The Financing of Radioactive Waste Storage and Disposal

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Abstract

The present paper reviews the results of a recently completed study on schemes for financing radioactive waste storage and disposal, carried out for DGXI of the European Commission. The study investigated the financing schemes in operation in European Union Member States, applicant countries of Central and Eastern Europe, Canada and USA.

The effectiveness of the various financing schemes was judged against three key criteria, namely sufficiency, fairness and efficiency. The study has shown that there is a considerable divergence in the schemes adopted by different countries. It is clear that in practice it is impossible to design a scheme that fully satisfies all three key criteria, and different countries have adopted schemes that suit their particular circumstances.

The generally accepted principle that the "polluter pays" implies that the financial burden of dealing with the waste should be borne by the organisations responsible for producing it. The study has shown that through the financing schemes currently in operation in the countries investigated, this principle is being widely respected in the radioactive waste sector, even to a growing extent in the countries of Central and Eastern Europe.

1 Introduction

Under a recent study contract with DGXI of the European Commission, information has been collected on the financing of radioactive waste management from ten Member States of the European Union (EU) and from the USA and Canada. In an extension to this contract, similar information was also gathered from the ten EU applicant countries in Central and Eastern Europe (hereinafter referred to as CEEC). The CEEC are considered in Section 3 of the present paper. The reader is referred to the study report [1] for the full analysis of all countries investigated.

A special feature of radioactive waste management is the time-scale over which there will be a need to ensure the availability of adequate sums of money for the proper discharge of all the obligations of the custodian of the waste. The study the application in a number of countries of the “polluter pays” principle to the financing of the storage and disposal of radioactive waste generated both by major producers and by small producers. The major producers are power generators, spent fuel reprocessors and nuclear defence establishments. The small producers include hospitals, research establishments and industrial companies.

The “polluter pays” principle requires that the costs of managing radioactive waste, from initial generation through to final disposal, are borne by the organisations whose activities produce it. There is, however, a considerable divergence in the financing schemes adopted by different countries. This has arisen not because of any disagreement with the principle as such but rather as a re-

sult of particular circumstances in individual countries and because of the wide scope for variety in putting the principle into practice.

In the broadest sense, all the financing schemes studied fall into one of two categories:

- those which rely on a levy on electricity generation;
- those which rely on payments based on characteristics of the waste.

These categories are considered in more detail in Sections 2.1 and 2.2.

2 Description of Financing Schemes

2.1 Levies on Electricity Generation

This is the most reliable method of providing for the costs of radioactive waste management, since, in effect, the ultimate consumer of electricity pays direct for those costs on the basis either of electricity sold, as in Spain, or of electricity generated, as in Sweden. Thus a charge per unit of electricity is levied on the generator at a level, regularly reviewed, sufficient to cover those costs as and when they occur.

The most prominent examples of levy mechanisms are found in Spain and Sweden. However, although categorised together in the broadest sense, the mechanisms in these two countries display considerable differences at the more detailed level. Apart from those being imposed in some CEEC, the only other example of a levy system among the countries studied is the one employed in the USA for high level waste.

Spain

The Spanish system of advance payments by levy was established by Royal Decree 1899/1984 and ensures that revenues, when added to an accumulating interest earning fund, are sufficient to cover projected future expenditures. The Spanish Government fixes the percentage value to be applied in the Royal Decree on Electricity Tariffs for each year.

The percentage is calculated such that the income in a period of time is proportional to the electricity generated by the Nuclear Power Plants (NPPs) in this period. The incomes from the quota are collected by a public body called the Comisión Nacional del Sistema Eléctrico (CNSE). CNSE transfers these incomes to ENRESA (the Spanish radioactive waste management organisation) on a monthly basis. No taxes are levied on the earnings of the fund, and ENRESA annually revises the adequacy of the levy calculation.

In the case of small producers, separate tariffs are calculated for different types of wastes. These tariffs take into account the different processes to which the waste is subjected and emplacement schedules throughout the operational period.

ENRESA is responsible for the financial management of the funds following the instructions of a Fund Control and Follow-up Committee (representing the Ministry of Industry and Energy and the Ministry of Economy and the Exchequer). Funds are invested in a fixed income financial assets portfolio. Only instruments with first class financial ratings are considered. The real rate of return assumed in the calculation of the levy is 3.5%.

