

Spent Nuclear Fuel and Radioactive Wastes

What amount of spent nuclear fuel and radioactive waste is expected during the operation of KhNPP-3 and 4?

Amount of SNF that will be generated during the operation of power units No. 3,4 of the Khmelnytsky NPP

In accordance with the revised feasibility study for the construction of power units No. 3, 4 of the Khmelnytsky NPP, during the operation of power units from the core of a reactor of one power unit will be unloaded the following amount of SFA:

- 12 months cycle - 42-48 spent fuel assemblies;
- 18 months cycle – 66 spent fuel assemblies.

There is a temporary scheme of spent nuclear fuel management system is using in Ukraine.

SFAs of power units No. 3,4 of the Khmelnytsky NPP will be kept in the cooling pool for at least 5 years after they are sent for temporary storage (up to 100 years) to the central spent fuel storage facility.

It's expected that roughly 5300 NFA is going to be used during 60 years term of power units №3,4 Khmelnytsky NPP exploitation.

Estimated amount of solid and liquid radioactive waste accumulated during operation of Kh-3,4 units

Low-level RW, cubic meters	Intermediate-level RW, cubic meters	High-level RW, cubic meters
8700	180	12,6

Table 1 – Estimated amount of solid RW during Kh-3,4 operation (60 years)

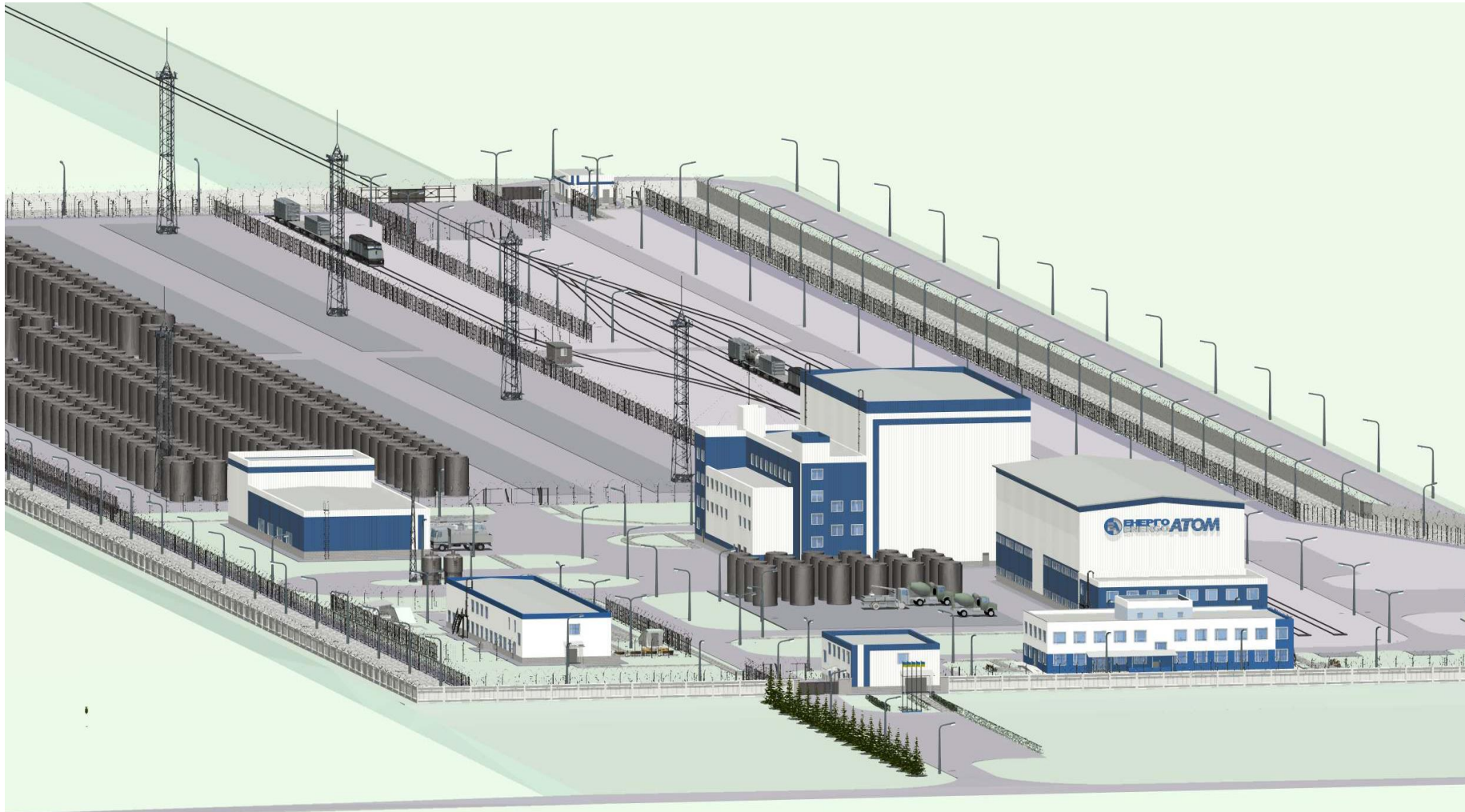
Vat residue, cubic meters	Waste-filter, cubic meters
1740	132

