



The European Union's PHARE Programme for
Nuclear Safety for Lithuania

Decommissioning of the Ignalina Nuclear Power Plant: safety requirements, projects, management of radioactive waste

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*Support to VATESI and Lithuanian TSOs in licensing activities related to
decommissioning of Ignalina NPP*

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1. Decommissioning of a nuclear power facility

The life cycle of a nuclear power facility consists of its design, construction, operation, and the final stage, decommissioning. This is a complex process that requires as much thorough preparation and responsible implementation as other stages of its service life.

Lithuania has several nuclear power facilities, including the Ignalina Nuclear Power Plant and facilities for managing radioactive waste. Decommissioning of a nuclear power plant comprises decontamination and dismantling of its equipment and buildings, managing decommissioning and other wastes, as well as putting in order the facility's area.



The life cycle of a nuclear power facility

The Ignalina NPP was constructed to supply electricity to the entire northwestern system of the Soviet Union rather than to meet Lithuania's demand in electricity. The nuclear power facility was built at Lithuania's border with Latvia and Belarus. All the facilities for managing radioactive waste are located on the territory of the Ignalina NPP, with the exception of Maišiagala Radioactive Waste Storage Facility situated some 30 kilometers northwest of Vilnius, the capital of Lithuania. The storage facility that was operated until 1989 accommodates waste collected from industrial enterprises, as well as medical and scientific institutions.

Unit 1 of the Ignalina NPP was commissioned in late December 1983, and Unit 2 in August 1987. The design deadline of operation of the two Units is 2013 and 2017, respectively.

After the decision was made to decommission the Ignalina NPP, Unit 1 was shut down on December 31, 2004, and Unit 2 is to be operated until the end of 2009. Defuelling, dismantling of plant and equipment, decontamination and other



Ignalina NPP

decommissioning operations of the nuclear power facility begin after a unit is shut down. The decommissioning of the Ignalina NPP is to take some 25 years.

To decommission a nuclear power facility, adequate preparation is necessary, and all kinds of organizational and technical measures need to be implemented. Organizational measures comprise preparation of plans and designs, coordination of these with regulating institutions, as well as obtaining licenses and permits. Technical measures of decommissioning comprise, among other things, construction of facilities for managing radioactive waste, storage facilities and repositories.

It is extremely important that in the course of decommissioning of a nuclear power facility nuclear safety be ensured and be paid as much attention as under the conditions of normal operation.

2. The key events related to the decommissioning of the Ignalina NPP

The decommissioning of a nuclear power plant begins when a country decides that the facility will no longer be used for the original purpose. After the decision has been made, legal measures are implemented. In Lithuania, its Seimas (Parliament) and Government adopt legal documents regarding the closure of the Units, determine the strategy and financial sources of decommissioning, and obligate the institutions and organizations concerned to commence preparatory work. Next, technical measures are implemented, i.e. the reactors are defuelled, the plant, equipment and buildings contaminated with radionuclides are dismantled and decontaminated and radioactive waste is managed.

3. The funding of the decommissioning

Decommissioning of a nuclear power plant is a process that requires large funds. The funds need to be accumulated throughout the period of operation of the facility, with a certain part of the price of the sold kilowatt-hour being deducted.

In accordance with the decision of the Government the funds for decommissioning the Ignalina NPP have been accumulated since 1995. After the decision was made to close the Units prematurely, additional funds are allocated by the EU and donor countries.

The contributions of the EU and other donor countries are accumulated in the Ignalina International Decommissioning Support Fund that is being administered by the European Bank for Reconstruction and Development. Technical projects of Ignalina NPP decommissioning and modernization of AB *Lietuvos elektrinė* are financed from this fund. Additional EU support is also provided through the special financial instrument – Ignalina Program.

The key events related to the decommissioning of the Ignalina NPP

Date	Event
October 5, 1999	The Seimas approves the National Energy Strategy in accordance with which Unit 1 at INPP is to be shut down by 2005, given the long-term substantial financial support conditions of the European Union, G-7 and other countries and international financial institutions.
May 2, 2000	The Seimas passes the Law on Decommissioning Unit 1 at Ignalina NPP.
February 19, 2001	The Government approves the Program of Decommissioning Unit 1 at INPP envisaging the measures for 2001–2004.
April 25, 2001	The Ministry of Economy prepares, approves and updates on an annual basis (until 2005) the plan on implementation of measures of the decommissioning program of Unit 1 at INPP. Technical, environmental, social and economic measures that need to be implemented with a view to safely decommission Unit 1 at INPP are identified in the plan.
July 12, 2001	The Seimas passes the Law on the Decommissioning Fund of the Ignalina NPP.
October 10, 2002	The Seimas updates the National Energy Strategy envisaging that Unit 2 at INPP will be shut down in 2009 provided that financial support is available including funding in accordance with agreements with EU institutions and other contributors.
November 26, 2002	The Government adopts the resolution identifying immediate dismantling as the method of decommissioning for the Ignalina NPP. Immediate dismantling is a continuous decommissioning process of a nuclear power facility that begins with the dismantling of the nuclear power plant and ends with remediation of the facility's territory and managing of radioactive waste. There will not be a period of the contaminated plant being stored without being dismantled and of waiting for the activity of radionuclides to decrease.
April 29, 2003	The Seimas passes the Law on Additional Employment and Social Guarantees for the Employees of the Ignalina Nuclear Power Plant State Enterprise.
December 31, 2004	Unit 1 at the Ignalina NPP is shut down.
February 2, 2005	The Government updates the decommissioning program for both Units of INPP.
February 25, 2005	The plan is approved by the order of the Minister of Economy on implementation of measures of the decommissioning program of INPP Units 1 and 2 envisaging the measures for addressing environmental, social and economic problems, as well as the consequences of premature decommissioning. The document is reviewed once a year.

