

**ARMENIAN SCIENTIFIC-RESEARCH INSTITUTE
FOR NUCLEAR POWER PLANT OPERATION**

ARMATOM, CJSC
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**Status of Nuclear Legacy Facilities in the
Republic of Armenia**

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The Armenian NPP consists of 2 power units, the design life is 30 years. The Armenian NPP is the first nuclear power plant in the USSR built in a region with high seismicity.

Therefore, significant changes were made to the basic project V-230 (VVER-440), ensuring the integrity of the reactor plant equipment and safety systems during seismic events, as well as significantly increasing the seismic resistance of the building structures in which this equipment is located. Accordingly, the reactor was assigned a new identifier - V-270.





After the earthquake in 1988, as a preventive measure, in 1989, by the Decision of the Council of Ministers of the USSR, the operation of the Armenian NPP was stopped.

The power units were not decommissioned, but remained in a long-term shutdown mode. The absence of NPP in generation led to an energy crisis, which in turn caused not only a collapse in the country's economy, but also led to an environmental accident (due to large-scale deforestation and lowering of the level of Lake Sevan, due to an increase in the release of water from the lake for electricity production). De facto, Armenia lost the necessary level of energy safety during this period.

In order to overcome the severe energy and economic crisis in April 1993, the Armenian government decided to resume the operation of the Armenian NPP. Due to the long downtime of power unit No. 2, in order to reassess seismic safety, a number of additional studies and upgrades were carried out.

With the technical and financial support of the Russian Federation and other countries, the power unit No. 2 of the Armenian NPP was restarted on November 5, 1995. Power unit No. 1 remains in the downtime mode. The cooling down pond of power unit No. 1 is in operation.

A large set of measures to improve the safety and reliability of operation has been consistently implemented at the NPP. The reconstruction and modernization of the operated equipment is constantly being carried out.



The issue of continuous improvement of the nuclear safety level of the operating unit of the Armenian NPP has been and remains one of the highest priorities for the Armenian Government, given the special role of the Armenian NPP in the uninterrupted supply of electricity to the Republic of Armenia. Since 1993, more than 1,400 safety improvement measures have been implemented. The design life of power unit No.2 ran out in September 2016.

The work on the first extension of the design life of power unit No. 2 of the ANPP has been completed, the General Contractor was Rusatom Service, JSC. Various specialized organizations of the Russian Federation, as well as the Armatom Research Institute from the Republic of Armenia were involved in the work. Currently, work is underway to re-extend the service life for at least an additional 10 years.



DRY STORAGE OF SPENT NUCLEAR FUEL OF NUCLEAR POWER PLANTS (SNF DS)

After the restart of NPP Unit No. 2 in 1995, taking into account the limited capacity of the cooling down pond, it was decided to build an independent long-term special storage of spent nuclear fuel (SNF) at the site of the NPP. The practical application of such storage facilities has already been available and is widely used at many nuclear power plants around the world.

In Soviet times, after the first four years of operation, SNF was annually sent by rail to a processing plant in Russia, the last shipment of SNF for processing was carried out in 1990. After that, 612 pcs. of SFAs still remained at the NPP. Due to the collapse of the USSR and the blockade of Armenia, the design layout for the shipment of SFAs was violated.

Brief description of the SNF management layout

349 pcs. of SFAs and 37 pcs. of absorber parts are installed in the reactor core. In accordance with the design, one fuel company lasts 3 years in stationary operation with an annual overload of 1/3 of the core. Currently, the nuclear power plant uses a four-year fuel cycle. Spent nuclear fuel from the core is discharged into the cooling down pond to reduce activity and residual heat generation. According to the terms of the design, the capacity of the cooling down pond allows to hold SFAs in the reactor compartment (cooling down pond) for three (four) years, provided that there are 386 free units in the cooling down pond at any time of the fuel company for emergency full discharge of the core.



