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A CASE STUDY OF NUCLEAR WASTE MANAGEMENT IN LITHUANIA: TECHNICAL, ECONOMIC AND SOCIAL ASPECTS

1. Introduction

Lithuania is one of 32 countries using nuclear power in the world. Lithuania possess the Ignalina Nuclear Power Plant (INPP) with two reactors, each with a capacity of 1500 MW, which are the largest nuclear power units in the world. These reactors are of RBMK[1] construction, which in Western countries is considered in principle unsafe due to technological shortcomings. It is not possible to construct a protective shield, which is common to most Western nuclear power reactors, also RBMK reactors are of the same construction as the Chernobyl Nuclear Power Plant reactors. Due to safety reasons, the European Union has demanded the decommissioning of the Ignalina Power Plant as a condition for Lithuania joining the EU. May 2000 the Parliament of Lithuania adopted the Law on the Decommissioning of Unit 1 at INPP. The block has to be decommissioned by 2005. The destiny of the 2nd reactor at INPP, as well as the future of Lithuania as a country using nuclear power should be decided by the Lithuanian government during 2002.

The closing of the nuclear reactor implies technical, environmental, social and economic problems. One of these problems is nuclear waste management. This is a long – term process, involving social and financial resource planning, as well as high – level technical solutions. Nuclear waste management is a real problem to all countries using nuclear power, as no

[1] RBMK is a pressurised water reactor with individual fuel channels and using ordinary water as its coolant and graphite as its moderator.

solution has yet been found for long – term radioactive waste storage. There are broad scientific, as well as public discussions, on what are the possibilities, risks and commitments related to this issue.

This paper will analyse the technical, economic and social aspects of nuclear waste management in Lithuania and will also discuss nuclear power management in the world. The paper will also discuss the following questions: In the case of the INPP closure, nuclear waste management requires experienced personnel, that means that the personnel of the INPP will be re-qualified to storage personnel, while the plant will not bring economic benefits. What will be the social and economic consequences of long- term radioactive waste management?

From the environmental point of view, nuclear waste management involves the risk of radioactive contamination. Before the burying of used nuclear waste, it should be held in special containers for 50 years. During that time a place for burying waste should be found. Such a place does not exist in Lithuania. Will the nuclear waste be exported to another country? What are the experiences of other countries in nuclear waste management? What environmental consequences will nuclear waste management bring?

2. Main concepts and definitions

Radioactive waste is produced through the generation of electricity using nuclear fission. It also arises through coal fired electricity generation and is released into the environment through oil exploration. Radioactive waste can be divided into the following categories [www.world-nuclear.org]:

– *Very low level waste or exempt waste.* These categories contain negligible amounts of radioactivity and may be disposed of with domestic refuse.

– *Low level waste* comprises the bulk of waste from the nuclear fuel cycle. It comprises paper, rags, tools, clothing, filters etc., which contain small amounts of mostly short-lived radioactivity. Worldwide, they make up 90% of the volume, but only have 1% of the total radioactivity of all radioactive wastes.

– *Intermediate level waste* contains higher amounts of radioactivity and normally requires shielding. Generally short-lived waste (mainly from reactors) is buried, but long-lived waste (from fuel reprocessing) will be disposed of underground.

– *High level waste* contains the fission products and transuranic elements generated in the reactor core, which are highly radioactive and

hot. High-level waste accounts for over 95% of the total radioactivity produced, though the actual volume of material is low.

Spent fuel is generally removed from the reactor core underwater and transferred to large water filled pools, where the fuel is held in racks underwater. The water both shields the radiation and cools the spent fuel which may be destined for either long term storage or reprocessing.

Duncan [1999] argues that the disposal of waste is a four-dimensional issue regarding space (three dimensions) and isolation time (the fourth dimension). The time range needed for the isolation of each class of radioactive waste is 300–500 years for low level waste, 5,000–8,000 years for intermediate level waste and 100,000 years or more for high level waste.

