

Status report on nuclear power plants decommissioning preparations in Ukraine



Kyiv, 2017

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Abstract

In Ukraine there are fifteen operating nuclear power units, and Chernobyl nuclear power plant (NPP) in preparation for the decommissioning. There is a legal framework put in place which regulates preparations for the decommissioning of nuclear power plants, including financing issues. The operating company is responsible for the decommissioning of operating nuclear power units but not for the final utilizations of the radioactive waste and not for the decommissioning of Chernobyl NPP. The report provides an overview of the main aspects and current status of the decommissioning preparations – accumulation of the funds, preparation of decommissioning concepts and plans, progress with the decommissioning of the Chernobyl NPP and with construction of the necessary infrastructure for the radioactive waste management and utilization.

This publication has been produced with financial contribution by the Friends of the Earth Norway (Naturvernforbundet). The views herein shall not be taken to reflect the official opinion of Naturvernforbundet or its donors.

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On-site dry spent nuclear fuel storage at Zaporizhzhia NPP, Ukraine

1 Operating nuclear units in Ukraine

Ukraine has fifteen nuclear units at four operating NPPs run by the state owned energy company Energoatom.

All fifteen operating nuclear units are equipped with VVER-type nuclear reactors. All of them were designed, and most of them also built, in Soviet times and they all have a 30-year design lifetime. As of September 2017 the design lifetime of seven out of the fifteen operating nuclear units in Ukraine has expired (See Table 1.) However, they were not shut down and preparation for their decommissioning is only in the very preliminary stages.

According to the governmental plan from 2004 and the Energy Strategy of Ukraine up until 2035, the operational lifetime of all the nuclear units in Ukraine is planned to be extended for 10-20 years beyond the initially designed term. Lack of funding for the unit's decommissioning, as well as the fact that zero efforts have been made by the government to develop alternative energy solutions, are the main reasons for the prolonged operation of Ukraine's old nuclear units.

As of December 1st, 2017, seven nuclear power units had their lifetime extended: Rivne unit 1 and 2 – by 20 years, South Ukraine NPP units 1 and 2, Zaporizhya NPP units 1, 2 and 3 – by 10 years. There are also two units at Khmelnytsky NPP that have now been formally under construction for over 30 years. After the Agreement with Russia for their completion was denounced by the Ukrainian Parliament in 2015, the process has once again stalled.

All Ukrainian nuclear units use Russian nuclear fuel manufactured by TVEL company. As of 2000 Ukraine has been implementing a plan to diversify nuclear fuel supply, which is not an easy task as only two companies in the world produce fuel for Russian type reactors – TVEL and Westinghouse, a Japanese-American corporation. As of June 2017 three nuclear units – SouthUkraine NPP unit 3 and 2, Zaporizhya NPP unit 5 – have Westinghouse modified fuel assemblies (TB3-WR) loaded in the active zones of the reactors, mixed with TVEL assemblies. As of June 16 this year, all together 167 of these TB3-WR have been loaded in these three nuclear units¹. However, none of the Ukrainian nuclear units have been yet loaded fully with Westinghouse fuel.

Spent nuclear fuel (SNF) from three Ukrainian NPPs is sent to Russia for reprocessing and temporary storage. The fourth one, Zaporizhya NPP, has its own on-site dry storage for SNF. The construction of centralized SNF storage for the other three NPPs has for many years been planned to take place in the Chernobyl exclusion zone, but the process is moving very slowly due to lack of money and procedural complications. In July 2017 Energoatom received a license from the state nuclear safety regulatory authority for the “construction and putting into operation” of centralized SNF storage and in late 2017 the construction has started.

