

# ***Ignalina NPP Decommissioning: Commitment to Achievement***



## About the Ignalina Nuclear Power Plant

### Vision

The enterprise aims to become known as leader and expert in the safe and effective decommissioning of the nuclear power plants units with RBMK type reactors as well as to use its expertise in future energy sector projects.

### Mission

The enterprise's mission - safely and in time to implement the unique project in the world - to discontinue the operation of RBMK type plant using resources effectively, while maintaining public support for nuclear energy.

### Values

Nuclear and Radiation Safety  
Activity Transparency and Responsibility  
Experienced Personnel  
Activity Efficiency  
Social Responsibility



In line with accession to the European Union treaty commitments, SE Ignalina Nuclear Power Plant (hereinafter - INPP or enterprise) completely suspended the production of electricity on 31 December 2009.

INPP activity has been changed from electricity producer to decommissioning organization while maintaining the status of nuclear facility operating enterprise. Two INPP energy units with RBMK-1500 type (electrical capacity - 1500MW) reactors were closed (Unit 1 was shut down on 31 December 2004, Unit 2 on 31 December 2009) and the decommissioning of the power plant started.

Since 1 January 2010 decommissioning has become the major INPP activity. The main goal of the enterprise is effectively using resources safely and in time to implement the unique project in the world - to terminate the operation of RBMK type plant while maintaining public support for nuclear energy.

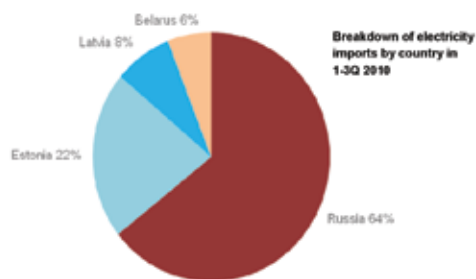
**Do you know** that one of the main advantages of RBMK-type reactors operated at the INPP is that operators can manage the refueling process without power loss. It makes RBMK reactors different from water-cooled reactors.

Lithuania complied with the requirements of the Treaty of Accession to the European Union to shut down Ignalina NPP and the EU committed itself to provide adequate additional financial assistance to the decommissioning. It was declared that the Member States are, in solidarity with Lithuania, ready to continue to provide adequate additional Community assistance to the decommissioning efforts also after Lithuania's accession to the European Union.

In closing this nuclear power plant, Lithuania has become highly dependent upon imported electricity and imported natural gas - both from the same source - to meet its energy needs. The percentage of imported electricity in Lithuania in 2010, at 62%, was the highest in the European Union.

Lithuania transformed from an exporter to an importer of electricity and consumer electricity prices rose nearly 30%.

In the first three quarters of 2010, imports of electricity rose nearly 9-fold compared with 2009 and imports of gas by 14%. Lithuania is still heavily integrated into the energy networks (electricity and gas supply) of the former Soviet Union and isolated from western Europe's energy systems. This makes the country highly reliant on a single source of all energy resources, and vulnerable to price fluctuations and limitations of supply.



The Russian generating capacity that now supplies Lithuania includes eleven operating RBMK reactor units.

**Do you know** that in 1993 INPP produced record amount of electricity – 12, 26 billion kWh and this figure was recorded in the Guinness Book of Records as the largest contribution to the common electricity production in the world's nuclear history.

## Ignalina NPP Decommissioning

It is a situation in which Lithuanian consumers have become more vulnerable to energy supply interruptions and large price fluctuations. We appreciate the support that we are receiving from the Community to modernise electricity production in Lithuania and establish electricity transmission interconnections with other EU countries.

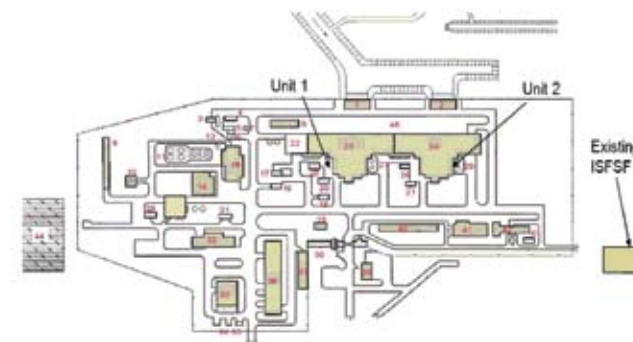
Lithuania is pioneering the dismantling of an RBMK plant and so there are many technical uncertainties and, when forecasting a process that extends nearly 20 years ahead, there must inevitably also be financial uncertainties. However, it is essential for the planning and continuity of safe decommissioning that sufficient funding is in place.