Table 1 – Estimated amount of liquid RW during Kh-3,4 operation (60 years)

❖ **During operation of the power units, solid and liquid radioactive wastes will be processed at the complex for the processing of solid RW / liquid RW, as a result, prior to transfer to the final disposal, their volume will be reduced by 7-10 times and 3-7 times respectively.**

Centralized Spent Fuel Storage Facility status

General view of spent fuel storage facility



Project history (1)

- Earlier
- ✓ 2002 - The Ministry of Fuel and Energy approved the concept of centralized storage of spent nuclear fuel from reactors of nuclear power plants in Ukraine proposed by DP “NAEK“ Energoatom ”with a storage period of at least 100 years.
- ✓ 2003-2004 - An international tender for the construction of a nuclear spent fuel storage facility was held; the offer from Holtec International USA was accepted.
- ✓ December 26, 2005 - A contract for the construction of a nuclear fuel storage facility with Holtec Int. has been signed.
- 2016 – 2017
- ✓ Construction project for the nuclear spent fuel storage facility (order No. 380-p dated 07.06.2017) developed by designer and approved by The Cabinet of Ministers of Ukraine.
- ✓ Holtec International has completed the development of technical projects for basic and auxiliary equipment. for handling spent nuclear fuel of VVER-1000 and VVER-440 reactors. Preliminary approvals have been obtained from the State Nuclear Regulatory Authority Technical Specifications. Main equipment manufacturing began.
- 2018 – 2019
- ✓ Completion of the railway construction. CSFSF construction and installation procedures are performing. Delivery to Ukraine of the Holtec equipment for the 1st start-up complex of the CSFSF.
- ✓ Testing Holtec equipment on power units.
- 2020 (are expected)
- ✓ Completion of the construction of the CSFSF. Individual and complex tests.
- ✓ Acceptance of CSFSF in pilot production.
- ✓ Preparations for the introduction in Ukraine of the production of Holtec Int SNF storage systems.

CSFSF project capacity

The capacity of the nuclear fuel storage facility must ensure the storage of SNF generated at Ukrainian NPPs (including power units No. 3.4 of the Khmelnytsky NPP).

CSFSF project capacity: 12 010 SNFA VVER – 1000;
4 519 SNFA VVER – 440.

Filling the CSFSF with spent fuel to the design volumes will be in 45 - 50 years.

Within the framework of the 1st start-up complex all necessary infrastructure will be built at the site of the CSFSF and 4 SNF storage systems will be installed.

Special equipment for 4 storage systems will be supplied under a contract with the technology owner - Holtec International



CSFSF characteristics

- For the storage of SNF, the technology of surface “dry” storage will be used using two barrier systems for isolating SNF from the environment, which is provided by the equipment of specially designed container-type engineering systems.

- The design of the CSFSF is carried out under a contract with a Ukrainian designer - the Kiev Research and Design Institute "Energoproekt" .
- The design life of the object is 100 years.
- The term of commissioning of the 1st start-up complex is 2020.
- Deliveries of SNF storage systems for 4 PCs (94 pcs.) Will be completed in 2020.
- After commissioning of the start-up complex, the design capacity of the nuclear spent fuel storage facility will be achieved through the production of containers, which will be deployed in Ukraine using US technology.



CSFSF building state (basic objects)

Casks storage ground :



CSFSF building state (basic objects)

Technical service building and MPC storage:



CSFSF building state (basic objects)

Technical service building and MPC storage:



CSFSF building state (basic objects)

Cask accept building (ZPK):



CSFSF building state (basic objects)

Cask accept building (ZPK):
Central block



CSFSF building state (basic objects)

Cask accept building (ZPK) :
auxiliary buildings



CSFSF building state (basic objects)

Administrative building (AB):



CSFSF building state (basic objects)

Security building complex:



CSFSF building state (basic objects)

Physical border (SFZ):



CSFSF building state (basic objects)

Physical border (SFZ):



CSFSF building state (basic objects)

Garage:



CSFSF building state (basic objects)

Railway:



CSFSF building state (basic objects)

Railway:



Information about Holtec equipment which has been already arrived in Ukraine

- ❖ Received 66 items of equipment manufactured by Holtec.
- ❖ Basic equipment :
 1. MPC-31 (№ 1- 3)- 3 items;
 2. HI-TRAC (Transfer Cask)- 1 item;
 3. HI-STAR cargo - 2 items;
 4. HI-TRAC cargo - 1 item.
- ❖ Auxiliary equipment:
 1. Cask Transfer device;
 2. HI-STORM storage module cargo.