Sweden

The Swedish Nuclear Fuel and Waste Management Company (SKB) does not have responsibility for the totality of decommissioning and waste management. The nuclear operators have responsibility for on-site waste storage, and SKI (the Swedish Nuclear Power Inspectorate) and SSI (the Swedish Radiation Protection Institute) have separate budgets to SKB. There are four financing mechanisms in place to recover these various costs.

1. An annual fee per kWh is levied by SKI on behalf of SKB on individual nuclear plants to cover the future expected costs of spent fuel management, the decommissioning of reactors and associated R&D. The fees are based on an assumed 25 year operation of each of the dozen reactors in Sweden, which is consistent with the period over which the nuclear operators write-off (depreciate) their investment in nuclear plant. They are fixed annually by Government following the presentation of calculations from SKI based on cost estimates prepared by SKB. This is by far the largest of the four financing mechanisms.
2. An annual fee per kWh is levied on the same basis to cover the decommissioning and waste management costs associated with the closed Agesta reactor and with the research facility at Studsvik - these costs are outside the Financing Act which governs the activities under (i) (hence the need for separation) but are still covered by SKB in terms of operational remit and include the management of wastes from small producers which are collected and conditioned by Studsvik.
3. An annual flat rate fee paid to SKI and SSI to cover the costs of administration, radiation monitoring etc.
4. An 'internal' fund, fed in proportion to nuclear electricity generation, set up by the various operators to cover both the costs of on-site storage of wastes and the costs of sending current operational LLW and ILW wastes to SKB's SFR1 disposal facility at Forsmark (but not future decommissioning LLW and ILW to the planned SFR3 facility).

A nuclear waste fund was established in 1982. It consists of four separate accounts, because the four nuclear operators' payments and drawdowns are handled separately. Until 1995, these payments were held as deposits in interest-bearing accounts with the Bank of Sweden. Since 1995, they have been deposited into an account with the Swedish National Debt Office. The payments are repaid to operators by SKI as and when they are required (for decommissioning and waste management).

The investment strategy for the nuclear waste fund is determined by the Board of Directors for Nuclear Waste Funding, and is closely related to the real return on government bonds of appropriate maturities. A review of the investment strategy recently took place, and this has led to adoption of a more aggressive 4% real return target for the fund up until 2020 and 2.5% thereafter. Previously the fund simply targeted 2.5% for the duration of its projected existence.

As a basis for determining the fee and the need for guarantees, three types of amounts are reported:

- A fee-determining amount (discussed above under SKB annual fee), which includes all costs for managing and disposing of the spent nuclear fuel from 25 years of operation of the reactors and for decommissioning and dismantling the reactors and carrying out the necessary research and development.
- a basic amount, which is supposed to include corresponding costs for managing and disposing of the fuel which has been used up to and including the year when the calculation is performed, plus the costs for decommissioning and dismantling the reactors.
- a contingency allowance, which includes reasonable additional costs depending on unforeseen events.

Summary

Although Spain and Sweden both obtain the funds required by means of a levy on electricity, the methods of collection and administration differ considerably. The most significant differences are:

- In Spain all electricity is levied; in Sweden only nuclear production is levied.
- The Spanish system applies a universal levy; the Swedish is plant-specific.

- Sweden's system requires guarantees from waste producers; Spain's does not.
- The Spanish waste fund is managed by the national waste management organisation; the Swedish fund is not.

2.2 Funding based on Waste Characteristics

Countries which have opted to require waste producers to pay for radioactive waste management on the basis of the characteristics of their waste have used a variety of different properties for this purpose, including volume, radiation levels, waste categorisations and treatment requirements. In some cases more than one property is used in constructing a financing mechanism. The methods used in Belgium, the Netherlands and Finland are described below to illustrate the variety of mechanisms in use.

Belgium

The Belgian radioactive waste management agency, ONDRAF/NIRAS, works at cost price, with complete financial transparency with respect to the producer. For that purpose, it has established a financing mechanism for major waste producers based on the charging of fees on each volume unit delivered, specific to different waste categories, in order to ensure complete financing of all the operations to be performed.

For disposal operations the fees are paid into a fund - the so-called "long-term fund" - which is interest bearing. ONDRAF/NIRAS has responsibility for managing the fund, using external money managers. Each accounting year the financial performance of the fund is reassessed.