As part of our commitment to the values of the European Union, we have accepted to bear the economic and social impact of Ignalina NPP closure and we recognise that there will be ongoing costs to the country for the safe-

keeping and disposal of radioactive wastes until long into the future. Lithuania is seeking the continued support of the European Union for the window of the technical dismantling of the power plant. We trust that the Community will continue to display its solidarity with the citizens of Lithuania in this respect.

Lithuanian citizens treat the EU obligations, recorded in Protocol No. 4 of the Accession Treaty of Lithuania to the European Union, to provide adequate financial support for decommissioning as an absolute EU's commitment to Lithuania. Lithuanian citizens are convinced that the EU must carry out its duty of solidarity because noncompliance with its commitments will have very serious social and economic outcomes not only for the Visaginas town and the whole region but also for Lithuania in common.

## INPP Decommissioning Scheme



### INPP Operational waste (→2009)

Spent fuel	→22000 assemblies
Stored solid waste	→30000 m <sup>3</sup>
Bituminized waste	→14000 m <sup>3</sup>
Waste to be cemented	→6000 m <sup>3</sup>

### INPP Decommissioning waste (2009→)

Equipment	→130000 tons of steel
Reactors	→4000 tons of steel →4000 tons graphite →11000 tons filling
Buildings	→1000000 m <sup>3</sup> of concrete →200000 tons of steel

**Do you know** that INPP specialists were the first ones who started using the enriched fuel with a burnable absorber—erbium.

# Decommissioning Strategy

Decommissioning is the last stage of power plant existence after it was designed, constructed, started to operate and was in operation. The ultimate goal of decommissioning is to achieve the condition when the territory is out of control of national supervisory authorities and may be used for other purposes.

The Ignalina NPP decommissioning project includes decommissioning of Unit 1 and 2 and auxiliary facilities. One of the Ignalina NPP decommissioning priorities is in-house approach - to perform as many works as possible with the INPP personnel help. It is expected to achieve the "brown field" end-stage by 2029 - to arrange power plant's environment in a proper way so that it would be possible to rehabilitate its territory and develop economic activity preserving buildings and infrastructure that can be used.

## Decommissioning Strategy — Immediate Dismantling

### INPP Dismantling

On 26 November 2002, Lithuanian Government passed a resolution to the effect that the Ignalina NPP Unit 1 is to be decommissioned through immediate dismantling; i. e. dismantling should be commenced immediately after the suspension of the power plant.

The goal of this strategy is the safe, cost-effective and environmentally friendly removal of all inventories (radioactive, non-radioactive and hazardous) from the buildings and territory according to a process that should progress in an uninterrupted manner until "green field" conditions are reached. For a large part of

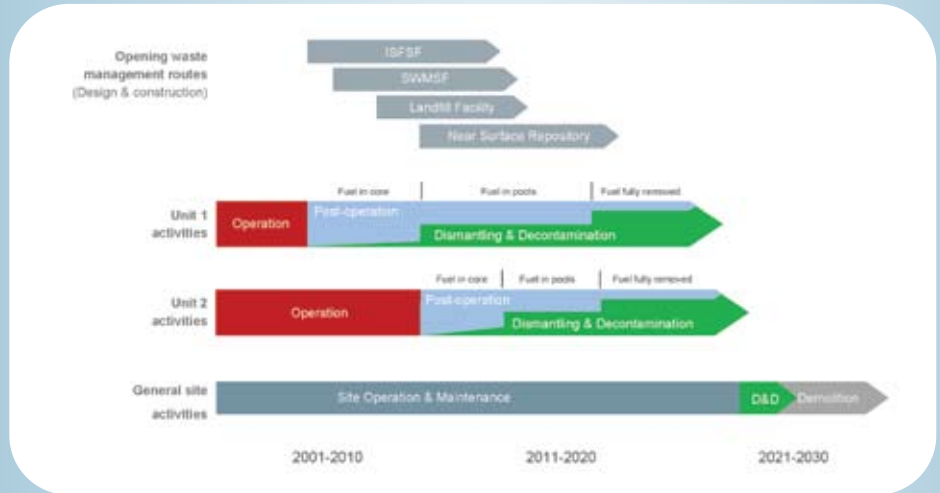
the Ignalina NPP site, this is foreseen by 2030. However, return to fully "green field" conditions of the entire site will not be achieved at that time as storage of spent fuel is expected beyond 2050 pending final disposal and other on-site radioactive waste disposal facilities will still be under institutional control.



