

**PLANNING FOR DECOMMISSIONING OF IGNALINA NUCLEAR POWER
PLANT UNIT-1****P. Poskas, R. Poskas, Rim. Zujus**

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Abstract. In accordance to Ignalina NPP Unit 1 Closure Law, the Government of Lithuania approved the Ignalina NPP Unit 1 Decommissioning Program until 2005. For enforcement of this program, the plan of measures for implementation of the program was prepared and approved by the Minister of Economy. The plan consists of two parts, namely technical- environmental and social-economic. Technical-environmental measures are mostly oriented to the safe management of spent nuclear fuel and operational radioactive waste stored at the plant and preparation of licensing documents for Unit 1 decommissioning. Social-economic measures are oriented to mitigate the negative social and economic impact on Lithuania, inhabitants of the region, and, particularly, on the staff of Ignalina NPP by means of creating favorable conditions for a balanced social and economic development of the region. In this paper analysis of planned radioactive waste management technologies, licensing documents for decommissioning, other technical-environmental and also social-economic measures is presented. Specific conditions in Lithuania important for defining the decommissioning strategy are highlighted.

INTRODUCTION

There is only one nuclear power plant in Lithuania - the Ignalina NPP (INPP). It is situated in the northeast of Lithuania near the borders of Latvia and Belarus, on the bank of the largest Lithuanian body of water, Druksiai lake. The Ignalina NPP is a vital component in Lithuania's energy balance because it is producing more than 70 % of the total electricity production in Lithuania. There are a variety of reasons for this high percentage, but the main is a significantly lower production cost at the present economical and technical circumstances in the Lithuanian power sector.

The INPP possesses two similar units of RBMK-1500 reactors. RBMK-1500 is the last and the most advanced version of RBMK-type reactor design series (actually only two units were constructed). Compared to the Chernobyl NPP reactors (RBMK-1000), the Ignalina RBMK-1500 reactor is more powerful and is provided with an improved accident confinement system. The INPP reactors were commissioned in December 1983 and August 1987 respectively. The original design lifetime is projected to be 2010-2015. After the accident in Chernobyl, the safety systems were re-evaluated and it was decided to decrease the maximum thermal power of the units from 4800 to 4200 MW. That limits the maximum electric power to about 1250 MW per unit. There are no more nuclear facilities in Lithuania.

On October 5, 1999 the Seimas (Parliament of Lithuania) approved the National Energy Strategy where it is indicated that the first Unit of INPP will be shutdown before the year 2005, taking into consideration substantial long-term financial assistance from the EU, G7 and other states as well as international institutions. Regarding the second Unit, the conditions and precise date of closure shall be decided upon the next National Energy Strategy in 2004, when more detailed information on the work of Unit 2 is available.

On May 2, 2000 the Seimas adopted the Ignalina NPP Unit 1 Closure Law. This law indicates that:

- Preparation for decommissioning must be planned in such way that it should be finished by 1 January 2005.

- The Government, taking into account implementation of the Decommissioning Programme and Decommissioning Plan, and future possibilities for financing from Lithuanian and international support sources will define exact date of final shutdown.
- The Government of Lithuania will prepare and approve a Decommissioning Program by 1 November 2000.
- Following the Decommissioning Program, the Government of Lithuania will approve the Final Decommissioning Plan for Unit 1 by 31 March 2002.

DECOMMISSIONING PROGRAMME FOR UNIT 1

In accordance with the Ignalina NPP Unit 1 Closure Law the Government of Lithuania, by its Resolution No. 172 of 19 February 2001, approved the Ignalina NPP Unit 1 Decommissioning Program until year 2005 [1]. For enforcement of this program, the plan of measures for implementation of the program was prepared and approved by the Minister of Economy by his Order No. 145 of 25 April 2001 [2]. The plan consists of two parts, namely technical- environmental and social-economic measures. Technical-environmental part lists the legal, organizational, financial and technical measures, which need to be in place to support the closure of Unit 1. The social-economic part includes the preparation of laws and plans related to social and economic problems associated with the closure of Unit 1. The Decommissioning Programme forms the basis, and gives the milestones, for the preparation of the Unit 1 Decommissioning Plan.

To ensure the effective preparation for decommissioning of Unit 1, the Decommissioning Service organization was established at INPP. To strengthen the capacities of this service the International Support Unit was created as a part of this Decommissioning Service. An on-site Engineering Decommissioning Project Management Unit (DPMU) was created that will adopt an integrated approach to project management, engineering design, planning, procurement, safety and licensing activities at the INPP site. The DPMU will assist the INPP management in the implementation of the pre-decommissioning and decommissioning projects.

