaporozhye NPP. The HI technology selected for the CSFSF allows for the full spectrum of handling and managing the SFA over a long-term period.

A key feature of the HI system is the multipurpose containers (MPCs) that can be interchangeably set within a transport overpack (HI-STAR) or a long-term storage module (HI-STORM). The MPCs will be loaded with SNF at each NPP and transported to the CSFSF via rail using the HI-STAR overpack on a specialized rail car, as part of cargo train. At the CSFSF, the MPCs will be transferred from the HI-STAR overpack and placed in a long-term storage module (the HI-STORM). The HI-STORM units will be housed on concrete pads at the CSFSF and monitored over the life of the facility.

2.2 Aging Management of Equipment

The HI-TRAC transfer cask, HI-STAR transport overpack, and HI-STORM storage overpack are passive equipment, and the HI-STORM storage yard does not require a power supply for safe storage. During the operational life of the CSFSF, these systems require only minimal maintenance mainly due to environmental conditions at the storage facility site.

The HI-STAR units are intended to be reused for shipment and will have an inspection program to ensure they are not damaged before being reused. The HI-STORM units are designed for long-term storage at the CSFSF. Surveillance activities will verify that the air vents (covered by fine mesh steel grids) on the HI-STORM storage overpacks are clear to allow passive convective cooling. Inlet vents will be monitored and cleaned of dust, snow, or other blockages; outlet vent ports will be similarly monitored and maintained. A continuous temperature monitoring system will be implemented to remotely monitor the air temperatures in the inlet and outlet vents of HI-STORM. Significant change in the temperature at the top of the unit, where the convection air currents leave the unit, could indicate blockage of the HI-STORM inlet vents or that the MPC is leaking. In addition, temperature monitoring of the surface of the HI-STORM units will occur on a periodic basis. Temperature sensing equipment will require periodic maintenance and replacement over their life (EnergoAtom, 2009).

In the event of leakage from an MPC, the canister can be transferred from the HI-STORM storage overpack to the HI-STAR transport overpack and sent back to an NPP for repackaging. The containment provided by the HI-STAR allows for interim storage of the MPC until it can be repackaged. The processes to manage and ship the MPC and the HI-STAR will be established with normal operations. An event that requires an MPC to be removed from a HI-STORM and shipped back to a NPP would follow the same procedures in reverse (EnergoAtom, 2009).

2.3 CSFSF Facility Decommissioning

Current Ukrainian legislation sets out general decommissioning requirements for nuclear facilities (NP.306.1.02/1.004-98). The basic requirements for decommissioning are as follows:

- Ensure low risk levels for both personnel and the environment
- Minimize radioactive waste production during the decommissioning process
- Minimize economic costs

At present, the plan for final SNF disposition has not yet been decided. The Investment Feasibility Study (EnergoAtom, 2007) considers relicensing of the CSFSF and the potential need for construction of a facility for long-term storage or disposal SNF. However, even if the CSFSF license is extended, a decision will need to be made regarding disposition of SNF.

Once the CSFSF is slated for closure and a disposition path for SNF has been decided, a decommissioning work plan will be developed based on the final decision regarding SNF and the facility (EnergoAtom, 2007). The work plan is required to be a separate design task and will include the following main topics: decommissioning goals and strategies; an assessment of the types and quantity of radioactive waste that will be generated; and a recommendation for management of the generated waste. Regulations require the decommissioning strategy consider items such as, but not limited to (EnergoAtom, 2007):

- Radiological levels

- Integrity of the facilities
- Current legislative and regulatory requirements
- Management of radioactively contaminated wastes that are generated, including collection, conditioning, temporary storage, transfer, and disposal
- Availability of decontamination and dismantling method and technology
- Availability of trained and experienced personnel
- Availability of the necessary financial resources
- Intended use of the facility
- Environmental impact assessment
- Social factors

Safety during CSFSF decommissioning will be based on minimizing radiation exposure to personnel, the public, and the environment, as set forth in the regulatory requirements. The design of the CSFSF includes measures to minimize not only radiation exposure but also generation of radioactive waste and contamination of equipment. The dry storage system that will be employed at the CSFSF minimizes generation of liquid radioactive wastes. Because the SFAs are stored in sealed MPCs, the potential for contamination of the long-term storage units (HI-STORMs) and for radiation exposure of personnel during decommissioning will be minimal. The use of cask storage also limits the possibility of contamination of large areas, even in the event of depressurization of individual MPCs (EnergoProjekt, 2016b). The storage yards and the overpacks themselves are easily decontaminated both during the operational life and the decommissioning process. The selected technology is a passive system that does not require the use of toxic and other potentially hazardous non-radioactive substances. The radiation dose rates during normal operations will be lower after SFA are removed from the site.