Funds administered by ONDRAF/NIRAS are under the supervision of a board of representatives from the State and the main waste generators involved, the so-called Supervisory Committee, which monitors cash flow and the portfolio of investments.

In 1996 the financial mechanism was changed. Before that date, there were no guarantees with regard to fixed costs, and tariffs were based on simple net present value calculations. A new mechanism was put in place in 1996 by ONDRAF/NIRAS which aims to reduce risk while satisfying the fundamental principles of financing. The new financing approach uses two part tariffs, specific to each waste category, which are charged to the waste producer for waste delivered to ONDRAF/NIRAS.

The tariffs are based on the following principles:

- A distinction is made between "fixed costs", independent (within certain limits) of the quantities emplaced, and "variable costs", proportional to the quantities expected to be emplaced in the future.
- The fixed costs are charged to producers according to committed volumes. In the case of storage and disposal payments, producers receive in return 'reservations of capacity'. Each producer makes a binding minimum commitment to cover its share, regardless of the future fluctuations of its actual programme. This commitment takes the form of an irrevocable guarantee on behalf of the producer.
- Variable costs are charged to producers according to volumes delivered.

The contract stipulates in detail the precise requirements of the producer regarding waste management, such as waste types, quantities and operations to be performed. In exchange, ONDRAF/NIRAS quotes a price valid for a minimum time period of 10 years (or 5 years for treatment and conditioning). The parts of the payments that relate to fixed costs are offset against the guaranteed sum and hence the size of the producer's guarantee reduces with time.

Small producers do not enter into long-term contracts but pay on delivery of waste according to separate tariffs established by ONDRAF/NIRAS.

The Netherlands

Fees paid by waste producers to the Dutch radioactive waste management company, COVRA, include all direct costs of transport, conditioning and storage and also all financial provisions for the costs of future storage and eventually disposal. COVRA takes full title of the waste on transfer and fees paid are guaranteed not to be adjusted retrospectively. There is no difference in the financing scheme between large and small producers.

Future disposal costs will be covered by money placed in a capital growth fund. This money is drawn from the fee paid at transfer of the waste to COVRA. During the long period of interim storage the fund has to grow to the desired level. Adequacy of the fund will be analysed periodically.

The fee to be paid for full transfer of low and intermediate level waste is mainly related to the treatment needed, to the resulting volume of the conditioned waste to be stored and to the final radiation level of the conditioned package. No direct account is taken of the activity content of the waste.

For high level waste, mostly vitrified waste and other reprocessing waste, a dedicated storage building will be constructed. The users of this storage vault will directly finance its construction according to the percentage of the volume reserved per producer. During the active operating phase, users will pay annually for operating costs on the basis of capacity used. Thereafter, users will pay lump sums to cover operating costs during the long passive phase prior to disposal and to cover the share of final disposal costs attributed to high level waste.

The planned final disposal facility will deal with all categories of waste and final disposal costs will be split one-third to low and intermediate level wastes and two-thirds to high level waste.

Finland

Repositories for the disposal of low and intermediate level wastes are operated by the power companies. Financial provision for future costs of spent fuel management is made through the Finnish State Nuclear Waste Management Fund, most contributions to which are made by the nuclear power companies.

The incurring of some costs, such as those for the construction of waste management facilities, is very unevenly spread, but provision for future costs through contributions to the Fund during the operating years of the power plants means that the companies' contributions to the Fund are distributed more evenly. Since the underlying principle of the Fund is that a sum must be available at all times sufficient to provide for full discharge of all existing future liabilities, the companies are required to provide to the State securities to cover all unfunded liabilities. The scale of these securities reduces as the assets of the Fund grow.

The basis for calculating each company's contribution to the Fund in any year is that company's future liabilities at the time (although it is worth noting that its actual liability is not limited to the assessed liability), assessed each year by the Finnish spent fuel management company, POSIVA. The actual fund contributions are calculated annually by the Fund on the basis of the confirmed fund targets and the existing capital in the Fund, and are subject to approval by the STUK (the Finnish Centre for Radiation and Nuclear Safety). They are based on achieving equalisation between the assets of the Fund and the future liabilities within 25 years of plant operation.