Technical-environmental measures (including legal, organizational and financial) are mostly oriented to the safe management of spent nuclear fuel and operational radioactive waste stored at the plant and the preparation of licensing documents for Unit 1 decommissioning. Some most important technical measures are presented below.

Implementation of the Interim Spent Nuclear Fuel Storage Facility. The existing interim dry storage facility (for 72 casks) has a capacity to store fuel from both Units up to the year 2004. As a part of the preparation for the closure of the Ignalina NPP, fuel assemblies currently stored in the pools require safe interim storage for a period of up to 100 years with adequate containment for heat decay prior to final disposal. There is more than 6700 spent fuel assemblies that are stored in the reactor pool of Unit 1.

Modernisation of the Short-Lived Waste Management/Storage. The operational waste was never fully characterised in line with international standards for long-term storage and disposal at Ignalina NPP. The existing facilities for storage of short-lived solid waste at INPP were not designed for long-term storage. There is a clear necessity to retrieve the waste from the existing facilities and to sort and re-package it, in order to reduce the potential environmental impact on the surrounding area. Because of that modernisation of the existing handling system for short-lived, low and intermediate level solid waste at INPP, including retrieval, characterisation, packaging and re-storage of stored waste is necessary.

Implementation of the Waste Incineration Facility. There are currently 12,000 m³ of combustible waste stored at the INPP site. It is estimated that by 2005 the volume will have increased to 15,000 m³ (filters, personnel protection clothing & plastics). The main goals of the project are to process combustible waste and to reduce the overall volume of short-lived radioactive waste stored at the INPP site, thus reducing the overall risk to the environment. The facility will also be used to treat

combustible waste produced during the decommissioning phase.

Modernisation of the Long-Lived Waste Management/Storage. Long-lived waste (not heat generating) without proper characterisation is currently dumped into concrete vaults for stored in the building for short-lived waste. The current storage conditions for long-lived solid waste do not meet the Lithuanian requirements and IAEA recommendations on such waste management. Special containers for the interim storage of this type of waste are necessary. The goal of this project is the modernisation of the existing waste management/storage system for long-lived radioactive waste at INPP and to ensure safe retrieval, sorting and characterisation of accumulated long-lived radioactive waste in concrete vaults.

Construction of the cement solidification facility for spent ion exchange resins. The spent resins are currently stored in concrete tanks. The remaining storage capacity is limited and Ignalina NPP has initiated the project for immobilisation of ion exchange resins into a cement matrix. The German company, Framatome ANP, is the winner of the tender for construction of the cementation facility and also of the interim storage facility for these cemented waste.

Heat and Steam Plant Replacement. At present the INPP facilities and the town of Visaginas are supplied with heat and steam from the district heating facility at INPP. A back-up system, dating from 1979, supplies heat and steam when the district heating system is under repair or in case of outages of Units 1 and 2. The existing back-up system no longer meets applicable technical and safety standards. A breakdown of the back-up system might result in the interruption of the supply to INPP of heat and steam necessary for a number of processes, including waste management.

There are also other very important measures planned such as preparation of the radwaste management strategy for Lithuania (already approved by Government), performance of the safety case for a single unit operation at INPP, etc.

Social-economic measures are oriented to mitigate the negative social and economic impact on Lithuania, inhabitants of the region, and, particularly, on the staff of Ignalina NPP by means of creating favorable conditions for a balanced social and economic development of the region. They are structured into organizational, legal, business development, employment and labor markets, social policy, Ignalina NPP and the public relations measures.

FINAL DECOMMISSIONING PLAN

The Ignalina NPP Unit 1 Closure Law and Decommissioning Programme form the basis, and gives the milestones, for the preparation of the Unit 1 Final Decommissioning Plan.

The Final Decommissioning Plan will be a document setting forth the actions for the final shutdown, implementation of the decommissioning strategy, the decommissioning costs and the sources of financing and safety implications and requirements. Requirements for the Final Decommissioning Plan and Decommissioning Projects are indicated in the regulatory document [3]

In order to produce a decommissioning strategy in a final decommissioning plan, practical reality requires that a preliminary decommissioning plan is prepared. This preliminary plan should identify and evaluate strategy options that can be used as a basis in preparing the final decommissioning plan.