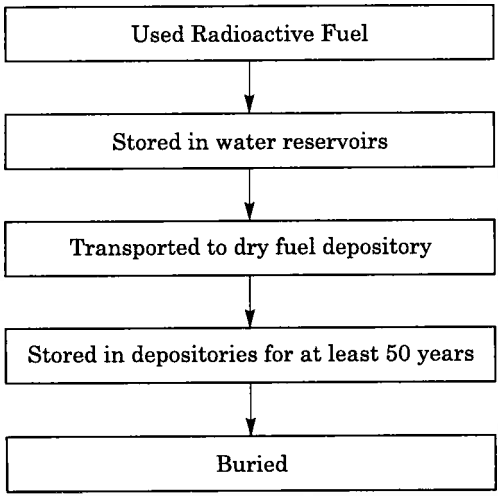

Fig. 1. The stages of radioactive waste management in Lithuania
Source: www.tvnet.lt

The first three stages of radioactive waste storage have already been implemented, and during the coming 50 years the most important question of long term nuclear waste burial has to be solved.

3. Nuclear waste management experience in the world and possibilities in Lithuania

The problem of long term nuclear waste storage has not been solved in any of the countries using nuclear power. The main questions are where, when and how to store radioactive waste and whether the countries

using nuclear power should store in their own territory or is the export of waste to other countries legal and ethical. The international company Pangea proposed a concept of international waste disposal [International Nuclear Waste Disposal Concept, 2000]. It identifies Australia, South Africa, Argentina and western China as having the appropriate geographical conditions for becoming a deep geologic repository. It would be located in places, where the geological structure has been stable for several hundred million years to keep waste securely isolated for thousands of years. Three components of Pangea's strategy are (1) technical, primarily focused on demonstrating safety; (2) economics, being "profitable, but not profit driven"; (3) political and public acceptance. The novelty of Pangea's project is that it emphasizes the safety and importance of public acceptance, whereas other similar projects stressed the form of waste and the engineering barriers.

In Lithuania, a new interim dry storage facility for spent fuel has been built close to the site and has started operating [Report on nuclear safety in EU applicant countries, 1999, 55–6]. An evaluation has been made of the present facilities for the storage of solid and bitumenised waste and improvements are being implemented.

Only recently scientists have opened the question of nuclear waste management in Lithuania to public discussion. The possibilities of radioactive waste management in Lithuania were discussed, and they include following options[2]:

1. Export of radioactive waste to Russia. Unofficial sources state that for the storage of 1 kg of uranium, Russia is asking for 1000 USD. In Lithuania the storage of the same amount of uranium would cost 80 USD.

2. The building of a long term nuclear waste site in Lithuania. One of the possibilities is to build the site in salt layers near Kaunas. It is very likely that such a decision would be met by strong public opposition, as strategic roads pass through Kaunas. Furthermore, the land near Kaunas may be attractive to investors. The investment sites may lose their attractiveness in the case of having nuclear waste stored near the city.

3. There was an ides, that Byelorussia should take part in solving the nuclear waste storage problem, as electrical energy generated in the INPP is exported to Byelorussia almost for free. However, this possibility was strongly opposed by official Byelorussian bodies [Lithuanian News Agency ELTA, Feb. 15, 2002], which identified this as an internal problem of Lithuania and the possibility of storing nuclear waste in Byelorussia is totally unacceptable.

[2] Outlined in Lithuanian press articles and news agencies reports, January–March 2002.

4. Financial commitments of nuclear waste management

As noted above, nuclear waste management is a long-term process, which encompasses huge financial resources. It is important to note, that nuclear waste is the only waste, whose management costs are included in the price of electricity. According to the World Nuclear Association [www.world-nuclear.org], the costs of the managing and disposing of waste from nuclear power plants represent about 5% of the total costs of electricity generated.

The Ministry of Economy of Lithuania has calculated the preliminary costs of the closure of the 1st INPP block. These costs will reach 3.5 billion USD (for comparison – the yearly Lithuanian national budget in 2000 was 2.17 billion USD [Lithuanian Department of Statistics]). Figure 2 presents the cost structure.