The principal sources of Ignalina NPP decommissioning:

- Ignalina International Decommissioning Support Fund.
- Decommissioning Fund of Ignalina Nuclear Power Plant.
- The State Budget of the Republic of Lithuania.
- Special target subsidies intended for the municipalities of Ignalina NPP region.
- Ignalina Program.

The EU allocated over € 200 million for preparatory work of Ignalina NPP decommissioning in 2004–2006, another € 815 million is to be earmarked for 2007–2013. Part of funds allocated by the EU is used for updating other power stations that will supply electricity after Unit 2 at INPP is shut down. The preliminary cost of INPP decommissioning is € 1.3-odd billion. Additional funds will be required for disposal of spent nuclear fuel and long-lived radioactive waste.

4. Requirements for safe decommissioning of the nuclear power facility

It is of extreme importance while decommissioning the Ignalina NPP that operations related to it, such as dismantling of the plant and equipment, decontamination of rooms and equipment, etc., are conducted safely. Radioactive waste needs to be properly managed, stored and disposed of. The activities of decommissioning need to be planned and operations conducted in a manner that ensures the safety of the personnel, population, and the environment.

When addressing the issues of nuclear safety in Lithuania, the functions are precisely divided between the operating organization and the institutions that are carrying out supervision. The Ignalina NPP, the organization operating the nuclear power facility, is responsible for safe operation and dismantling of the NPP's Units, as well as for management of radioactive waste. The State Nuclear Power Safety Inspectorate (VATESI) is responsible for control and supervision of the nuclear power facilities' safety and accounting for nuclear materials. Other state bodies also control and supervise nuclear power facilities within their competence, and so do municipal institutions on their respective territories.

The main document the Ignalina NPP complies with while planning and carrying out the decommissioning, as well as producing documents related to it is *General requirements*

for decommissioning the Ignalina Nuclear Power Plant, approved by the Head of VATESI in 1999 and supplemented in 2003. Requirements for preparatory decommissioning operations and the safety of decommissioning are set in the document.

In accordance with the requirements of the document, the Ignalina NPP must produce the final decommissioning plan. The final decommissioning plan of INPP comprises the strategy of decommissioning, the program of decommissioning actions and their schedule, the guidelines for assessment of safety and environmental impacts, the strategy of radioactive waste management, the means of plant decontamination and dismantling, the descriptions of safety and radiation protection, and quality assurance.

VATESI issues a license for conducting decommissioning operations at the Ignalina NPP. All the activities of decommissioning are divided into decommissioning projects that are described in the Final Decommissioning Plan. The Ignalina NPP must produce and coordinate with relevant institutions the decommissioning project and substantiate its safety. All the operations and organizational and technical measures of decommissioning need to be envisaged in the project, and radiation protection ensured. The methods of dismantling and decontamination must be set forth in the project, the plant and equipment necessary for the operations and the conditions of their utilization must be described, the methods must be envisaged for radioactive waste management, etc. It must be proven in the Safety Analysis Report that individual decommissioning operations and the process as a whole will be safe.

After INPP decommissioning has been completed, a final report must be produced that describes the performed operations of decommissioning, the plant used, the accumulated amounts of radioactive wastes, their properties and management methods, the exposure doses received by the population and personnel, as well as the results of radiological studies of the territory. The report must also contain information about the decommissioning expenses, the further use of the area, etc.



A view of the Ignalina NPP now and... in 50 years

5. Ignalina NPP preparation for decommissioning

The decommissioning of Ignalina is a complicated process not only from the technical, but from the administrative viewpoint, too. Numerous projects and measures need to be implemented whilst performing the decommissioning of the Ignalina NPP. The activities of decommissioning must be planned and the envisaged operations carried out in a timely manner.

The Decommissioning Service was set up at the Ignalina NPP in 2000. Next year, the Decommissioning Project Management Unit (DPMU) was formed from representatives of the consortium comprising NNC Limited, the UK, Belgatom, Belgium, and SwedPower, Sweden, as well as the members of the Decommissioning Service. The DPMU plan, produce and manage decommissioning projects.

The Ignalina NPP has completed the following preparatory work:

- New steam and heat boiler houses have been designed and constructed that will supply hot water to the Ignalina NPP and the heating system of the town of Visaginas, and steam to radioactive waste evaporators at the INPP.