SNF management strategy in case of non exploitation CSFSF and not using geological disposal

- Despite the fact that this scenario is unlikely, since at the moment the implementation rate of the CSFSF project is more than 75%, in case there is no capacity for SNF storage in Ukraine, it will be sent for long-term storage with subsequent processing in the Russian Federation or at the La Hague (the project is under development by the parties - SE "NNEGC Energoatom" and the Orano company).
- In absence of a deep geological storage, the CSFSF project provides the possibility of extending its operational life. The manufacturer of the main equipment of the interim storage facility for spent nuclear fuel is developing methods for aging management of the systems and elements of the interim storage facility for spent nuclear fuel.

What are the plans for the final stage of the nuclear fuel cycle? Is the possibility of reprocessing spent nuclear fuel in Russia considered?

Are there any plans of international partnership in the framework of final geological disposal of nuclear spent fuel and/or radioactive wastes?

Geological disposal of SNF and High-level wastes international cooperation

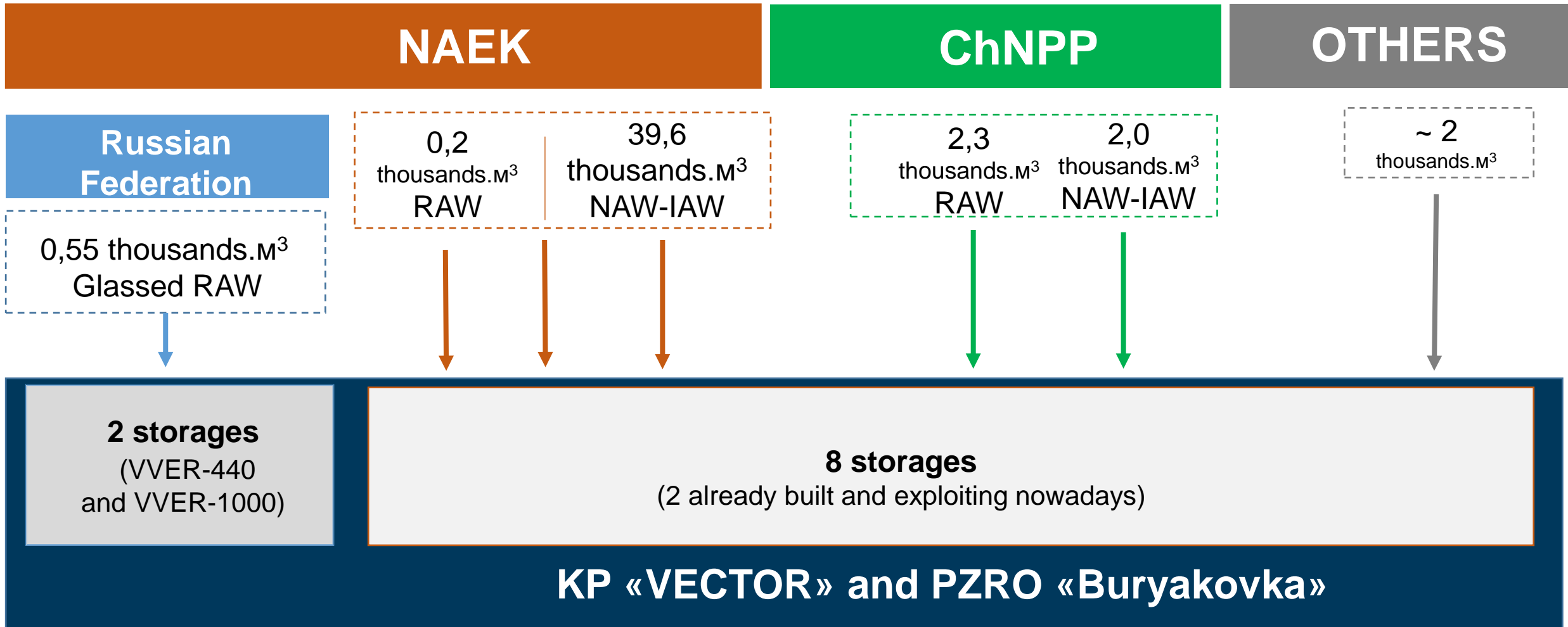
In the framework of the international project INSC - U4.01 / 14B “Development of a National Plan for the Geological Disposal of Radioactive Waste in Ukraine and the Schedule for its Implementation”, which is carried out as part of the cooperation instrument in the field of nuclear safety (INSC) between the EU and Ukraine:

- determining a process that will allow the selection of a technically suitable and socially acceptable site for the placement of a deep geological burial;
- development of a detailed plan and cost estimate for deep geological disposal in Ukraine;
- safety area specialists training, safety studies, program management, etc., in relation to the development of a deep geological storage;
- forming a positive public attitude to the process of choosing a site for locating a geological storage in Ukraine, taking into account the international practice of creating such objects.
- The beneficiary of the project is the State Agency of Ukraine for the Management of the Exclusion Zone (GAZO), the contractors are such well-known organizations: ANDRA (France), BGE TECHNOLOGY GmbH (Germany), SKB International (Sweden).