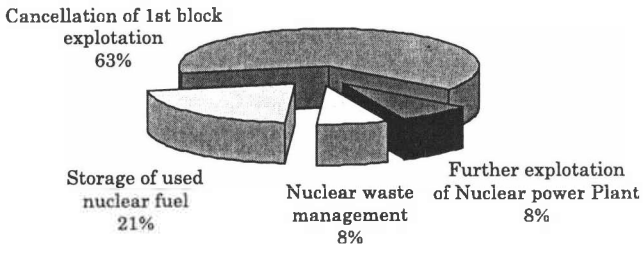

Fig. 2. Closing of the 1st INPP block: cost structure

Source: www.tvnet.lt[3]

5. Public perception of radioactive waste

Duncan [1999] argues, that society rejects long term nuclear waste storage in its communities. The community rejection of this burden is called the "NIMBY" (not in my back-yard) phenomenon. Communities are not willing to accept the storage of radioactive waste in their residential areas. Tellegen and Wolsnik [1998] discuss the concepts of NIMBY and LULUS (locally unwanted land use). They argue that the NIMBY effect or syndrome is commonly put forward as a basis of opposition to the construction of nuclear waste storage installations. There are four types of such opposition [Tellegen and Wolsnik, 1998, 159–160].[4]

[3] Tvnet.lt prepared a cycle of TV programs devoted to the closure of the 1st INPP block.

[4] The authors present these types based on gene technology plants. I try to point out the characterizations of views towards nuclear waste management.

Type A: A positive attitude towards the installation (of a nuclear waste depository), combined with the rejection of, and opposition to the construction of, a depository anywhere in one's own neighbourhood. This combination of perception-behaviour reflects the only true NIMBY standpoint.

In Lithuania, this is likely to be the standpoint of the public, while talking about the location of long term nuclear waste storage. Though the majority of the population reacts positively towards nuclear energy in Lithuania, the plans for storage near Kaunas, which is the second largest city in Lithuania, is likely to cause strong public resistance. (the public opinion regarding nuclear power industry is discussed later in Section 6)

Type B: Rejection of, and opposition to the storage of nuclear waste in ones neighbourhood, because one is against nuclear energy in general. This position is called NIABY (not-in-any-backyard).

Nuclear waste, its management and the risks it causes are arguments of the opponents of the production of nuclear energy. Opponents emphasize the environmental consequences and risks related to the nuclear industry.

Type C: A positive attitude towards the storage of nuclear waste, which turns into a negative attitude as a result of the discussion surrounding the proposed construction of facilities. This is the dynamic NIABY variation, which reflects the development of risk perception during the decision-making process.

In the discourse of the nuclear power industry in Lithuania, little attention is paid towards the problem of nuclear waste (the analysis of the discourse on the nuclear industry in Lithuania will be presented later in Section 7), thus this type of perception is not yet evident, but it is likely to emerge in the decision-making process. I assume this type will mainly be characteristic to experts and the scientific community, not to the lay-public.

Type D: Resistance created by the fact that some projects are themselves considered faulty, without a rejection of the technology itself.

In Lithuania, this is the likely position of European Union officials. Though the nuclear power industry is broadly developed in Europe, the European Union is in principle against nuclear power in Lithuania, because of the construction peculiarities of the Ignalina NPP.

Tellegen and Wolsink [1998, 160] also argue, that "the risks people associate with the facilities are the main reasons for opposition. Risk judgments become salient factors as a result of the decisional context. Decision making on facility sitting is putting environmental risk on the political agenda. In these political processes the differences between the

assessments of risks by experts and the social rationality of public perceptions become apparent".

It is important that the public is well informed about the risks coming from the nuclear power industry and nuclear waste management, so that society could have objective opinions about these issues based on facts.

A public opinion poll, carried out in the UK by Duncan [1999, 5–6], states that a community accepting waste disposal in its area should be compensated for the apparent risk. He also investigates the public perceptions of time and trust regarding radioactive waste management. People were asked, how far ahead do they think when considering (1) the welfare of their families; (2) the environmental welfare of their home township and (3) the total global environment. Answering question (1), 92% of people stated, that their upper time horizon is 100 years or less. Of the respondents answering question (2) 90% had a time perception of 100 years or less. Reflecting on the global environment, cumulatively 81% of people expressed a horizon of 1000 years or less. Thus, as Duncan notes, "there is a lengthening of the time horizon when considering global effects. [...] The spatial dimensions inherent in the greenhouse issue fits into the global scenario, whereas the spatial dimensions of waste disposal clearly puts it into the dimension of a community".