**Do you know** that during the 26 years of operation Ignalina NPP has produced 307,9 billion kWh of electricity.

# Decommissioning Stages & Current Status

## Overall schedule



(ISFSF—Interim Spent Fuel Storage Facility, SWMSF—Solid Waste Management and Storage Facilities)

The entire decommissioning process of Ignalina NPP is phased over approximately 30 years, starting with preparatory planning in 2001 and culminating with the demolition of on-site structures by the end of 2029. Within each unit, dismantling will commence with the less radioactively contaminated areas (primarily the turbine hall); the reactors will be tackled last.

One of the most significant State Enterprise Ignalina Nuclear Power Plant Decommissioning stages – unloading of spent nuclear fuel from Unit 2 reactor and transfer of it into the storage pools – started on 1 February. The Fuel Part Unloading

Programme was developed by the specialists of INPP Decommissioning Projects Management Service Nuclear Fuel Department. The Programme has been agreed with State Nuclear Power Safety Inspectorate (VATESI). This Programme is also the part of the Decommissioning Project for INPP Unit 2 Final Shutdown and Defuelling Phase (U2DPO). It foresees unloading of 500 fuel assemblies from the second reactor of the power plant and transfer of them to the storage pools. The completion of the Programme is foreseen in February 2011.

**Do you know** that the total weight of the reactor with fuel is 9400 tons.

## Key Decommissioning Projects

After the beginning of the implementation of INPP decommissioning projects clear goals were set. One of the goals is to become known as the international leaders and experts in the effective and safe decommissioning of the Nuclear Power Plants Units with RBMK reactors. In order to meet this goal the high-level system of human resources, cost and process management, project management and radioactive waste management

should be amplified. The following aims will be laid down: the effective and transparent implementation of the decommissioning projects, personnel retention by carrying out all the works using own resources to the extent possible, and use of personnel knowledge and skills by providing them the possibility to gain a new and unique experience. All the factors are strongly emphasized.

### New Interim Spent Fuel Storage Facility (ISFSF) – project B1

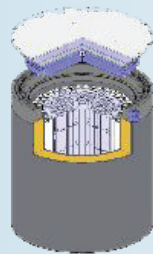
The **objective** of B1 project is:

- ▶ to build a new dry type Interim Spent Fuel Storage Facility (ISFSF) for the spent nuclear fuel, unloaded from the Units 1 and 2;
- ▶ to design, construct and install all equipment, necessary to pack the spent nuclear fuel into the special containers, to seal them and to transport them from the storage pools to the ISFSF.

**After putting the new ISFSF into operation:**

- ▶ all spent nuclear fuel will be transported from the INPP storage pools to the dry type Storage Facility;
- ▶ the spent nuclear fuel from the INPP will be safely stored according to the requirement of the Republic of Lithuania, EU standards and IAEA recommendations.

**Interim Spent Fuel Storage Facility:** This facility, essential to remove spent fuel from the reactor units, will house 15,555 fuel assemblies in 190 dry-store casks (figure). It complements an existing facility used during Ignalina NPP operation. The fuel will remain in this facility for 50 years pending a solution on final disposal (deep underground disposal or reprocessing). The decision to use a new design of cask has led to delays in completion of this project, now scheduled for 2012.