Table 1. Overview of operating NPPs in Ukraine and their lifetime

NPP	Unit No.	Reactor type	Grid connection	Termination of operational licence	Start of decom plans preparations**
Zaporizhya NPP	1	VVER-1000/320	10.12.1984	23.12.2025*	23.06.2024
	2	VVER-1000/320	22.07.1985	16.02.2026*	19.09.2025
	3	VVER-1000/320	10.12.1986	05.03.2017	05.09.2015
	4	VVER-1000/320	18.12.1986	04.04.2018	04.10.2016
	5	VVER-1000/320	14.08.1989	27.05.2020	27.11.2018
	6	VVER-1000/320	19.10.1995	21.10.2026	21.04.2025

1 <http://www.energoatom.kiev.ua/ua/actvts/implementation/>

NPP	Unit No.	Reactor type	Grid connection	Termination of operational licence	Start of decom plans preparations**
South-Ukraine NPP	1	VVER-1000/302	31.12.1982	02.12.2023*	12.06.2032
	2	VVER-1000/338	06.01.1985	31.12.2025*	12.11.2023
	3	VVER-1000/320	20.09.1989	10.02.2020	10.08.2018
Rivne NPP	1	VVER-440/213	22.12.1980	22.12.2030*	22.06.2029
	2	VVER-440/213	22.12.1981	22.12.2031*	22.06.2030
	3	VVER-1000/320	21.12.1986	11.12.2017*	11.06.2016
	4	VVER-1000/320	10.10.2004	07.06.2035	07.12.2033
Khmelnitsky NPP	1	VVER-1000/320	22.12.1987	13.12.2018	13.06.2017
	2	VVER-1000/320	07.08.2004	07.09.2035	07.03.2034
	3	VVER-1000...	Construction is suspended		
	4	VVER-1000...			

Note* Term of licenses already extended beyond projected lifetime

Note** Data obtained from calculations: expiry of operational license minus 18 months. Data on grid connection and start of operations as in the General Decommissioning Concept -2015.

2 Chernobyl NPP and its decommissioning process

The accident at the Chernobyl NPP on 26 April 1986 that destroyed reactor number 4 has had a great impact on the nuclear industry domestically and worldwide. As of the beginning of 2017, the nuclear units at Chernobyl NPP are in the final closure phase and are being prepared for conservation. The period of safe storage during which radioactivity is expected to reduce naturally to a tolerable level will last approximately until 2045, with the NPP equipment and site eventually dismantled and cleaned by 2065.

The cost of preparations for decommissioning the Chernobyl NPP is being covered by the state budget of Ukraine and by international donors through a variety of projects. In 2000, the Chernobyl NPP was removed from the state nuclear units operator, Energoatom, and re-organised in the state specialised company that is currently run by the State Exclusion Zone Agency and subordinated to the Ukrainian Ministry of Environment and Natural Resources. **Energoatom does not provide any financing to fund the expenses related to the decommissioning of the Chernobyl NPP, nor is it responsible for this process.** So the nuclear operator in Ukraine was not only released of the obligations to finance clean-up measures and decommissioning of the destroyed unit # 4, but was also discharged from its duty to fund the cost of decommissioning of the remaining three units of the Chernobyl NPP. The cost of the Chernobyl clean-up is not included in the cost of electricity produced by the nuclear energy company.

BOX 1. “The leftover principle applied to the financing of relevant Government programmes has resulted in a number of problems at the Chernobyl NPP’s site awaiting solutions. ... underfunding prevents the performance of works necessary to decommission the units of the Chernobyl NPP and challenges the maintenance of international projects and **14 years after the plant’s complete shutdown, expenses are primarily made to support the safety of the plant rather than to have it decommissioned**”²...

2 Adapted from the Parliament hearings approved by Resolution No. 348-VIII of the Ukrainian Parliament, dated 22 April 2015. Source: <http://www.golos.com.ua/rus/article/254321>

Chernobyl NPP has three reactors that continued to operate after the accident at unit 4 in 1986. The last one was shut down in the year 2000. Activities to prepare the plant for decommissioning are ongoing. High-level radioactive waste (RAW) are collected in special containers (KTZV-0.2) and are stored at the temporary storage organised at the building originally used to store fresh nuclear fuel. Overall 3,783 m³ of the high-level and long-life RAW is stored there with the cumulative activity of 8.59 TBq³. Low and medium level waste is sent directly to Buriakivka storage⁴ in Chernobyl exclusion zone.

There is an Industrial Complex for Solid Radioactive Waste Management (ICSRM) constructed by RWE NUKEM GmbH with the support of the European Commission at Chernobyl NPP, as well as a Liquid Radioactive Waste Treatment Plant (LRWTP) built with the support of EBRD. The European Commission has also financed construction of the Long-Length Waste Cutting Facility at Chernobyl NPP (LICF Project). All of the facilities were completed in recent years.