- A new technical archive has been established.
- The Ignalina NPP Final Decommissioning Plan and the Ignalina NPP Unit 1 Final Shutdown and Defuelling Phase Decommissioning Project and its Safety Analysis Report have been produced and coordinated with different regulating institutions.

Work still due to be done:

- Design and construction of a new storage facility for spent nuclear fuel.
- Siting, designing and construction of a new facility for managing and storing solid radioactive waste.
- Transferring partially burnt fuel from Unit 1 into Unit 2.
- Siting and constructing a repository for very-low-level radioactive waste.
- Constructing a near-surface repository for short-lived low- and intermediate-level radioactive waste.
- Acquiring free release measurement facility.

6. VATESI activities in preparation for and implementation of Ignalina NPP decommissioning

The institution regulating nuclear safety must also get ready for decommissioning of a nuclear power facility. In Lithuania this function is performed by the VATESI. The Decommissioning and Radiation Protection Division was set up in VATESI in 2001 which coordinates implementation of the state regulation of nuclear power facilities.

The Ignalina NPP will carry out all the decommissioning operations by implementing individual projects. Prior to starting implementing the projects, VATESI specialists will review them, assess their safety and will give authorization to commence. VATESI will control compliance with license conditions and implementation of decommissioning operations. After the Units have been shut down, the operation license will be valid. When the fuel has been unloaded from the reactors, VATESI will issue a decommissioning license. Then the plant will be dismantled, the buildings decontaminated and cleaned, and radioactive waste managed. Upon ascertaining that the buildings and the territory of the nuclear power facility pose no danger for the population and environment, the decision will be taken to discontinue the control of the facility's nuclear safety.

VATESI specialists assisted by experts of Lithuanian technical support organizations and from Western Europe have reviewed and analyzed the legal basis governing the decommissioning and produced the documents governing radioactive management. They have also supplemented the *General requirements for decommissioning of the Ignalina NPP*. International practice and recommendations of the International Atomic Energy Agency (IAEA) are taken into consideration while drafting all the documents.

VATESI specialists have been continuously extending their knowledge at IAEA events and while implementing PHARE projects. The software received from international support enables to apply the experience gained in everyday activities.

7. PHARE project *Support to VATESI and Lithuanian TSOs in licensing activities related to decommissioning of Ignalina NPP*

The principal function of VATESI in preparation for decommissioning of the Ignalina NPP is to analyze and approve the documents submitted by the INPP. Experts of foreign countries that have experience in decommissioning nuclear power facilities assist VATESI specialists. VATESI has been implementing the PHARE project funded by the EU *Support to VATESI and Lithuanian TSOs in licensing activities related to decommissioning of Ignalina NPP* with a view to obtaining support on issues related to licensing INPP decommissioning.

Implementation of the project began on December 26, 2001, after an implementation agreement had been signed with the SKI-ICP/RISKAUDIT consortium. Experts from Belgium (AVN), France (IRSN), Germany (GRS), Finland (STUK), the United Kingdom (Serco Assurance), and Lithuanian and Swedish Technical Support Organizations participated in the project.



Introductory meeting of PHARE project

The project is being implemented in stages. The work planned for three stages of the project was completed in November 2006.

As Lithuania has joined EU, the European Commission no longer provides the support through PHARE projects. VATESI is planning to receive a further support for implementation of continuous projects from the funds of Ignalina Program aimed to support the decommissioning of nuclear power plant and consequential measures in the energy sector for Lithuania. It is planned to receive support in analyzing documents related to the projects of the Ignalina NPP dismantling and decontamination, a new storage facility for spent nuclear fuel, a new facility for managing and storing solid radioactive waste, a repository for very-low-level radioactive waste, and a near-surface repository.

The main objectives of the project:

- Production of legal documents.
- Review of documents submitted by the Ignalina NPP and the Radioactive Waste Management Agency (RATA).
- Strengthening VATESI and Lithuanian TSOs (the Institute of Physics and Kaunas University of Technology).

Project implementation activities and results:

The following new legal documents were drafted:

- *Requirements for disposal of very-low-level radioactive waste.*
- Draft documents regarding quality and personnel management at the Ignalina NPP.

General Requirements for decommissioning of Ignalina NPP were supplemented.

The following documents and draft documents were reviewed and analyzed:

- Justification of selection of Ignalina NPP decommissioning strategy.
- The Ignalina NPP Final Decommissioning Plan.
- The Ignalina NPP Unit 1 Final Shutdown and Defuelling Phase Decommissioning Project and its Safety Analysis Report.
- The safety analysis report of the facility for cementation of spent ion-exchange resins and storage facility.
- The study on construction of a near-surface repository for short-lived low- and intermediate-level radioactive waste in Lithuania.
- The report on site selection for a repository for short-lived low- and intermediate-level radioactive waste.
- The report on preliminary acceptance criteria for very-low-level radioactive waste intended for disposal in a repository and the technical specification on construction of the repository.
- The technical specifications on the new spent nuclear fuel storage facility and modernization of radioactive waste management.
- The safety case for the single operating Unit 2.