During the period when the Fund's assets remain below future liabilities, the costs to the companies of waste management operations (e.g. construction of facilities) may be offset by a resulting reduction in their liabilities and hence their annual contributions. Once the assets exceed the liabilities,

the fund will be sufficient, barring unexpected circumstances, to provide for all nuclear waste management costs as they are incurred. Any unused capital on completion of the process will be returned to the contributors.

The costs estimated by POSIVA include a contingency of up to 20%. In addition, the nuclear power companies are required to provide 10% extra securities above target costs to cover 'unexpected expenses in nuclear waste management'.

The nuclear power companies are allowed to borrow back up to 75% of their contributions to the Fund at the Fund's standard rate of interest (Bank of Finland base rate plus 2%) against the provision of securities and the Government is permitted to borrow, on the same basis, any sum not borrowed by the companies. To date practically the whole of the Fund has been borrowed back in this way and there is therefore no cash in the Fund.

Liabilities are split between the two power companies, TVO and IVO, on the basis that fixed costs are split 60:40 (in line with generating capacities) and that variable costs are allocated on the basis of amounts of fuel produced (which are not necessarily volume-based but may instead be related to numbers of assemblies or canisters).

Summary

The descriptions of the mechanisms in operation in Belgium, the Netherlands and Finland illustrate the scope for variety in devising financing schemes based on properties of waste. All of them are designed to ensure that the polluter pays, but the methodologies display marked differences.

Most notably:

- For a given waste category, the Belgian mechanism employs only volume; the others take other parameters into consideration.
- Payments under the Dutch system are in full settlement of liabilities; waste producers in Belgium and Finland retain certain financial liabilities and have to give guarantees.
- All waste producers are treated the same under the Dutch system; under the others small and large producers are treated differently.
- In Belgium and the Netherlands, the waste management organisations manage the waste fund; in Finland the fund is state-managed.
- The Belgian and Dutch systems cover all categories of waste; the Finnish system applies only to spent fuel.
- Fixed and variable costs are charged to waste producers by different mechanisms in Belgium and Finland; no distinction is made in the Netherlands.

There are also important differences in the management of funds and in the methods of calculating, and assessing the adequacy of, future costs.

2.3 Summary of Schemes

Besides the countries considered in detail above, a review was made of schemes in operation in seven other countries. In summary, the bases for allocating charges to waste producers in all the countries studied are as follows:

Country	Basis for allocation of charges to waste producers
Belgium	Unit volume. Waste category-specific.
Canada	Undecided.

Denmark	Estimated commercial cost per item of waste.
Finland	Fixed costs contribution based on generating capacity, variable costs contribution based on amounts of waste (not solely volume-based).
France	Unit volume (or commercial tariff for specified packages) on delivery for disposal. Payments for underground storage studies on basis of long-term waste production volume forecasts.
Germany	Unit volume for a fixed waste mix. Repository development costs distributed according to nuclear electricity generation.
Netherlands	For LILW - treatment, volume and radiation level of conditioned waste. For HLW - reserved capacity (volume).
Portugal	Part of estimated cost per item of waste.
Spain	Levy on electricity sold for electricity generators. Estimated commercial cost for small producers.
Sweden	For advance payments and some management costs - plant-specific levy on electricity generated. For remaining management costs - flat fee. For operational LILW disposal - commercial costs drawn from internal funds.
United Kingdom	For waste management R&D services - volume. For LLW disposal - tariff-based charges.
United States of America	For LLW - varies from State to State (may be volume based or 'multi-attribute' based). For HLW - levy on electricity output.

As seen above, in most countries with substantial commercial nuclear power generation the financial mechanism involves the build-up of a fund intended to cover future costs associated with storage and disposal. The funds are sometimes managed separately from other waste management activities, either directly by government or by independent fund managers. A summary of the arrangements in the countries studied is set out below.

Country	**Management of advance payments**
Belgium	Interest-bearing fund, managed by ONDRAF/NIRAS using external money managers.
Canada	None.
Denmark	None.
Finland	State-managed fund, investable at best 'zero-risk' rate, but 75% may be borrowed by producers against provision of securities and 25% may be borrowed by Government.
France	None. Waste producers build up provisions.
Germany	Reserve funds built up by waste producers.
Netherlands	Capital growth fund managed by COVRA.
Portugal	None.

Spain	Interest-bearing fund managed by ENRESA.
Sweden	Fund (the Nuclear Waste Fund) managed by SKI and invested with the Swedish National Debt Office.
United Kingdom	Waste producers build up provisions (but see Note).
United States of America	Variable between different States for LLW. HLW fund used for current expenditure purposes by Government.