There is spent nuclear fuel stored in the amount of 21,284 spent fuel assemblies (SFA) at the site of Chernobyl NPP and no fresh nuclear fuel. The majority (21,231.5, some are broken) of SFAs is stored in the cooling pool of Wet Spent Fuel Storage Facility (ISF-1), which was commissioned in 1986. There are 52.5 damaged SFAs stored in the cooling pools of unit 1 and 2 of Chernobyl NPP. The State Specialized Enterprise Chernobyl NPP is in charge of Chernobyl SNF.

In order to start the decommissioning of unit 1 and 2 of Chernobyl NPP, spent nuclear fuel should be removed from its cooling pond. The life-time of ISF-1 will end in 2025. A new dry type storage facility (ISF-2) is under construction at the site of Chernobyl NPP in order to provide for long-term safe storage of all spent nuclear fuel of Chernobyl plant. This construction is sponsored by the international community as part of efforts for the safe decommissioning of the Chernobyl plant. It was originally planned to be completed in 2004. The construction was started by French company Areva, but the contract was cancelled as the storage technology was shown to be inadequate for the Chernobyl SNF. The work was further taken over by US Holtec company and in December 2017 construction works are 99 % finished. The start of operations is now planned for the end of 2018- beginning 2019.

3 State Nuclear Regulatory Inspectorate of Ukraine. "Report on Nuclear and Radiation Safety in Ukraine in 2014." Kyiv, 2015b.

4 Kondratiev S., Boroznets H., Yarmosh I., Kutuzova T., Chepurnyi Yu. *Radioactive Waste Management at Ukrainian Nuclear Power Plants. State and Challenges*. Nuclear and Radiation Safety Journal. State Scientific and Technical Center for Nuclear and Radiation Safety (SSTC NRS), 2016.

3 Preparation for the decommissioning of operating nuclear units

3.1. What is nuclear power plant decommissioning?

Nuclear power plants (NPP) are highly hazardous facilities, subject to regulatory control. After the operational lifetime of a nuclear power unit ends one cannot simply shut it down and leave: they must be decommissioned, i.e. brought to a condition that would be safe for the environment and allow for further use of relevant territories. Spent nuclear fuels and other nuclear waste must be disposed of safely.

"The objective of the decommissioning of a nuclear power station is to deliver conditions that allow for the reuse of its territory. In the decommissioning process full or partial release from regulatory control must be achieved".⁵

The pre-decommissioning of an NPP starts well ahead of the closure of the plant and consists of a number of steps that are crucial to a successful and safe completion thereof:

- development of decommissioning concepts and projects (plans);
- implementation of pre-decommissioning measures; and
- accumulation of funds necessary to finance decommissioning measures.

A proper and timely implementation of such measures will be central to the efficient and safe decommissioning of NPPs in future. The successful and effective achievement of this large-scale goal will require adequate government regulation, significant financial resources, the availability of innovative technologies and a huge number of skilled personnel. All of this must be put in place before a closure decision is made in respect of any of the plants.

3.2. Status of decommissioning concepts and plans

Seven of the fifteen nuclear units currently operating in Ukraine have seen their lifetime ended before September 2017. But no detailed decommissioning projects (plans) have been developed for these units as is prescribed by national legal requirements⁶. The legal requirement is that these projects are

5 Наказ Держатомрегулювання України №162 від 19.11.2007 <http://zakon2.rada.gov.ua/laws/show/z0056-08>

6 An order "On consideration and approval of the decommissioning plan (project)", approved by the Cabinet of Ministers decree # 594 from 27.04.2006.

to be prepared 18 months before the expected end of the unit's operation. The operator argues that decommissioning projects for operating units were not necessary because there is a governmental decision to extend units' operation instead of closing them.

Some preparatory steps for decommissioning of the operating units have been taken during the last 13 years. The general decommissioning concept and separate concepts for each of the power plants has been prepared, and the decommissioning fund has been set up to accumulate money for the future decommissioning of the nuclear reactors.

The **General Concept for the Decommissioning of Operating NPP Units (hereinafter The General Concept) was developed**⁷ from 2012-2015 and approved by Ukrainian Ministry of Energy and Coal Industry Order No. 798 on December 10, 2015. An agreement between the Ukrainian government and the European Atomic Energy Society (Euratom) from 2003 to develop the draft concept for the decommissioning of nuclear units was one of the grounds for the development of the General Concept.