A Preliminary Decommissioning Plan (PDP), covering both Units of the INPP, was prepared by the European Commission under the PHARE Project [4]. It contains a preliminary cost analysis of the different strategy options. It was revealed that there is no big difference in cost (up to 15 %) between different dismantling strategies.

The Immediate dismantling strategy is the most expensive in the short term, since the main work of dismantling in the reactor area begins considerably earlier than in case of the other options. The estimated cost for this strategy is 928.74 million Euro during 25-30 years. But the later dismantling with maximum safe enclosure is the most expensive strategy of all and Entombment strategy is the

cheapest one (duration more than 200 years).

The decommissioning process requires not only a long period of time but also a rather large number of highly qualified personnel (up to 1000 – 2000 persons during more than 20 years). So the cost of the decommissioning becomes very much dependent on the labour cost. The cost of 928.7 thousand Euro is including the actual labour cost at the Ignalina NPP. But it is about 10 times smaller than the labour cost in western countries. As it is indicated in [4] with labour cost of western countries and optimising the number of staff, the decommissioning cost of the INPP would increase up to 3 000 million Euro. Though it is very difficult to predict how the labour cost will change in time in Lithuania but it is necessary to take this into account when comparing different decommissioning strategies

At the request of the Vice-Minister of Economy, the IAEA agreed to start a project in 2000 with the objectives of providing technical advice and training in connection with the decommissioning of the Ignalina NPP, and specifically reviewing the provisions and resources for the planned decommissioning activities. One of the expected results was the recommendation of a strategy, including technical aspects, for the decommissioning of Ignalina Unit 1 based on the Preliminary Decommissioning Plan results.

Based on Preliminary Decommissioning Plan detailed analysis by IAEA experts group was performed of such aspects as impact of cost, waste, social, regulatory, safety and technology on the reference decommissioning strategy [5].

The summary statements from [5] for each mentioned aspect are presented below:

- Based on the cost criteria, immediate dismantling is the best reference strategy, principally because it gives a boundary to the cost and is more robust to uncertainty
- Based on the PDP and other information collected during the mission, it can be concluded that there is no significant impact of the waste arising and treatment on the proposed selection of the strategy even including the graphite issue. Since there are no significant benefits in reducing the amount or types of waste with deferred strategies, it can be concluded that immediate dismantling is the recommended strategy based on the waste issues.
- In countries with a robust nuclear power program, social issues, although important, are not generally critical decision criteria. Workers terminated from a shut down nuclear plant can usually find employment at other nuclear power plant sites or in related industries. However, because Lithuania with only one nuclear power plant containing two nuclear reactors and the skills of nuclear workers are unique, shut down and decommissioning of the INPP has significant national and local impacts. On the basis of the considerations, the immediate dismantling strategy is preferred. It maximizes the use of existing personnel, and takes advantage of technical expertise and language skills. Immediate dismantling provides more jobs for more workers in the short term.
- Based on regulatory issues, immediate dismantling is the best reference strategy. It provides the most continuity between operations and decommissioning by allowing the use of experienced plant and regulatory agency staff. Strategies that defer the decommissioning will require the rehiring and retraining of both the plant and regulatory agency staffs.
- The safety of Unit 2 must be considered in the Unit 1 decommissioning strategy. In order to ensure the safety of Unit 2 will not be affected by Unit 1 decommissioning activities, and should Unit 2 continue to operate greater than five years after Unit 1 shutdown (the time period assumed in the PHARE report), additional work and cost will be required in order to ensure that the safety of Unit 2 will not be affected by Unit 1 decommissioning activities. Continued Unit 2 operations can take place and does not have to affect the overall strategy, but will require modification of the Unit 1 decommissioning schedule and costs for all strategies.

- It has been shown that dismantling a power plant is feasible with current technology, in a reliable, safe and economical way. There are no expected significant technological advantages that would warrant delaying the dismantling.

The general conclusion was done in [5] that “Based on the information provided the expert team through the numerous discussions with various Lithuanian organizations and the European Commission PHARE report, the recommended decommissioning strategy for the Ignalina Nuclear Power Plant Unit 1 is immediate dismantling”.

Also it was stressed “an ongoing, iterative process that considers any other relevant inputs should be performed to ensure that the reference strategy is still acceptable based on new information that may become available or developed under the requirements of the Decommissioning Programme”.

Currently, the Decommissioning Project Management Unit at Ignalina NPP is working on better characterisation of the waste streams and updating of other input data for the decommissioning cost and other process data estimation. This will allow having more relevant information for selection of a decommissioning strategy at Ignalina NPP and preparation of the Final Decommissioning Plan.

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