Note: A Decommissioning Fund has been set up (on privatisation) to provide for the decommissioning of British Energy's reactors.

2.4 Assessment of Schemes

Three key criteria emerge from analysis of the attributes of individual schemes (not in any order of priority):

- **Sufficiency** - ensuring that sufficient money will always be available when it is needed and not transferring undue burden to future generations
- **Fairness** - ensuring that waste producers pay in proportion to the contribution which their wastes make to costs
- **Efficiency** - ensuring that unit costs are minimised by giving appropriate economic signals, e.g. for better control of waste streams, reduction of high cost drivers

The ideal situation is a financing scheme that performs well against all three of these criteria. In practice, however, the evaluation of different financing schemes is complicated by the fact that the criteria tend to be contradictory. For example, a scheme that gives the greatest assurance of available money may not be the fairest or give the right economic signals. For this reason, no attempt was made during the study to formulate an ideal system. The weighting placed on each of the above criteria must depend on particular circumstances and not on any idealised formulation. What is best, for example, for a country whose waste arises predominantly directly from nuclear power generation may be unsuitable for one with substantial other sources of nuclear waste, while state-owned waste management agencies may have different priorities from company-owned waste management organisations.

Different countries may also have differing views on what economic signals are appropriate to achieve efficiency. Thus there are two views about the desirability of using volume as a main pricing parameter. One view is that it is beneficial to use volume because it results in steps being taken to reduce volume, especially when prices are raised. The converse view is that using volume as a parameter is liable to lead to some waste producers obtaining an unfair advantage through taking volume reduction measures which are not matched by others, although such concerns do not arise in countries, such as Belgium, where the national waste management organisation is in a position to manage volume reduction fairly.

It is also worth noting that simplicity is an important secondary attribute in a financing scheme. Any scheme needs to be understood not only by those with direct responsibility for operating it but also by those who are affected by it. There is some evidence that, whatever merits a particular scheme possesses in terms of fairness or efficiency, there is liable to be opposition to it if it is, or if it is perceived to be, too complex.

Overall, it is concluded that all the countries studied have established schemes that aim to provide adequate funds for future radioactive waste management. As a general rule, schemes based on an

electricity levy give the best assurance that money will be available when it is needed, but such schemes tend to give the least efficient economic signals. They are also less practicable in countries with substantial waste arisings from non-electricity-generating sources. Schemes that take account of a range of waste characteristics in setting tariffs tend to be fairer than those that base tariffs on only one parameter, such as volume, but they are more complicated to operate.

3 Financing of Radioactive Waste Management in the CEEC

3.1 Introduction

Systems for financing radioactive waste management and disposal are intended to provide sufficient means for funding such activities at the time required. Even in a stable economic context and within a well-developed institutional environment, achieving this goal represents a novel challenge. This challenge arises mainly out of uncertainties about future technological, economical and social developments. There is typically a gap of several decades between the time when the activity giving rise to the waste, namely nuclear power generation, takes place, and the time when the last waste management step, final disposal, is carried out. It follows that there are also large gaps in time between receipt of the revenue out of which waste management costs will need to be covered and the actual incurring of those costs. Obviously, technological development continues during this time, and the institutional framework tends to adapt to the improving technology. These facts are *per se* the source of a threefold uncertainty regarding:

- Which technology will be finally used in which step of waste management?
- How much will waste management cost in total?
- When will this money be needed?

Furthermore, the social and political environment has dramatically changed in the last few decades in Europe and, especially in the new market economies of Central and Eastern Europe, the present pace of change can realistically be expected to continue in the future. From this, further uncertainty follows.

- Which institutional arrangement is most likely to endure during the coming changes?
- Will technical solutions devised today be accepted by society in the future?

Finally, several European countries have in the past undergone severe economic setbacks during a period comparable with the prospective time span until completion of the management and disposal of wastes currently being produced. Some have even seen a total collapse of the value of money and financial assets. Such developments cannot be ruled out for extended future periods. Again, this leads to further uncertainties:

- How secure in the future will be the value of money set aside today?
- How high will the yield of this money be, if any?

Having regard to all of this, it becomes apparent that there is no optimal financing scheme leading to good results in all countries. Moreover, even systems performing as intended would most likely undergo changes in the course of time to adapt to a changing context.