The following was done to strengthen VATESI and Lithuanian TSOs capabilities in assessing licensing documents:

- Workshops were held on issues related to NPP decommissioning (Germany, 2002), radioactive waste management (Lithuania, 2002), integrity of nuclear fuel assemblies, and characterization and processing of radioactive wastes (France, 2004), as well as dismantling and decontamination of nuclear power facilities (Germany, 2005).
- A training course on safety assessment issues was arranged (The UK, 2002).
- The SPRING code was acquired that enables to simulate radionuclide transfer in the geosphere.

8. Documents and projects of the decommissioning

8.1. The Final Decommissioning Plan

The Final Decommissioning Plan is the principal document in accordance with which Ignalina NPP decommissioning operations are planned and carried out. The Ignalina NPP is preparing the document and coordinating it with competent authorities. The Ministry of Economy of the Republic of Lithuania confirms the Final Decommissioning Plan.

The Ignalina NPP started drafting the Final Decommissioning Plan in 2002. *The Preliminary Plan of Ignalina NPP Decommissioning* and *Technical and financial arguments in selection of INPP decommissioning strategy* were used as the basis for preparing the document. VATESI reviewed several versions of the document. In May 2004, VATESI approved the Final Decommissioning Plan, and it was confirmed by the Ministry of Economy of the Republic of Lithuania.

In the Final Decommissioning Plan, the strategy of Ignalina NPP decommissioning is analyzed, the decommissioning operations are described and their schedule drawn up, conceptual assessment is made of safety and environmental impacts, analysis is made of the management and engineering methods to be used in the decommissioning, as well as dismantling, decontamination and cutting technologies, and the remote control equipment. The program of radioactive waste management is also set forth in the Plan, as well as safety and radiation protection procedures and the requirements for the quality assurance system.

Based on the Final Decommissioning Plan, projects of decommissioning will be prepared. Some decontamination and dismantling projects will be implemented with operation license effective.

Information on the projects implemented with operation license is tabulated below

Project	Operations
<p>Project one of decontamination and dismantling</p>	<p>Dismantling in reactor turbine halls of systems and equipment that are not necessary from the viewpoint of nuclear safety and operation.</p> <p>Dismantling of turbines, some of their piping and water deaerators in the control, electricity and deaerator compartments.</p>
<p>Project two of decontamination and dismantling</p>	<p>Dismantling in reactor buildings of systems and equipment that are not necessary from the viewpoint of nuclear safety and operation.</p> <p>Dismantling of reactor gas circuit and special ventilation system.</p> <p>Dismantling of uncontaminated equipment in the reactor emergency cooling system's building.</p>
<p>Project three of decontamination and dismantling</p>	<p>Dismantling in reactor buildings of equipment related to criticality and electric power supply control systems, as well as the devices of the core.</p> <p>Dismantling of reactor's lower water communications, steam and water piping, discharge pipes, and the facility for treatment of low-mineralization water in the headers of the main circulation circuit.</p> <p>Implementation of the project will only start after all fuel has been unloaded from the reactor.</p>

After nuclear fuel is unloaded from Units 1 and 2, all other decommissioning operations will be carried out in compliance with the decommissioning license. Equipment in the controlled and surveillance zone will be dismantled. After buildings and different structures have been decontaminated, it will be possible to discontinue nuclear safety control. Later on, these structures will be demolished.

Information on the projects that will be implemented with decommissioning license is tabulated below

Project	Operations
<p>Project four of decontamination and dismantling</p>	<p>Dismantling operations in reactor buildings, the facility for treatment of low-mineralization water in the main circulation circuit and the system of special ventilation:</p> <ul style="list-style-type: none"> - internal decontamination of the cooling system of spent nuclear fuel storage ponds and the system of low-salinity water; - ultrasonic decontamination of the pond and fuel transfer channel walls; - dismantling of the remaining large-size equipment (pumps, heat exchangers); - dismantling of drum separators.
<p>Project five of decontamination and dismantling</p>	<p>Dismantling of fuel channels, unloading of graphite, dismantling of activated internal elements and biological protection screen in reactor buildings.</p>
<p>Project six of decontamination and dismantling</p>	<p>Dismantling of headers in the compartments of heat piping, fire-protection equipment, control, electricity supply, and deaerators.</p> <p>Dismantling of facility for treatment of liquid waste.</p> <p>Dismantling of all controlled ventilation equipment and ventilation stacks of Units 1 and 2.</p>
<p>Project seven of decontamination and dismantling</p>	<p>Demolition of buildings.</p> <p>Remediation of the territory. The project is to be implemented without supervision by the safety regulating institution.</p>

The first five projects will be implemented in Ignalina NPP Units 1 and 2 separately, whereas projects six and seven are common for the entire INPP. Prior to carrying out operations, authorization must be obtained from VATESI for all decontamination and dismantling projects and their safety cases.