Selection of the SNF DS design

A bid was announced for the selection of a temporary SNF storage facility. Two proposals for long-term (50 years) storage of SFAs were submitted to the invited bids:

- horizontal type storage (NUHOMS)
- vertical type storage (CASTOR)

Both storage designs are of the passive type, i.e. they practically do not require maintenance and expensive monitoring during the specified time.

The Ministry of Energy of Armenia (the owner of the ANPP), having considered both proposals, chose the first one - a dry horizontal storage system of SFAs of the NUHOMS type, which has proven itself well at various nuclear power plants since the late 80s.

SNF DS Design Description

The basis of the design is based on a typical NUHOMS design, with horizontally arranged containers for dry storage of spent fuel cartridges. The initial version of NUHOMS (NUN-001) was licensed by the US Nuclear Regulatory Commission (US Nuclear Regulatory Commission) in 1986, and provided for the storage of seven SFAS PWR reactors.



The NUHOMS system provides storage of SFAs in dry, horizontally arranged leak-tight bottles. The leak-tight bottles, in turn, are located in storage modules made of reinforced concrete. The modules are arranged in two rows, each of them is closed by an armored door. Each module is designed to install one leak-tight bottle.

The transportation system consists of a transfer cask (TC), a rigging fork, a trailer with a hydraulic cylinder system, a support frame for the TC, a positioning system for the support frame and a tow tractor. The transportation system is integrated into the existing system of the station (cooling down pond, crane for loading containers) and adapted to the specific conditions and procedures of the NPP.



Horizontal storage module (HSM)

Due to its geographical location, the storage facility is not subject to the danger of flooding over the intake vents of the modules.

The first stage of the SNF DS consists of 11 HSMs arranged in two rows, end to end, respectively, 5 and 6 HSMs in each row. The second stage consists of 12 HSMs (two rows of 6 HSMs). The storage buildings with 11 and 12 HSMs are surrounded by a double fence (external and internal).

The removal of residual heat generation during storage is carried out by natural air circulation and heat exchange through the walls and cover of the HSM. The air enters through the lower part of the HSM, circulates around the sanitary protection area, rises and exits through the holes in the upper part of the HSM.



SNF DS filling

The first stage of the SNF DS was provided for the storage of 616 pcs. of spent fuel cartridges that remained at the ANPP after the collapse of the USSR and were not taken out for recycling. The filling of 11 HSMs of the first stage of the SNF DS was carried out in the period from August 2000 to April 2004.

In order to accommodate the spent fuel cartridges unloaded from the reactor core after the resumption of operation, it was decided to expand the existing storage and build a second stage of the SNF DS.

The first part of the second stage was built on the site of the existing storage and consisted of 12 HSMs. It was put into operation in 2008. It is currently fully filled.

The second part of the second stage was built on the site of the existing storage and consisted of 12 HSMs. It was put into operation in 2016. Currently, 9 out of 12 HSMs are filled.

Thus, as of November 01, 2022, 32 of 35 HSMs available in the SNF DS have been filled in. The number of spent fuel cartridges stored in the SNF DS is 1792.



Available quantity of spent fuel cartridges

As of November 01, 2022, there are 963 pcs. of SNF at HAEK, CJSC:

- 369 pcs. - in 1BV;
- 349 pcs. – in the active zone of RU No.2;
- 245 pcs. - in 2BV.

If to assume that an average of 75 spent fuel cartridges will be discharged from the reactor core annually, then by 2026, the number of spent fuel cartridges will reach 1,283.

It is necessary to construct 23 HSMs for these cartridges storage.

In 2023, it is planned to construct the third stage of the SNF DS, consisting of 12 HSMs. Consequently, to arrange all spent fuel cartridges, it will be necessary to construct another fourth stage (2035). The design of the fourth stage is under discussion. Apparently, vertical dual-use tanks will be used there.

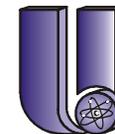


SNF DS appearance





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Thank you for your attention!!!