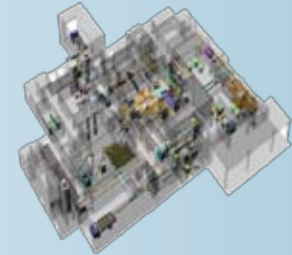


Price of the project: 193 million Euro

**Do you know** that the construction of INPP necessitated constructing 142 km of roads, 50 km of railway, 390 km of communication lines, 334 km of electricity lines, 133 km of sewerage lines, and 164 km of thermal lines.

## Solid Waste Management and Storage Facilities (SWMSF) - project B2/3/4

The objective of B2/3/4 project is to build a new **INPP Solid Waste Management and Storage Facilities (SWMSF)**. The project includes two independent components to be implemented simultaneously: B2 (New Solid Waste Retrieval Facilities Design and Construction) and B3/4 (New Solid Waste Management and Storage Facilities Design and Construction). The commissioning of the new facilities will enable to introduce at the INPP the new solid radioactive waste management and storage system which will comply with new requirements of the Laws of the Republic of Lithuania, European Union Standards and IAEA recommendations.



Price of the project: 123 million Euro

**Solid Waste Management & Storage Facility:** This facility, which includes the retrieval of existing operational wastes, is for the sorting and management (super-compaction, incineration, etc.) of operational and decommissioning wastes, and their storage until disposal in the Near Surface Repository or a deep underground repository. Construction of the management and storage part is underway and the facility should become operational by 2013; the retrieval units will follow in mid-2014.

### Landfill Facility for Short-lived Very Low Level Waste (Landfill)

To be sited adjacent to the SWMSF, the facility offers a safe and cost-effective solution to the disposal of short-lived very low level solid waste and will have a capacity of 60,000 m<sup>3</sup> in 3 cells. The cells will be constructed, filled in campaigns and closed during the course of decommissioning. The first stage of the project is underway (construction of a 4000 m<sup>3</sup> buffer store and the detailed design of the cells). Construction of the first cell will start in 3Q/2012.



Price of the project: 30 million Euro

**Do you know** that 5000 designers were involved in development of the design documents during construction of INPP.

## Near Surface Repository for Low and Intermediate Level Short-lived Radioactive Waste

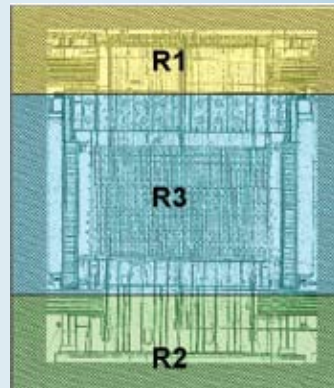
**Near Surface Repository:** for short-lived low and intermediate-level radioactive waste, following conditioning (cementation) in reinforced concrete casks, to be disposed into concrete vaults constructed above ground level. Directly adjoining the Ignalina NPP site, the multi-barrier design of this repository will reliably protect the environment against contamination for at least 300 years, until the activity of the radioactive waste naturally decreases and no longer constitutes a hazard. Currently at the design stage, construction of the first cell will start in mid-2015.



Price of the project: ~290 million Euro

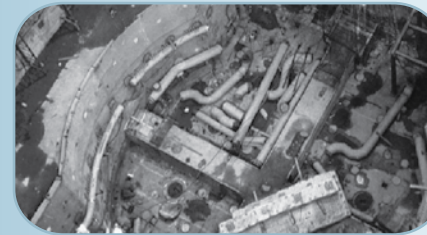
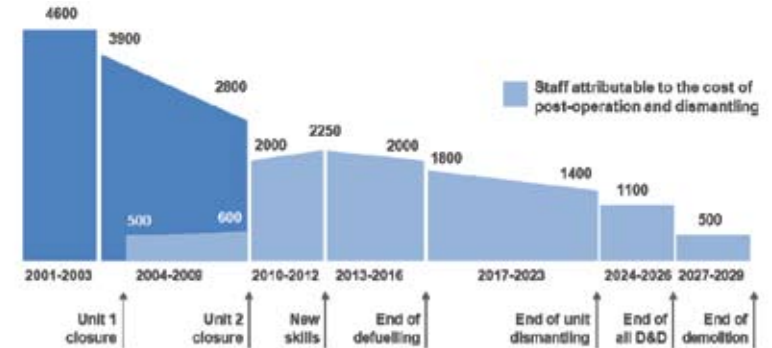
## Engineering on Dismantling of Units 1 and 2 Structures from the Reactor Shafts – project UP01

Project UP01 was initiated as an internal project which will enable the INPP personnel to use their knowledge and experience maximally. The internal projects reduce the need in the decommissioning funds significantly. There is the intention to cooperate with Lithuanian and foreign scientific institutions. In June 2010, the agreement between INPP and IAEA was signed concerning the participation in the project "The management of irradiated graphite in order to ensure compliance with the criteria of the waste acceptance for disposal".