8.2. The Ignalina NPP Unit 1 Final Shutdown and Defuelling Phase Decommissioning Project

After Ignalina NPP Unit 1 was shut down, part of nuclear fuel remained in the reactor, therefore most of the systems are still being operated. The spent fuel from the core is taken to the cooling ponds and, later on, to the interim storage facility. The necessary systems will be further operated and modified, if necessary. The systems that are not necessary will be prepared for dismantling.

The main objective of the project is to identify the decommissioning operations related to defuelling due to be carried out, to draw up a plan of actions, to gather information necessary for producing procedures and conducting operations. After analysis was made systems were identified that will further be operated with or without modification, as well as those that will be conserved for operating at later stages. The systems that will not be operated were also identified. They will be prepared for dismantling or isolated and dismantled during later stages of the decommissioning.



Reactor hall of the Ignalina NPP Unit 1

The following operations are planned for the project implementation:

- isolation of systems or their parts that are no longer necessary, modification and operation of systems that are necessary;
- removal of nuclear fuel from reactor core and cooling ponds;
- removal of cooling liquids, gases and other substances from technological circuits that are no longer necessary;
- internal decontamination of the main circulation circuit, its purification and cooling system, and the refuelling machine;
- management of radioactive waste.

Part of fuel from Unit 1 will be taken to Unit 2 for further utilization. Some 1000 fuel assemblies will be reloaded in this manner. This will be done in compliance with a separate project funded by the INPP. The operations of fuel transferring from Unit 1 are expected to be completed in 2006–2013. Fuel unloading is related to the construction of a new facility for storage of spent nuclear fuel where the fuel from the cooling ponds will be stored.

9. Modernization of radioactive waste management

In the course of decommissioning, large amounts of radioactive waste accumulate that need to be safely managed and disposed of. The method of disposal depends on radioactive waste properties. Classification of radioactive wastes and the methods of their disposal are defined in *Regulations on the pre-disposal management of radioactive waste at the nuclear power plant* approved by VATESI.

Classification of solid radioactive waste

Class	Definition	Surface dose rate, mSv/h	Final processing	Method of disposal
<i>Short-lived very-low, low- and intermediate-level radioactive waste</i>				
A	Very-low-level radwaste	≤ 0.5	Not required	In repository for very-low-level radwaste
B	Low-level radwaste	0.5-2	Required	In near-surface repository
C	Intermediate-level radwaste	> 2	Required	In near-surface repository
<i>Long-lived low- and intermediate-level radioactive waste</i>				
D	Low-level radwaste	≤ 10	Required	In intermediate-depth repository
E	Intermediate-level radwaste	> 10	Required	In geological repository
<i>Disused sealed sources</i>				
F	Disused sealed sources		Required	In near-surface or geological repository

It is important to separate short-lived wastes from long-lived, as the former may remain dangerous for hundreds, and the latter for thousands of years. That is why long-lived wastes are disposed of in complex repositories constructed deep under ground, and short-lived wastes in repositories constructed close to the surface. Radioactive wastes having beta and/or gamma emitters with a half-life of over 30 years, with the exception of ^{137}Cs , and/or alpha emitters whose measured or calculated specific activity in an individual waste package exceeds 4000 Bq/g, or if the mean specific activity of alpha emitters in a single package averaged from all the waste packages exceeds 400 Bq/g, are considered to be long-lived radioactive wastes.

The policy of radioactive waste management is identified in the *Radioactive waste management strategy* approved by the Government of the Republic of Lithuania in 2002. Management of radioactive waste at the Ignalina NPP is to be updated. To this end, the nuclear power plant in preparation for managing radioactive wastes that will form during decommissioning will be provided with facilities required for radioactive waste management. The strategy identifies the methods to be used for managing different types of waste (solid, liquid, and spent nuclear fuel).

Solid short-lived and long-lived radioactive waste is managed at the Ignalina NPP with a view to:

- reduce, with the use of the best technologies, the total activity and volume of radioactive waste;
- retrieve, characterize, condition and place in new storage facilities short-lived waste accumulated in the existing Ignalina NPP storage facilities of solid radioactive waste, and properly process long-lived radioactive waste;
- construct a repository for disposal of very-low-level radioactive waste;
- prepare for disposal in a near-surface repository solid short-lived low- and intermediate-level radioactive waste from the Ignalina NPP;
- construct adequate interim storage facilities and store the long-lived radioactive waste in there, without its final immobilization until the decision is taken regarding the method of its final management.

While managing liquid radioactive waste at the Ignalina NPP it is necessary to:

- solidify and pack liquid radioactive waste in such a manner that its packages are suitable for transport, storage and disposal in a near-surface repository;
- cement spent ion exchange resins and concentrate sediments;
- conduct studies and decide whether or not the storage facility of bituminized radioactive waste could be converted into a repository and license the storage facility of bituminized waste as a repository, or modify the technology in such a

manner that the radioactive waste packages are suitable for transport, storage and disposal in a near-surface repository;

- select a suitable technology for managing spent oil.