Currently, Task 2 is being carried out: “Current state review of affairs and input data to create a deep geological storage”.

What temporary and final storage facilities for radioactive waste are operated in Ukraine, will they be sufficiently large for the disposal of all radioactive waste generated from the operation of KhNPP-3 and 4?

Radioactive wastes volumes and flows in Ukraine



HAW MANAGEMENT SYSTEM IMPROVEMENT

DONE

The targeted use and accumulative nature of the State Fund for RW Management has been restored. The procedure for the use of this fund was approved, which allowed construction of facilities for radioactive waste management in 2018.

IN PROCESS

Improving the classification of radioactive waste, which will reduce the burden on the state budget by optimizing the safe handling of waste :

- *Law project passed the first reading in the Verkhovna Rada of Ukraine (registration number 6089 of 02/15/2017).*
- *Creating a territory of special industrial use within the exclusion zone, which will optimize the safe disposal and storage of radioactive wastes.*
- *Law project is on the agenda of the 10th session of the 8th Verkhovna Rada of Ukraine.*

COMPLEX «VECTOR»



Construction of the complex began in 1996. Thankfully to the restoration of the targeted use of the Fund of RAO, conditions were created for the completion of the first phase of the complex in 2018.

The only complex in Ukraine that is intended for long-term storage and disposal of radioactive waste from VP ChNPP, DP NAEK Energoatom and other enterprises.



High level wastes management after processing on NPP

Spent nuclear fuel (SNF) from VVER reactors of GP “NAEK” Energoatom ”is currently exported for technological storage and processing to enterprises of the Russian Federation (FGUP“ PO “Mayak” and FGUP “PO“ GHK ”). The radioactive waste received after the reprocessing of spent nuclear fuel, as well as valuable reprocessing products (during reprocessing of VVER-1000 SNF) must be returned to Ukraine. The return of processed products to Ukraine will be subject to the conditions and terms that are determined by the relevant contracts.

The expansion of infrastructure for handling vitrified high level radioactive waste (VAO), which will be returned to Ukraine, accordingly to:

- **“Nationwide ecological program of radioactive wastes management”.**
- 04.04.2019 President of Ukraine Petro Poroshenko signed **Decree №104/2019**. Paragraph 8 provides financing of building storage and infrastructure which are necessary for long-term storage and further burial of high-level wastes of nuclear spent fuel and other NPP’s wastes.

High level wastes management SNF VVER-440

- “Calculating methodic of amount high-level wastes which will be returned in Ukraine after storage and processing spent fuel assemblies VVER-440” has been agreed between Ukraine and Russia regulating agency and setups amount of wastes which will be returned to Ukraine.
- According to “Nationwide ecological program of nuclear radioactive wastes managing” has been planned building of storage on complex “Vector” for intermediate long-term storage (100 years).
- Storage represent of itself ground with sections where MPC will be storage in concrete casks and cooling with natural convection of air flow.
- Project capacity of storage calculated for high-level wastes storage with corresponding stock. According to the project storage exploitation stars in 2020-2021.

High level wastes management SNF VVER-1000

- Spent fuel assemblies of VVER-1000 will be processed in Russia and processing starts after 2025.
- Processing wastes will be returned to Ukraine for long-term storage and burial according to agreements.
- Vitrified high-level radioactive wastes, solid high-level wastes, concreted wastes of NSF VVER-1000 processing will be returned in Ukraine.
- Valuable products of NSF VVER-1000 processing will be returned in Ukraine, it will be represented as mixed dioxides of Plutonium and Uranium and Uranium oxide brand B as well.
- There is a preplan for creating a geological burial for storage of high-level wastes of VVER-1000 and VEER-440 in future.

GLASSED VVER-440 HAW STORAGE



Exploitation term – 100 years

Construction, the commissioning of the storage and infrastructure in time will avoid the payment of penalties to Russian Federation for exceeding the storage period.

At the moment, the design cost of the storage is 5.9 billion UAH.

Over-storage in the Russian Federation will result in significantly higher penalties.

Implementation state :

A storage facility project has been developed for the intermediate storage of VAO, which will be returned from the Russian Federation after the reprocessing of spent nuclear fuel from Ukrainian VVER-440 water-cooled power reactors in. Facility project is currently undergoing examination.

**THANK YOU
FOR
ATTENTION**