The existing **plant-by-plant Decommissioning Concepts** as developed in 2004-2013 differ distinctly from the General Concept, and should be aligned with it. These plant-by-plant decommissioning concepts should provide necessary strategy and data for preparation of detailed decommissioning projects (plans) for each of the nuclear units. There are no defined timelines for when plant-by-plant concepts should be aligned with the new General Concept. As of the end of 2016⁸, only the concept for the South Ukraine NPP has been submitted for approval to the State nuclear regulatory inspectorate of Ukraine.

3.3. Problems with the General Concept for the Decommissioning of operating nuclear power plants

The General Concept for the Decommissioning of Operating NPP Units is the key strategic document for preparing nuclear units for decommissioning. It defines the decommissioning strategy, including the number of stages, the total expected costs and the annual financial allocations to the decommissioning fund and a radioactive waste fund. The concept suggests that the size of financial allocations are calculated based on existing decommissioning practices around the world, as well as on the situation in Ukraine's nuclear sector, including plans for its further development.

7 This is already a third concept, the previous two were developed in 2004 and 2013 respectively.

8 SNRIU's reply to NECU № 24-24/8682-430з from 28.12.2016

There are a number of issues with this approach.

The economic data is outdated. Calculations in the concept are based on an exchange rate of 7.9 hryvnas to the euro, which is now in 2017 fluctuating between 29-32 hryvnas to the euro. A significant part of decommissioning costs are salaries, and while most of the work will be done decades from now, the concept assumes a minimum wage of UAH 1134 (EUR 38). In 2016 minimum wage was already UAH 1600, and 3200 UAH as of January 2017. Further inflation has not been properly accounted for in calculations.

The total expected cost of decommissioning per unit is unrealistically low. According to the concept, the total cost of decommissioning of one 1000 MW nuclear unit (VVER-type) in Ukraine is expected to be UAH 2.9 billion (or EUR 100 million at an exchange rate of 29 hryvna to the euro) and UAH 2.3 billion (EUR 76 million) for a 440 MW unit. But the cost of nuclear decommissioning projects in Europe is seven to ten times higher, with costs of decommissioning projects in Bulgaria, Slovakia and Lithuania continuing to rise⁹ (see 3.4).

Lifetime extension for 20 years is assumed. Calculations used in the General concept for decommissioning only look into options with an extended lifetime of 15 or 20 years for each reactor. Currently four units got their licenses extended for 10 years and there is no guarantee that their lifetime can be extended further. Annual allocations to the decommissioning fund are, however, calculated based on the assumption that all units will be able to operate for 20 years beyond the projected lifetime.

The general concept for decommissioning needs to be revised as soon as possible to reflect actual decommissioning costs and recent economic data.

3.4. Ukraine's nuclear units decommissioning strategy and timelines

According to the General Concept for the Decommissioning of Operating NPP Units, the optimal option of nuclear units decommissioning for Ukraine is a deferred dismantling with a storage period of 30 years, and authors further recommend this option as a decommissioning strategy for the Ukrainian nuclear units. Deferred dismantling allows splitting the total cost of the decommissioning over longer period of time, which seems to be one of the key arguments for such a choice in Ukraine. Deferred dismantling requires maintenance, ensuring security and regulatory control over the whole storage period. The spent nuclear fuel

9 http://www.eca.europa.eu/Lists/ECADocuments/SR16_22/SR_NUCLEAR_DECOMMISSIONING_EN.pdf



should be removed from the reactors during the closure stage, and safely placed in the mid-term or final storages on or outside of the site. The whole process of deferred decommissioning in the case of Ukraine, including stages of final closure, conservation, safe storage and dismantling, is expected to take about 50-55 years.

It is the operator, Energoatom, that implements the decommissioning of nuclear units, including preparation of all relevant documentation¹⁰. However, with regards to the radioactive waste management and its final disposal, it is the state agency that is responsible, and the operator is only responsible for paying an annual allocation to the Radioactive Waste Management Fund and preparing the wastes for the transportation from the site (see Chapter 5).