**Do you know** that during construction of Ignalina NPP a unique walking transporter was used. It could lift metal structures needed for the reactor assembly and carry them as far as 1 km away. Some structures weighed 1000 tons.

INPP applies "in house" project implementation strategy which allows to optimize costs as well as use own staff and gain new know-how



During the planning of the UP01 project implementation, other major decommissioning projects were taken into account - the works of dismantling of pipelines and equipment, the construction of new storage facilities and repositories.

### Major project implementation stages:

- ▶ In 2010, the engineering investigation of R1 (constructions above the Unit 1 reactor) and R2 (constructions below the Unit 1 reactor) zones, data collection, planning of radiological measurements started. The engineering investigations and radiological measurements are scheduled for completion in 2011.
- ▶ The engineering investigations of R3 zone

(Unit 1 reactor), the planning of inspections at the site, the preparations for the inspections at the site, data collection started in 2010.

▶ The start of the preparation of the R1 and R2 (Unit 1 reactor) dismantling and decontamination design documents required for the obtaining permissions is in 2011. The package of R1 and R2 dismantling and decontamination design documents should be ready in 2013.

▶ The performance of the engineering investigations of R3 zone (Unit 1 reactor), data collection, the inspection of the dismantling and decontamination possibilities and waste management requirements for the site - in 2011-2013. In 2013 there must be a decision on the implementation method of R3 in accordance with this information. The preparation of the package of documents will be commenced for R3 dismantling and decontamination. The authorisation for the execution of these works should be obtained until 2016.

▶ The authorisation for the execution of the Unit 2 R3 zone (Unit 2 reactor) dismantling and decontamination works should be obtained in 2017.

**Do you know** that it is expected to achieve the "brown field" end-stage by 2029 - to arrange power plant's environment in a proper way so that it would be possible to rehabilitate its territory and develop economic activity preserving buildings and infrastructure that can be used.

## Ignalina Carbon Competence Center

The INPP endeavors to establish Graphite Competence Center. INPP specialists consider it to be a very perspective idea because the EU funding would support not only the implementation of INPP decommissioning projects but also spread the INPP experts accumulated experience working with graphite to other countries.

Issues, related to the irradiated graphite, should not be addressed alone. By sharing experience and planning in advance bounded investigative and development works, the INPP has an opportunity to achieve success.

The INPP team is convinced that management of waste from reactor should be concerted with dismantling technology. The lack of such integration may affect the whole INPP decommissioning programme.

The INPP team has the potential to accomplish the majority of works (for example, to carry out sampling. The INPP has necessary laboratories, the INPP personnel is pro-active, we have 15 tons of pure graphite for establishment of stands). All the missing parts will be developed within the framework of 2011-2029 enterprise's activity strategy.