Another important topic discussed by Duncan is public trust regarding nuclear waste management. Respondents were asked who they would trust the most to oversee the disposal of waste: a government department; the manufacturer of the waste; scientists; environmentalists or a composite body that includes government, industry, environment, scientists, doctors and academics. 81% of respondents selected the latter option and 12% – "environmentalists". This response shows public trust in composite bodies.

In Lithuania there has been no research of public opinion regarding nuclear waste management.

6. Risks from nuclear waste management

The opponents of the nuclear power industry point out nuclear waste as one of the most important shortcomings and risks of this mode of production.

Public fear of the nuclear power industry, especially in the United States of America, has increased after the terrorist attacks of September 11, 2001. A fear appeared that terrorists might choose not a nuclear reactor, but the storage sites as objects for an attack as these sites are not protected by shields as are reactors [Veidas, 2002].

7. An analysis of the debates over the nuclear power industry in Lithuania

The current debate over the nuclear power industry is largely reflected in the Lithuanian mass media. An analysis of its contents can help to identify, what the main interests are that play an important role in the decision-making process, who are the actors representing these interests and what social groups are involved in the public discussion on this topic.

The Dutch environmental sociologist Hajer suggests an analysis of "discourse coalitions" in the sphere of environmental politics. "People may have widely differing perceptions of what environmental politics is about. In this light the present hegemony of the idea of sustainable development in environmental discourse should not be seen as the product of a linear, progressive, and value-free process of convincing actors of the importance of the Green case. It is much more a struggle between various unconventional political coalitions, each made up of such actors as scientists, politicians, activists, or organizations representing such actors, but also having links with specific television channels, journals and newspapers, or even celebrities". [Hajer, 1995, 12–3].

Discourse coalitions differ from interest coalitions or political alliances, because the basis of a coalition is not the interests of specific groups, but so called 'story-lines'. The actors involved in coalitions around specific story lines, might share different interests, and even understand these 'story lines' differently. To identify the 'story lines' in a specific topic, nuclear power in Lithuania in our case, this discourse should be analysed. According to Hajer [1995, 44–5], this discourse is internally related to the social practices in which it is produced. Discourse is an ensemble, of ideas, concepts and categorizations. Discourse also has a clear institutional dimension, which is clearly seen in the case of the nuclear power industry. Characteristic to environmental discourse is the fact, that a typical environmental problem involves many different discourses such as the social sciences, philosophy, economics and others.

In order to analyse the discourse on the nuclear power industry in Lithuania and the identity of discourse coalitions, I examined articles from the Lithuanian mass media and news agencies from January-March 2002. Presented in Table 1 are the following main 'story-lines', standing for three main discourses: proponents, opponents and compromisers.

From this debate several important points can be distinguished:

– For the proponents of the nuclear power industry, the most important motives are economic, while for opponents, the political motive of joining the EU is leading in their discourse.

Table 1. The 'story lines' of debate over nuclear power industry in Lithuania

Opponents	Compromisers	Proponents
The decommissioning of the INPP is the main condition of joining EU, thus it should be closed	INPP is the responsibility of all of Europe, not only of Lithuania, thus a decision can only be made with EU commitments of financial support	There have been huge investments in the safety of the INPP and in principle it is safe
The reactors of the INPP are in principle unsafe as they are of RBMK construction and there is no protective shield	Due to the nuclear power industry, there are scientific and expert resources, so the possibility of constructing a third modern nuclear reactor with financial support from EU should be discussed	The closure of the INPP would have severe social consequences, as the region of Ignalina will lose its main source of income
The INPP is built on a 'tectonic slice', which increases the risk of an accident	The experts from Western countries, who analysed the safety status of the INPP, did not conclude that it is unsafe, thus EU motivation should be questioned	The closure of the INPP will make Lithuania dependent on resources from Russia for energy production
The nuclear power industry produces radioactive waste, storage of which is under question, and involves huge financial resources		The loss of nuclear power in Lithuania, will cause an increase in electric energy prices, thus the economic conditions of the population will be worsened
		Nuclear energy is environmentally clean, as the plant does not emit 'green- house' gasses
		Lithuania has bad conditions for developing alternative sources of energy, thus it should use nuclear power

– Although a significant share of the costs, related to the closure of the INPP are related to nuclear waste management, this problem is not clearly reflected in the debate over the nuclear power industry.