¹⁰ According to the General Concept for the Decommissioning of Operating nuclear units and laws of Ukraine.

4 Decommissioning Fund

4.1. Status of the fund

The accumulation of funds for the decommissioning of operating nuclear units in Ukraine only started in 2007. Creation of a dedicated fund for the decommissioning of nuclear units was a conditionality of the “Post start-up safety upgrade” loans for nuclear units Khmelnistky2/Rivne 4 (K2/R4 loans) granted to Energoatom by the EBRD and Euratom in 2005. This fund is to cover expenses for the decommissioning of all operating units at all 4 nuclear power plants.

In 2004 the Ukrainian Parliament adopted a law¹¹ prescribing Energoatom, with effect from 2005, to accumulate funds for financing measures related to the closure and decommissioning of nuclear installations, by making allocations to a special fund of the State Budget of Ukraine. It was not until 2007 that the first financial allocations were made to the fund. The size of the annual allocation has been fixed at the level of **UAH 283,4 million**, and was regularly paid by Energoatom. This amount has not been revised since 2006, despite a devaluation of the hryvna and a near fivefold increase in Energoatom’s revenues between 2006 and 2015¹². While a revision of the amount allocated to the decommissioning fund based on the company’s revenues is stipulated in the law ‘On regulation of the issues, related to ensuring nuclear safety,’¹³ this has never happened up until 2015 when the latest General Concept for the Decommissioning of Operating Nuclear Units was approved.

As of 1 September 2017, financial reserve for the de-commissioning of NPPs has accumulated 3,198 billion UAH (around 118 mln USD)¹⁴ which is not sufficient for the decommissioning of even one smaller (VVER-440) nuclear unit at Rivne NPP.

The General Concept of 2015 has provided new updated calculations of both the total expected cost of decommissioning the nuclear units, as well as annual allocations to both the Decommissioning and Radioactive Waste Management Funds. According to these calculations, Energoatom should be allocating **UAH 785.4 million** annually to the Decommissioning Fund. Due to the fact that this increase in

11 Law of Ukraine 1868-15, last revision from 11.06.2017 “On regulation of issues related to ensuring nuclear safety”.

12 In 2006 Energoatom’s revenues were UAH 6, 8 billion, and in 2015 – UAH 32,9 billion.

13 Law of Ukraine № 1868-IV from 24.06.2004, article 7.

14 http://www.energoatom.kiev.ua/ua/actvts/decomission/23595-dyalnst_dp_naek_energoatom_schodo_pdgotovki_do_znyattya_z_ekspluatats_dyuchih_aes_ukrani/

payment was not reflected in the state budget for 2016, Energoatom continued to pay only UAH 283.4 million in 2016. As of January 2017 the payment raised to UAH 785.4 million.

4.2 Insufficiency of accumulated funds

The set up for the accumulation of sufficient funds for the decommissioning of Ukrainian nuclear units is, however, not yet finalized: the total estimated cost of decommissioning one nuclear unit still looks to be unrealistically low. The second problem is that the money in the decommissioning fund is not safeguarded from devaluation and misuse.

Current estimates of the cost of decommissioning for one large industrial nuclear VVER-type unit in Europe are between EUR 670 and 1350 million (See Table 2). While some costs in Ukraine like wages and project management are lower than in EU countries, immediate dismantling is much cheaper on average. In the case of Ukraine, where deferred dismantling of nuclear power plants is chosen, there is a 30 year-period during which plants require financial resources to maintain safety and security, and the whole process is expected to take more than 60 years. In the case of immediate dismantling, decommissioning can be finished in 13 to 25 years (as in the case of the Trojan plant in the US and the Greifswald plant in Germany), and existing plant infrastructure can be used for dismantling to lower the total cost. Also Ukraine doesn't have storages for the disposal of the high-level radioactive waste and spent nuclear fuel. This is yet another reason to expect total decommissioning costs of nuclear units in Ukraine to raise once the technical solutions and construction cost of such storages will be determined.