## Strengthening of graphite management competence



**Do you know** that Ignalina NPP is pioneering the immediate dismantling of an RBMK type reactors.

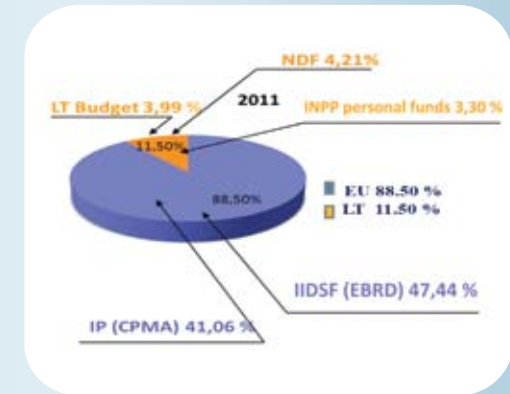
## INPP Decommissioning Funding



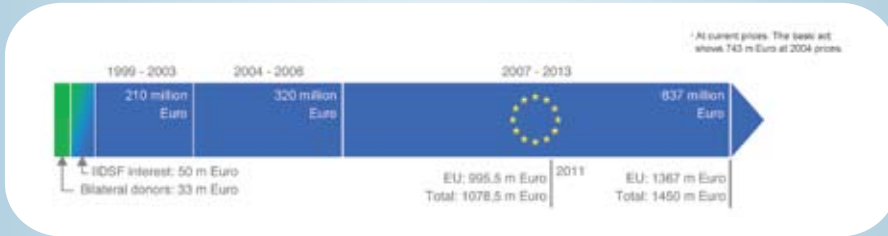
“Safe decommissioning of nuclear installations, including the long-term management of radioactive waste and spent nuclear fuel, calls for substantial financial resources. A lack of these resources at the time they are needed may adversely affect the decommissioning process. Sufficient financial resources at the appropriate time should be available to allow complete decommissioning at nuclear installations in conformity with safety standards”. – Commission Recommendation 2006/851/Euratom.

## European Union and International Resources

The EU members have admitted that the decommissioning of the INPP will take longer than the present financial prospects allow and that it is an excessive financial burden to Lithuania incommensurable with its size and economic power. The EU countries declared that being in solidarity with Lithuania they are prepared to continue additional financial support of the EU for the decommissioning efforts after Lithuania becomes a member of the EU. The primary source of funding for the decommissioning of Ignalina NPP and consequential measures in the energy sector is the European



**Do you know** that over the whole INPP operation period more than 18 thousand fuel assemblies were “burnt” and 850 thousand cubic meters of chemically purified water were produced. This water was required for generation of the steam needed for the turbines.



The primary source of funding for the decommissioning of Ignalina NPP and consequential measures in the energy sector is the European Union.

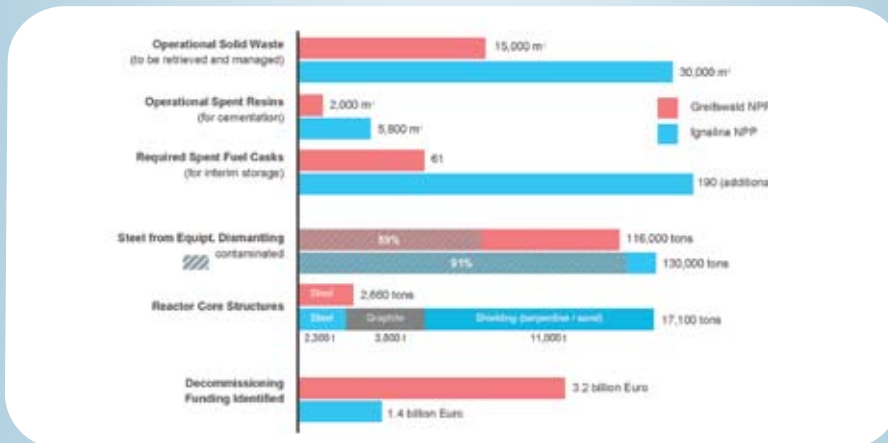
Through the Ignalina International Decommissioning Support Fund (IIDSF), 15 bilateral donor countries have also contributed for the same purpose.

The scale of EU funding increased significantly from Lithuania's accession in 2004 with the creation of the Ignalina Programme: it is now approx. 120 million Euro per year.

Less than 30% of the EU and international funding allocated until 2011 has been used for projects in the energy sector.

## Comparison with Greifswald NPP decommissioning

Greifswald NPP, in the former German Democratic Republic, comprises 6 x 440 MWe VVER (Soviet-design pressurised water reactor) units of which one unit was never operated and one was operated for only 23 effective full power days. The plant was subject to early closure in 1991, shortly after the reunification of Germany. Decommissioning at Greifswald NPP is now well advanced.



In technical respects, the scale of decommissioning work to be conducted at Ignalina NPP significantly exceeds that at Greifswald NPP. Moreover, while there is established experience in the dismantling of pressurised water reactors, no other RBMK has been dismantled and worldwide there has been no dismantling of any graphite-moderated reactor of equivalent size.