Analysis of present radioactive waste management arrangements and its financing in the transition economies of Central and Eastern Europe must be carried out bearing all these facts in mind. In the study, a qualitative analysis has been carried out in the light of the information provided by the countries in question, including such aspects as:

- Regulatory framework and institutional arrangements;

- Financing systems in place, including the general economic efficiency of the waste management systems;
- Special situations.

These points are dealt with in more detail in Sections 3.2 - 3.4.

3.2 Regulatory framework and institutional arrangements

The situation regarding regulatory frameworks and institutional arrangements in waste management and financing is widely dissimilar in the countries of Central and Eastern Europe. Whereas some of the countries have already installed waste management organisations, in others there is still a clear lack of such institutional arrangements. Even the necessary regulatory framework is either not yet enacted or is not fully implemented.

Transition from the previous central economic planning type of regulatory system and institutional organisation, without a clear separation of responsibilities to the western-style “classical triangle” of independent waste producer, regulator and waste management organisation, has proved difficult. In evaluating achievements to date, the general complications of the transition from central planning to market economies must be kept in mind. In several of the countries reviewed, such transition has been accompanied by the collapse of important sectors of the economy and, in a few instances, unrest in parts of the population and political instability. The regulatory and organisational framework of the nuclear sector and of waste management cannot be expected to be given priority under such circumstances. Consequently, there seems to be some correlation between the degree of progress achieved in this field and the severity of the crisis which countries have undergone in recent times. Countries which have experienced a relatively smooth transition have already managed to establish a satisfactory regulatory and institutional scheme

In the Czech Republic, Hungary and Slovenia, waste management organisations have been created and are expected to assume all responsibility for the activities in this field in the next few years. In these countries, in addition, there is a significant production of radioactive waste from electricity production and thus a pressing need to implement efficient waste management arrangements. Electricity sales provide a continuous source of revenue adequate to cover the costs of waste management and disposal activities.

There are three further countries whose electric systems rely heavily on nuclear power and which thus have significant waste arising: Bulgaria, Lithuania and the Slovak Republic. Bulgaria and Lithuania are still in the process of reforming their legal framework. Legislation either enacted or being prepared anticipates creating independent waste management organisations, but concrete steps in this regard have not yet been taken. In the Slovak Republic, responsibility for radioactive waste management rests with a branch of Slovak Electric specially created in 1996 for that purpose.

Romania is in a special situation because generation of radioactive waste on an industrial scale has only just started with the commissioning of the first reactor at the Cernavoda nuclear power plant. A waste management organisation has not yet been established, but there is no urgency in this regard due to the small volume of waste existing at present. For the future, a dedicated waste management organisation will be desirable, and this issue should be addressed at a convenient time by the Romanian authorities.

In the other three countries reviewed, Estonia, Latvia and Poland, the magnitude of the waste management task is relatively minor. Moreover, since the waste needing management and disposal is mostly legacy waste, it is obvious that, irrespective of the actual mechanism implemented, financing needs will have to be covered by the State. Estonia has already created an independent waste management organisation. In Latvia the former RADON organisation created under Soviet rule is still in charge of waste management in an updated regulatory context. In Poland, the National Atomic En-

ergy Agency has both regulatory and managerial functions, but a clearer separation of these functions within the NAEA is planned under a new version of the Atomic Energy Act.

3.3 Financing systems in place

As described in Sections 1 and 2 of the present paper, in Western Europe there are two different approaches for ensuring availability of the means needed to cover costs of waste management and disposal. In some countries, a segregated fund system has been established. In other countries, waste management is financed by means of provisions in the accounts of waste producers, and the costs of implementing waste management and disposal are directly charged to the producers when and as the costs are incurred by the waste management organisation.

These two systems, devised to ensure later availability of means, are very different in the economic signals they send to the waste producers. Therefore, financing systems with a segregated fund provide an incentive to the waste producers to limit payments to the fund as far as possible whereas financing systems based on provisions intrinsically promote over-provisioning.

The CEEC are currently just starting to establish a funding system. All of them intend to install a segregated fund, to secure the means as far as possible. In most cases the fund is under state control. This is possibly a direct consequence of an economic tradition lacking experience with private enterprises acting in open markets.