The following measures have been envisaged with a view to ensure safe disposal of spent nuclear fuel:

- to develop and implement the long-term program of scientific studies *Possibilities of disposal in Lithuania of spent nuclear fuel and long-lived high-level radioactive waste;*
- to analyze the possibilities of constructing in Lithuania a repository for spent nuclear fuel and long-lived radioactive waste;
- to analyze the possibilities of constructing a regional repository;
- to analyze the possibilities of disposal of spent nuclear fuel in other countries and to determine whether or not this method of disposal is economically feasible;
- to analyze the possibilities of extending the storage time of spent nuclear fuel in storage facilities by 100 years or more.

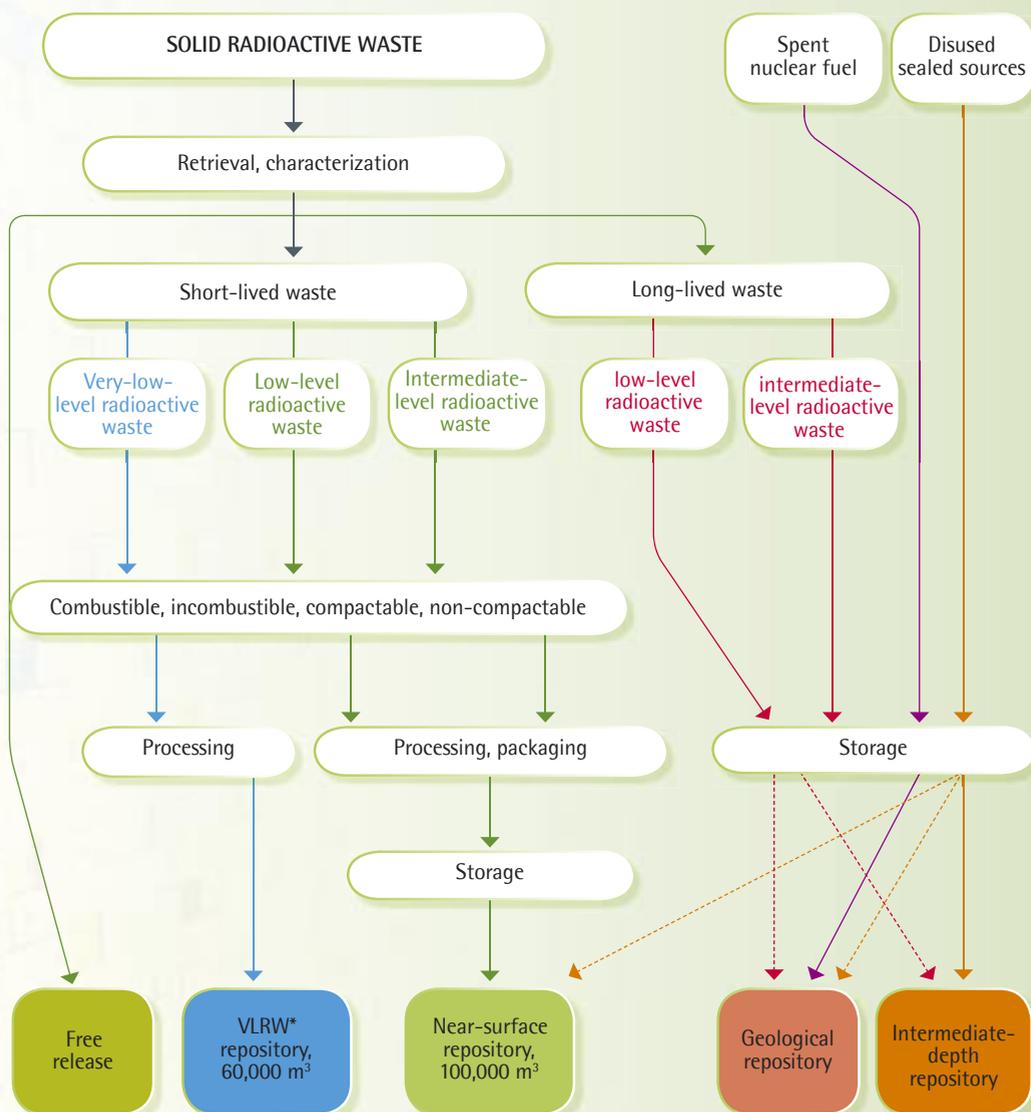


Spent nuclear fuel is currently being stored in a storage facility

10. Management of solid radioactive waste

Radioactive waste at the Ignalina NPP is currently characterized in accordance with the waste classification that was valid when the nuclear power plant was constructed. This practice, however, does not comply with the procedure established in the regulatory documents of the Republic of Lithuania. In order to comply with the new radioactive waste management requirements, the Ignalina NPP needs to introduce the new classification of radioactive waste and to modernize the system of radioactive waste management. The modernization of radioactive waste management will be completed in 2009, when new facilities for characterization, processing, conditioning and storage are constructed. It will be done through implementation of individual projects.