Management of any radioactive waste during decommissioning will be handled based on the waste type (EnergoAtom, 2007). Liquid radioactive waste will be removed from the CSFSF by tanker and treated at the Chernobyl NPP or other processing facility. Low-level solid radioactive waste will be removed from the facility by specialized transport for reprocessing at Chernobyl or the adjacent planned Storage and Disposal Facility (also known as Vector). Any intermediate solid radioactive waste would also be removed and transported by specialized equipment for either reprocessing or disposal. Generation of high-level radioactive waste during the CSFSF decommissioning is not expected.

2.4 Decommissioning Financial Reserve

International rules and regulations stipulate that EA must provide assurance that funding will be available to decommission the CSFSF at the end of operational service. The amount of funding is determined during the commission phase of the facility, and contributions will be made to a decommissioning financial reserve during the operational life of the facility.

The Investment Feasibility Study (EnergoAtom, 2009) estimates CSFSF decommissioning to be UAH 429.85 million. Contributions to the decommissioning financial reserve in this amount (or the amount verified during commissioning) will be made during the period of the active operation of the CSFSF (Ministry of Energy and Coal Industry of Ukraine, 2015).

3.0 Summary and Conclusions

The review presented herein shows that the aspects of decommissioning the CSFSF have been considered in the planning and design of the facility. Decommissioning includes aging management and maintenance of equipment, as well as the eventual facility decommissioning. The selected technology facilitates both aging management and maintenance of equipment, as the SNF is contained within a sealed container (the MPC) that can be transferred as required to overpacks. The procedures that will be implemented to transport SNF to the CSFSF can be used in reverse for handling a damaged MPC unit or to eventually remove the SNF from the facility.

Regulations require that a decommissioning work plan be developed as part of the design of the facility. The decommissioning plan is required to minimize radiological exposure to the personnel and the environment, minimize the production of radioactive waste, and minimize costs. By law, EA is required to provide a financial reserve specifically for facility decommissioning. This ensures that the CSFSF will undergo decommissioning at the end of its service life. As long as the facility is operated and decommissioned in accordance with the governing regulations, potential impacts to the environment during decommissioning are expected to be minimal.

4.0 References

EnergoAtom. 2007. *Centralized Spent Nuclear Fuel Storage Facility (CSNFSF) for VVER-Type Reactors of the Ukrainian Nuclear Power Plants, Investment Feasibility Study, Analytical Summary*.

EnergoAtom. 2009. Translation of the Feasibility Study for Creation of the Spent Fuel Storage Facility of Rivne, Khmelnitsky, and South-Ukrainian NPP (FS CSFSF) (Explanatory Note, Declaration of Ecological Consequences, Volume I Parts 1 – 3, and Volume III Parts 1 and 2.

EnergoProjekt. 2016a. *Construction of the Central Spent Fuel Storage Facility for the VVER Nuclear Power Plants of Ukraine. Vol. 12.1. Environmental Impact Assessment. Part 1 Materials: Edition 1.* 571402.201.012-OBOC01.

EnergoProjekt. 2016b. *Construction of the Central Spent Fuel Storage Facility for the VVER Nuclear Power Plants of Ukraine. Volume 1.1. Explanatory Note. Final.* 571402.201.001-P301

Ministry of Energy and Coal Industry of Ukraine. 2015. Order of the Ministry of Energy and Coal Industry: *Decommissioning Concept for Ukrainian Nuclear Power Plants Currently in Operation*. No. 798, December 10, 2015.

NP.306.1.02/1.004-98. General provisions on safety to be assured as nuclear power plants and test nuclear reactors are decommissioned. Ukraine Ministry of Environmental Safety.

Appendix A
Supporting Documents