**Do you know** that approximately 60 percent of Unit 3 was completed but after the Chernobyl accident the government of the LSSR requested USSR authorities to stop the construction of Unit 3. The construction of Unit 3 was preserved and totally suspended in 1989.

## National Decommissioning Fund

In addition to European Union and international resources, Lithuania is making a significant national contribution to Ignalina NPP decommissioning. It is a usual international practice to raise the price for electricity generated at a NPP gradually and thus accumulate the so-called closure fund over the years of its operation. Since 1995 funds for the INPP decommissioning have been started to deposit in the National SE Ignalina Decommissioning Fund. Over the period until closure, the National Decommissioning Fund (NDF) took in 161 m Euro; to the end of 2010 it committed 116 m Euro leaving a balance of 45 m Euro.

The NDF is used to meet the costs of commissioning by co-financing IIDSF projects and paying costs that are ineligible or, due to their low value, uneconomical for the use EU funding; these include physical protection, redundancy payments, low price goods and travel costs.

## Own-resources and Assets of Ignalina NPP

As a State Enterprise, Ignalina NPP was legally entitled to retain part of the revenue from its sales of electricity for its own use. At the closure of the plant, the balance of funding held amounted approx. 100 m Euro. Where decommissioning costs are reimbursed from the EU resources, this funding is used as an essential payment buffer. It is also used to meet certain staffing, utility and ongoing contractual costs. It is estimated that in the course of decommissioning, Ignalina NPP will earn up to 30 m Euro from the sale of redundant equipment and recyclable materials giving a total of 130 m Euro available to decommissioning.

## State Budget of the Republic of Lithuania

The State Budget is used to meet the elements of the salary of Ignalina NPP employees that are not eligible under the Ignalina Programme and taxes on procurements. This contribution does not include the costs associated with budgetary – funded institutions that have a role in decommissioning – such as VATESI (State Nuclear Power Safety Inspectorate). It also excludes nationally available social benefits to unemployed persons and their families made redundant by Ignalina NPP.

**Do you know** that there are currently about 22,000 fuel assemblies at INPP, this is 2,500 tons of spent nuclear fuel, of which 16,000 fuel assemblies or 1,800 tons of spent nuclear fuel are stored in the reactor and storage pools.

## In the new Financial Perspective for 2014-2020 Lithuania is applying for 870 m Euro for decommissioning activities

### The INPP decommissioning figures:

- ▶ 840 million Euro has been allocated for the 2007-2013 financial perspective;
- ▶ Complete closure of the INPP will cost 2.9 billion Euro;
- ▶ Lithuania's national contribution – 320 million Euro.

### The price of the closure of the INPP – 2.9 billion Euro – is it expensive or not?

- ▶ Refer to the comparison with the costs of the closure of Greifswald NPP;
- ▶ In Lithuania's case, the volume of works and radioactive waste is significantly higher but the estimated financial support is lower - at the moment the costs of Greifswald NPP already constitute 3.2 billion;

### Financing of energy security projects from funds, allocated for the INPP closure:

Funding of Lithuania's energy security projects in the 2007-2013 financial perspective constituted 29 percent of all the EU funds (for comparison - in Bulgaria - 43 percent and in Slovakia - 46 percent). The EU's financial support which is requested for the period from 2014 to 2020, is calculated exclusively for the decommissioning process excluding energy security projects.

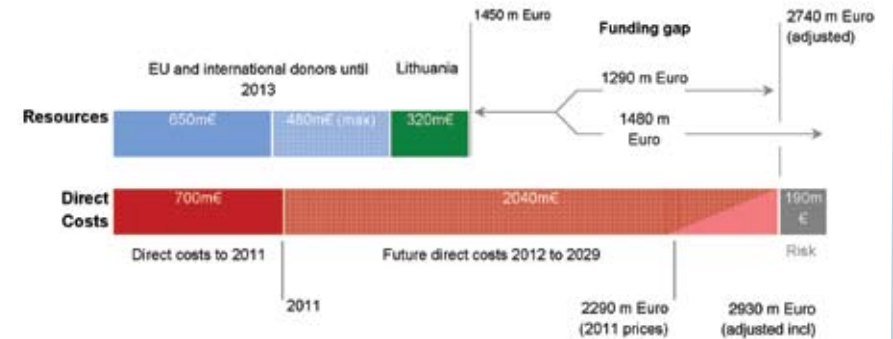
### Lithuania's national contribution to the financing of decommissioning process – what is it? Large or small?