Table 2. Decommissioning cost estimates for the nuclear reactors in Europe

Country	Name of NPP	Reactor type and capacity	Cost of decommissioning (millions of euros)		Planned year of finalizing decom
			Per plant	Per unit	
Germany	Greifswald	4 reactors VVER-440	6600	1320	2018
Bulgaria	Kozloduy	4 reactors BBEP-440/230	2697	674,25	2020
Slovakia	Bohunice	2 reactors BBEP-440	2705	1352,5	2035

* For Bohunice and Kozloduy decommissioning cost are as in Special report by EU Court of auditors, 2015, and includes the cost of final disposal of high-level RAD waste and spent nuclear fuel. For Greifswald estimates as provided by the operator NORD <http://www.ndr.de/nachrichten/mecklenburg-vorpommern/Rueckbau-von-DDR-Atommeilern-deutlich-teurer,lubmin558.html>

The decommissioning fund for Ukrainian nuclear power plants is a state fund within the state budget, for which the state treasury maintains a special account as a “financial reserve for the nuclear units decommissioning”. However, the money in this fund is not safeguarded from being used for other purposes within the approved state budget. The money is also not safeguarded against the devaluation of national currency – hryvna: a value of UAH 283 million in 2006 at an exchange rate of UAH 6 to 1 EUR is not the same as in 2017 when the rate is nearly 30 to one.

There are different ways to safeguard the funds for future use, including investing them into low-risk businesses or converting into securities. According to Ukrainian law¹⁵, the state may allocate part of the decommissioning fund into state securities. However, this has never been done to date, due to the fact that the managing authority – the Ministry of Energy and the Coal Industry – did not have the respective mandate. The ministry is a non-profit state organisation, and according to national legislation, it cannot purchase and sell securities, nor can it receive income from such operations¹⁶.

As a result, the decommissioning fund has been losing its value in the last decade. According to the protocol of its meeting, the national body on decommissioning, the Supervisory Board, raised this issue in 2015, and in October 2015, the Cabinet of Ministers of Ukraine granted the ministry of fuel and energy a respective mandate to purchase securities¹⁷. As of May 2017, the process is stuck at the ministry of finance, which has to give an order to the treasury to transfer money to the respective account at the Ministry of Power and Coal Industry for purchasing securities.

The decommissioning fund urgently needs to be properly safeguarded from devaluation. The calculations for the total cost of decommissioning of nuclear power plants needs to be checked by an independent body (experts) to ensure that the Ukrainian nuclear industry puts aside enough money for the safe decommissioning of its nuclear fleet.

4.3. National Body on decommissioning

The national body on decommissioning nuclear units was established by the Cabinet of Ministers in January 2014 ¹⁸to control the decommissioning fund and to prepare recommendations for improvements to the fund's management.

15 The law of Ukraine “On regulation of the issues, related to ensuring nuclear safety”, article. 8.

16 Letter to NECU from the Ministry of Power and Coal Industry from 25.03.2016

17 Cabinet of Minister's decree # 848 from 21.10.2015

18 Cabinet of Minister's decree №21 from 22.01.2014

It consists of seven representatives from Energoatom, the Ministry of power and coal industry, the State nuclear inspectorate, the Ministry of finance, the Ministry of economic development and trade, and two state committees that deal with state securities. The Board should meet at least twice per year and report annually in March to the Cabinet of Ministers. The Board has powers to:

- approve annual action plans for decommissioning preparations submitted by Energoatom;
- control the use and investment of the funds;
- approve annual plans submitted by Energoatom for investing money from the fund; and
- approve Energoatom's proposal regarding the conversion of the fund's resources into state securities.

It is unclear how the body can combine both its executive and oversight functions.

In 2016 the Board focused primarily on enabling the conversion of the fund's money into securities as described above. According to Energoatom¹⁹, the company did not use any money from the fund to implement preparatory works for future decommissioning, although such works are already ongoing. The use of decommissioning funds is only possible when decommissioning plans for each nuclear power plant are developed and approved, including for the development of those plans. From February 1st, 2017 until the end of November of that year,²⁰ there were no more Board meetings. Due to restructurings in ministries there was a need to approve a new list of Board members. The proposal for the new composition of the Supervisory Board was submitted for the approval to the Cabinet of Ministers on 24 October 2017.

19 Energotom letter to NECU №16395/32 from 11.11.2016.

20 As of 20.11.2017

5 Radioactive Waste Management Fund

Radioactive waste management fund was created in 2008 by the law of Ukraine № 515-VI. The fund is a part of the State budget of Ukraine.