Directions of solid radioactive waste management



*VLRW – very-low-level radioactive waste.

Part of the decommissioning waste can be taken to regular dumps or used as a secondary raw material, in other words, its radiation safety will no longer be controlled. However, this kind of waste can be taken outside the boundaries of the NPP only after its level of contamination has been checked and proven to be within permissible limits. Special facilities installed at the site of the Ignalina NPP are to be used for this purpose.

11. Projects related to modernization of radioactive waste management

11.1. Licensing of cementation facility and storage facility of cemented waste

On March 10, 2006, VATESI issued an operation license for the liquid radioactive waste cementation facility and an interim storage of cemented radioactive waste. The waste that generates when purifying the technological water of the Ignalina NPP and that has been accumulated in tanks is solidified by mixing with cement. The cemented waste is then placed into storage containers. Radioactive waste packages can be stored in the new facility for as long as 60 years.



Cementation of waste that forms while purifying technological water at INPP

11.2. A new facility for treatment and storing solid radioactive waste

At present, all solid radioactive waste is being stored in the storage facilities of the Ignalina NPP. The Ignalina NPP decided to install a new facility for solid radioactive waste management and storage comprising facilities for processing and storing long-lived waste, as well as facilities for managing and storing short-lived low- and intermediate-level waste. The accumulated solid radioactive waste will be retrieved from the existing storage facilities, processed and transferred to the newly constructed complex where it will be stored until repositories are constructed. All the solid radioactive waste generated during operation and decommissioning of the Ignalina NPP will be managed and stored in the complex.

To reduce the amounts of waste, state-of-the-art methods applied in international practice are to be used in the new facility, i.e. combustible low-level radioactive waste

will be incinerated, and intermediate-level waste will be compacted. The processed waste is to be placed into containers. Containers with short-lived intermediate-level waste will be sealed with cement. Radioactive waste can remain in the storage facility for some 50 years.

In 2003, the Ignalina NPP produced and obtained VATESI approval for the technical specification of the project. The NPP already has the contractor that will implement the project.

It is planned to commission the new facility for managing and storing solid radioactive waste at the Ignalina NPP in late 2009. Radioactive waste will then be managed in compliance with EU requirements and IAEA recommendations.

11.3. A new storage facility for spent nuclear fuel

Spent nuclear fuel is a variety of long-lived radioactive waste. In Lithuania, spent nuclear fuel is neither disposed of nor reprocessed. After being unloaded from the reactor it is stored for several years in cooling ponds installed nearby and, later on, in a special storage facility existing in the vicinity of the NPP. This facility has already been filled and it is due to be expanded. This, however, will not solve the storage problem of spent nuclear fuel. A new storage facility needs to be constructed to accommodate the fuel that the old facility is not capable of accepting.



Construction of a new storage facility for spent nuclear fuel

The Ignalina NPP prepared and coordinated with VATESI in 2003 the technical specification on the design and construction of a spent nuclear fuel storage facility. Some 19,000 spent nuclear fuel assemblies are to be stored there.

After the project of construction and installation of the new spent nuclear fuel storage facility has been implemented, the Ignalina NPP will have the facilities and

equipment that will ensure the management of fuel assemblies whose integrity has been damaged, safe retrieval of spent nuclear fuel from cooling ponds, its transportation to a new storage facility and safe keeping there for at least 50 years. Considerable attention will be paid to assurance of the storage facility's physical protection.

In early 2005, representatives of Ignalina NPP contractors met with VATESI specialists and discussed the issues related to design, construction and installation of the spent nuclear storage facility. It is planned to start transporting spent nuclear fuel from cooling ponds to the first part of the new spent nuclear fuel storage facility in 2008. By 2016 the storage facility will be filled with spent nuclear fuel.

11.4. Construction of a repository for very-low-level radioactive waste

Repositories with simple engineering barriers are used for disposal of very-low-level radioactive waste. The Ignalina NPP is preparing to construct a facility of this type. Some 60,000 m³ of waste is to be disposed of in the repository.

In 2003–2004, specialists of the Ignalina NPP assisted by Swedish experts from the STUDSVIK company (Sweden) began preparatory work for the construction of a repository for very-low-level radioactive waste. Swedish experts produced a study of the repository subsequently to be used in the technical specification of the design. In 2006, VATESI specialists assisted by experts of the PHARE project submitted comments regarding preliminary acceptance criteria for radioactive waste intended to be disposed of in the repository for very-low-level radioactive waste and their substantiation report, as well as regarding the technical specification on the repository's construction.

The Ignalina NPP plans to start operating the repository in 2010. However, a delay occurred in preparatory work. The NPP must obtain VATESI approval for the technical specification on the repository's construction and its design. Only then envisaged work can be started.