Taking into account the economic difficulties prevailing in many countries of central and eastern Europe, having a fund under direct state control will not necessarily be a guarantee of later fund availability. The likelihood that the fund will be used to cover current state budget deficits is rather high. It seems at least questionable whether such a funding system will be consistent with the “polluter pays” principle, whether it will actually lead to today’s waste producers - and today’s electricity consumers - paying for the management and disposal of the waste arising from present electricity use. An adequate degree of independence from the State, and a complete independence from the State budget, will be indispensable if the fund is really to be available in the future to cover waste management costs. A segregated fund under direct state control is actually not a much better system than the former one under Soviet rule of postponing waste management until the time of plant decommissioning and leaving it to the State to pay directly for both activities as they are carried out.

Consequently, the success of the funding systems now being put in place will heavily depend upon the details of their implementation, and on the degree of independence from the State budget. A higher independence than currently apparent will most likely be necessary. On the other hand, it is obvious that the provisioning system is in most countries not a viable alternative because of the lack of stable enterprises and market economy traditions.

Another aspect worthy of attention is the potential for the waste producer to influence the economic efficiency of waste management. The so called “classical triangle” of regulator and implementing organisation independent from the waste producer is likely to produce enhanced radiological safety, but mostly at the expense of economic efficiency. The costs of waste disposal are broadly determined at the planning level, with the conceptual design of the facilities and the selection of sites. In the classical triangle it is not easy for the waste producer to influence high-cost decisions of the implementing organisation at the planning level. The implementing organisation, in turn, may, depending on the detailed arrangements in place in different countries, have no economic incentive to keep expenditure as low as possible. On the contrary, in some organisations in western countries there is a tendency to maintain a rather high level of activity. Without incentives for the waste management organisation to minimise costs, the allocation of resources will tend to be far from optimum.

It follows that economic incentives must be incorporated into the system. This will imply some influence or even limited steering capability by the waste producer on the waste management organisation. Ownership by the waste producers of the waste management organisation may provide some influence, but this method would not be easy to implement in central and eastern Europe at present. An appropriate means could be the participation of the waste producers in a supervisory organisation that approves the budget of the waste management organisation. Such a mechanism has been implemented in the Czech RAWRA and in the Slovenian ARAO, and is likely to lead to an improved allocation of resources. Appropriate contractual arrangements between the waste producer and the waste management organisation may also help in this respect.

Finally, according to the information available, payments made so far into the funds seem for different reasons to be in many cases unsatisfactory. Moreover, cost assessments for the later geological ILW and HLW disposal seem to be broadly underestimated compared with existing western experience. Both these facts indicate under-financing in the mid-term, and this problem should be addressed. It is in this context that the options of a national versus a regional repository could be considered. A major influence on this choice will obviously be that each of the reviewed countries is operating only one or a few reactors.

3.4 Special situations

In the countries reviewed there are two situations which for different reasons are somewhat out of a general line common to all the others and are therefore worth specific attention. One is the case of the Krško nuclear power plant in Slovenia. Croatia, which jointly constructed the plant with Slovenia, is not contributing to the waste management fund while the issue of the legal status and ownership of the plant remains unresolved. It is obvious that Slovenia should not carry the total waste management burden in the long-term and it is to be hoped that negotiations between the two countries will soon be successful.

Another special situation is that of Lithuania. RBMK reactors, such as those in operation at Ignalina NPP, produce significantly more waste than western PWRs, magnifying the dimension of the waste management problem. Moreover, there are some reservations regarding operational safety in the long-term that might make early shutdown of both units at Ignalina advisable. Since, up to the present time, no fund or provisions are available to cover future costs of decommissioning and of waste management and disposal, it seems doubtful whether such costs could be financed from future proceeds of Ignalina's electricity sales. In particular, the costs of disposing of the resulting HLW, should it be in a national repository, would potentially put an enormous financial burden on Lithuania's economy in transition. Eventually, the possibility of sharing the burden with neighbouring countries in a regional repository should be envisaged.

4 References

[1] "Schemes for Financing Radioactive Waste Storage and Disposal"; Environment Directorate-General, European Commission; Main report EUR18185, October 1999; and EUR18185 Annex (covering the CEEC and the Brussels workshop held on 22/4/99) to be published late 1999 (also refer to http://www.europa.eu.int/comm/dg11/pubs/nuclear.htm)
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