All the entities producing radioactive waste (including nuclear power plants) pay “pollution fees for the creation and temporary storage of the RAW” to the RAD waste management fund. In return, the state guarantees acceptance without extra charge of all the RAD waste that is created by entities that produce them and pay prescribed fees to the fund²¹. The fund receives around UAH 600 million annually (EUR 20 million at the exchange rate of March 2016). The nuclear operator Energoatom has transferred around UAH 3.1 billion (over EUR 166 million) over the period 2009–2014.

It is important that the spent nuclear fuel is not considered to be radioactive waste under the Ukrainian legislation. The money from this fund can therefore not be used, for instance, for the construction of spent fuel storage.

The size of the annual payment to the RAD waste fund for Energoatom has increased, starting from 2017, to become UAH 962.19 million based on the General Concept for Decommissioning. This amount is included into Energoatom’s tariff for the electricity it produces.

State Exclusion Zone Agency (SEZA) is currently responsible for the long term storage and disposal of all the radioactive waste. It also acts as the manager of the Radioactive waste management fund.

The use of the fund is defined by the Cabinet of Ministers Order (20.05.2009 #473). The Order suggests that the fund is used for the implementation of the State environmental program on radioactive waste management. But the 2010 budgetary law widened the scope of the Fund’s use and allowed the spending money on other purposes. In its letter to Chernobyl United Trade Union Organization Energoatom has stated that the programme on waste management was financed at the level of 8–10 %.

The implementation of projects in RAD waste management has been delayed for years, and may cause big problems for the country in the near future. The most pressing one is a failure to construct mid-term storage for the high-level radioactive waste from reprocessing of spent nuclear fuel from Ukrainian VVER-440 reactors in Russia. In 2018 Ukraine should start taking back this RAW but the construction of the storage in the Exclusion Zone is yet to be started. The feasibility study for this storage only got approval of the state expert review²² in June 2016, and the schedule of the planned construction and putting into operation was prepared in the first half of 2017.

21 The law of Ukraine “On radioactive waste management”, article 4.

22 <http://dazv.gov.ua/novini-ta-media/vsi-novyny/zaversheni-roboti-z-rozrobki-proektnoji-dokumentatsiji-na-budivnitstvo-skhovishcha-osklovanikh-visokoaktivnikh-vidkhodiv-promizhno-go-zberigannya-yaki-budut-povertatisya-z-rosijskoji-federatsiji.htm>

Conclusions

In Ukraine there are fifteen operating nuclear power units. Between 2010 and 2017 projected lifetime ended for seven of them but decommissioning plans were not prepared for them. The operational lifetime of these seven units has been extended for an extra 10 to 20 years beyond projected closure dates.

In Ukraine there is a legal framework put in place which regulates preparations for the decommissioning of nuclear power plants, including financing issues. The operating company is responsible for the decommissioning process but not for the final utilizations of the radioactive waste.

The decommissioning process should be financed from the decommissioning state fund (financial reserve) where the nuclear units' operator pays an annual fee fixed by the government. The operator also pays a fee to the Radioactive waste management fund. Current annual "decommissioning" fee is fixed on the basis of calculation from The General Concept for Decommissioning of Operating NPP Units, and it looks insufficient to cover full cost of decommissioning. This General Concept needs to be revised to reflect up-to-date European knowledge and experience with decommissioning as well as recent economic data.

The decommissioning fund also needs to be properly safeguarded from devaluation. The process of money safeguarding via transferring them into state securities has been launched in 2016, and is currently being moved forward by the national body on decommissioning nuclear units (Supervisory Body).

The decommissioning of the Chernobyl NPP is still at the very early stage, and it is not under the responsibility of the nuclear units operator. It is the State Exclusion Zone Agency that is responsible for the decommissioning of the Chernobyl NPP, and the process of the decommissioning is financed from the state budget of Ukraine and the support of international donors.

The implementation of certain projects in radioactive waste management in Ukraine has been delayed for years, and may cause big problems for the country in the nearest future. The most pressing one is a failure to construct a mid-term storage for the high-level radioactive waste from reprocessing of spent nuclear fuel from Ukrainian VVER-440 reactors in Russia.

Sprinkling pools at Zaporizhzhia NPP, Ukraine