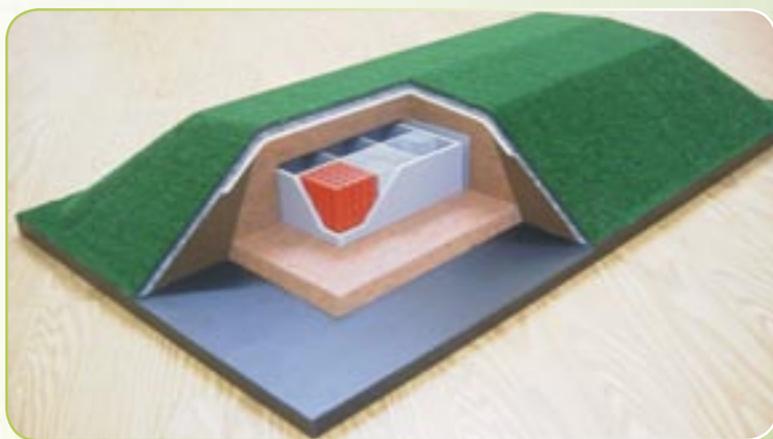
11.5. Construction of a near-surface repository of radioactive waste

All short-lived low- and intermediate-level radioactive waste is currently being stored in storage facilities of the Ignalina NPP. It is planned to dispose of this waste in a newly-constructed near-surface repository. Radioactive waste generated in the course of decommissioning is also to be disposed of there. The facility is to accommodate some 100,000 m³ of radioactive waste.

A near-surface repository is a repository constructed close to the earth surface with natural and engineered barriers that prevent the waste from spreading into the

environment. Repositories of this type must be supervised several hundred years (up to 300 years in the case of the proposed facilities). After this period of time the waste will pose no danger even if the engineered barriers degrade.

In 2002–2004, RATA worked out the concept of radioactive waste disposal in a near-surface repository, and conducted a study on selection of sites suitable for a near-surface repository. Lithuanian scientists studied the geological structure of the proposed Galilaukė and Apvardai sites and assessed the environmental impacts of the repository. The sites are in the vicinity of the Ignalina NPP, and thus a short distance away from Lithuania's border with Belarus and Latvia. Therefore the issue gained considerable attention from the public not only of Lithuania but also of the neighboring countries. In 2005, the decision was taken to study Stabatiškė site, too. In 2006, VATESI specialists jointly with experts of the PHARE project reviewed and assessed the study by RATA on selection of the site for a repository of low- and intermediate-level radioactive waste. After the environmental impact assessment report has been analyzed, the decision will be taken regarding the site on which the repository is to be constructed.



Model of a near-surface radioactive waste repository

After the site has been selected, in a couple of years construction of a repository for disposal of short-lived low- and intermediate-level radioactive waste would begin. The facility could be commissioned around 2012, after its safety has been assessed and VATESI license has been granted.

11.6. Possibilities of disposal of long-lived radioactive waste

Spent nuclear fuel will be finally managed only after it has been disposed of in a geological repository, a facility constructed at a depth of several hundred meters where safety of humans and the environment is ensured by natural barriers (rocks lying at a great depth) and several engineered barriers that complement one another. Other long-lived radioactive waste generated during the operation and decommissioning of the Ignalina NPP, as well as disused sealed sources will also have to be disposed of in this repository.

It is said in the Strategy of radioactive waste management approved by the Government of the Republic of Lithuania in 2002 that it is necessary to prepare for disposing of spent nuclear fuel and other long-lived radioactive waste as safely as possible. RATA, the Geological Survey of Lithuania, and the Institute of Geology and Geography produced *The program of assessment of possibilities of the disposal of spent nuclear fuel and long-lived radioactive waste for the years 2003–2007*. Scientists will decide whether or not spent nuclear fuel can be safely disposed of in Lithuania. The results available today suggest that technologically it is possible.

Alternative possibilities, those of disposal of long-lived radioactive waste in other countries or in a regional repository, provided that several countries decide to construct it in one of them, are also being analyzed.

Contributors to the PHARE project:

European Commission

Ministry of Finance of the Republic of Lithuania

Central Project Management Agency (CPMA), Lithuania

AVN, Belgium

GRS, Germany

Institute of Physics, Lithuania

ES-Konsult, Sweden

IRSN, France

Kaunas University of Technology, Lithuania

RISKAUDIT, France

SERCO Assurance, United Kingdom

SKI-ICP, Sweden

Studsvik RadWaste AB, Sweden

STUK, Finland

VATESI, Lithuania

**The brochure is prepared by VATESI specialists
Darius Lukauskas, Dijana Medelienė, Vidas Paulikas and Kristina Tumosienė**

Translation by Vytautas Petrukaitis

Photos by Nerijus Rakštikas and from VATESI archive

State Nuclear Power Safety Inspectorate (VATESI)

12 A. Goštauto St., LT-01108 Vilnius, Lithuania

Tel. +370 5 262 41 41, fax +370 5 261 44 87

E-mail: atom@vatesi.lt, www.vatesi.lt

Published by Leidybos įmonė „Kriventa“

5-3 V. Pietario St., LT-03122 Vilnius, Lithuania

Tel./fax +370 5 265 06 29

E-mail: kriventa@takas.lt, www.kriventa.lt