– Environmental considerations are the main motives of European Union officials in the request of closing the INPP. However, this concern is not expressed among Lithuanian opponents of the INPP. Often Lithuanian politicians mention, that the INPP has no safety shortcomings, due to significant investments in ensuring its safety.

– The formation of 'discourse coalitions' can be observed by analysing the debate. The majority of scientists (particularly from the Lithuanian Energy Institute, and the physical sciences, related to nuclear energy research) together with representatives from business form the side of the proponents of nuclear industry. Several political parties also take this position. Opposition to nuclear energy is mainly constituted of political parties with a strong emphasis on European integration. A minority of scientists share this view, but they have mostly environmental arguments. The 'compromisers' are those who firstly emphasize the financial obligations of Lithuania that must be made when the decision about the closure of the INPP is taken. The president of Lithuania Valdas Adamkus has expressed such a view.

After an analysis of the discourse of the coalitions of various institutions, it is important to see what public opinion is regarding these issues. There is no research on public opinion regarding nuclear waste management in Lithuania, however there were several polls regarding public opinion about the nuclear power option in Lithuania. In February 2002, the president of Lithuania, Valdas Adamkus, expressed the opinion, that the INPP should not be closed, as he is not convinced by the EU officials' opinion regarding the unsafety of the plant. From 1–4 March 2002, the public opinion research company Spinter executed a survey of the populations of the biggest Lithuanian cities (in total 500 respondents). The responses are presented in figures 3 and 4.

We can see from the results, that the population of Lithuania is rather of the opinion of "compromisers". The majority of population (64%) thinks that 2009 is too early a date for the closure of the INPP, but less than a half (42%) see the future of Lithuania with nuclear energy.

8. Conclusions

The nuclear power industry produces radioactive waste. Its management raises technical, economic and public acceptance problems in all countries using nuclear power.

The possible underground, long term storage of radioactive waste will provoke public opposition. Possible public opinion towards nuclear waste management includes the NIMBY phenomenon, when communities accept nuclear energy as an option, but oppose waste storage in their communities' areas; the NIABY phenomenon, where nuclear energy and radioactive waste storage are opposed in principle; the dynamic NIMBY variation, where the acceptance of nuclear energy is changed to its rejection during the decision-making process; and the questioning of the facilities without a rejection of the technology.

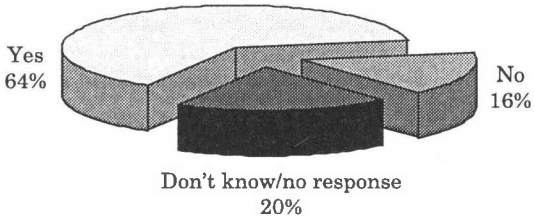

Fig. 3. Do you agree with V. Adamkus' opinion that the INPP should not be closed by 2009 as the EU demands?

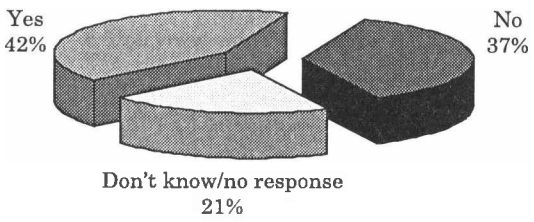

Fig. 4. Do you agree that Lithuania should remain a nuclear power country?
Source: Spinter, March 1–4, 2002 – published in "Veidas", 2002.

In Lithuania the possibilities of nuclear waste management include, but are not limited to: export to another country or long term storage in a site in Lithuania. The first option involves huge financial resources, while the second is likely to provoke public resistance.

During the discussions over the nuclear power industry, discourse coalitions can be identified, following different 'story lines', related to opposing the nuclear power industry, defending Lithuania's status as a country using nuclear power or seeking for a compromise in the decision regarding the closure of the INPP.

In the debate over the nuclear power industry in Lithuania, little attention is paid to the problem of nuclear waste management, which constitutes a significant share of the financial commitments of INPP closure. Environmental concerns are also not evident among the opponents of nuclear power, while political motives are leading.

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