Lithuania's national contribution – 320 million Euro (about 12 percent). Furthermore, Lithuania should allocate and allocate additionally a lot of resources to compensate economic and social effects in the INPP region as well as implement energy security projects. Accordingly, Lithuania's contribution is significantly higher.



**Do you know** that on the INPP site there are about 150 buildings.

## A Way Forward



Based on well-founded cost forecasts and identifiable resources, there exists a major funding gap for completing the safe decommissioning of Ignalina NPP.

Of the EU and international resources allocated to date, less than 30% has been used for energy sector projects. These projects have served to mitigate, but not resolve, the problems in the energy sector of Lithuania consequent to the closure of Ignalina NPP. If Ignalina Programme funding in the 2014-2020 financial perspective is focused only on decommissioning, innovative approaches should be sought to further address energy sector issues. With regard to the Accession Treaty commitments, and in the context of the Ignalina Programme in the 2014-2020 financial perspective, Lithuania is seeking European Union assistance to bridge the funding gap until 2029. In order to ensure proper funding of Ignalina NPP decommissioning process until 2029, **1 480 m Euro** from the EU funds should be allocated additionally.

**Do you know** that INPP territory is about 1000 ha.

Lithuania wishes to ensure that firm and realizable plans can be made for the safe decommissioning of Ignalina NPP to its completion. With regard to the Accession Treaty commitments, and in the context of the Ignalina Programme in the 2014-2020 financial perspective, Lithuania is seeking European Union assistance to bridge the funding gap, with attendant risks, to 2029 and thereby to achieve this mutual objective.

Lithuania is bearing the burden of the impact of Ignalina NPP closure on the national economy and already meeting the many indirect costs of decommissioning - it is clear that there will be continuing costs associated with radioactive waste from this power plant until long into the future.

The first-of-its-kind work that will be performed at Ignalina NPP to dismantle the graphite-moderated reactor core is of international interest and importance. Finding solutions for the problem of irradiated graphite is a challenge that Lithuania shares with other EU Member States and European Neighborhood Policy countries.

Lithuania would welcome European coordination of the valuable research and development opportunities that Ignalina NPP decommissioning can offer.

**Do you know** that after Lithuania took over its jurisdiction INPP in 1991, it became the 31st state in the world using nuclear energy for electricity generation.

## Proper Funding for the Mutual Objective

The total cost of immediate INPP decommissioning was estimated as **2 930 m Euro**:



the EU has already allocated a contribution of **1 450 m Euro until 2014**. In order to ensure proper funding of Ignalina NPP decommissioning process **until 2029**, **1 480 m Euro** from the EU funds should be allocated additionally:



**870 m Euro for the period from 2014 to 2020**

Comparison with the well-advanced immediate dismantling of Greifswald NPP demonstrates that the calculated costs are sound and reasonable.

At the moment the costs of Greifswald NPP already constitute **3 200 m Euro**.

**BUT**

In Lithuania's case, the volume of works and radioactive waste is **significantly higher** than at Greifswald NPP.

The EU has committed itself to provide adequate financial support for the mutual objective to decommission INPP in a safe and timely manner

By closing INPP beforehand and not of Lithuania's own volition, the country has become relatively the largest importer of electricity in the EU

Lithuania complied with the requirements of the Treaty of Accession to the EU and therefore reasonably expects that the EU will fulfil its obligation of solidarity to Lithuania, bearing in mind that decommissioning costs are inadequate and represent for Lithuania a crippling financial burden

If sufficient funding is not in place now, the whole process will require even greater financial resources, staff expertise will be lost and social tensions will exacerbate in the region

A lack of financial resources for the long term management of radioactive waste and spent nuclear fuel at the time they are needed will present a danger to the safety of the whole EU

EU's noncompliance with the obligations recorded in the Treaty may give rise to political instability in Lithuania



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