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# Comparison among different decommissioning funds methodologies for nuclear installations

**Final Report**

## Extended Summary

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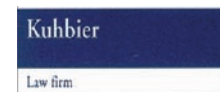
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## Extended summary

### Introduction

The European Commission estimates that approximately one third of the 145 power reactors currently operating in the European Union will need to be shut down by 2025. This will result in the need to dismantle, decontaminate and demolish these nuclear facilities as well as to undertake processing, conditioning and disposal of nuclear waste and spent fuel ('decommissioning'). It is of paramount importance that the **funding of these decommissioning activities will be adequate and available when needed** in order to avoid negatively affecting the **safety** of EU citizens. Nuclear operators are expected to accumulate all the necessary funds during the operating life of facilities.

The European Council, Commission and Parliament have highlighted the importance of decommissioning funds in a **joint statement** noted that "*separated management of decommissioning funds is essential to secure both the availability of funds to pay for decommissioning and radioactive waste management and in order to prevent market distortion*". While the European Commission published in October 2006 a **recommendation** for Member States that stated '*A segregated fund with appropriate control on prudent use should be the preferred option for all nuclear installations*' and '*Financial resources should be used only for the purposes for which they have been established and managed. In this context, due consideration should be given to transparency*'.

While the EU institutions have noted the importance of the correct management of decommissioning funds, Member States oversee different regimes for estimating, collecting and managing decommissioning costs. Furthermore, there are significant differences in the operation, governance, investment and accessibility of the existing funds across the EU.

This report reviews the different approaches taken by Member States and assesses the risks associated with the different methodologies. The report is divided into **four main parts**: Current decommissioning financing approaches from those Member States that have or have had commercial nuclear power facilities; Analysis of the financial consequences and risks of the different decommissioning financing schemes in place; Legal framework for dealing with these financial risks; Conclusions and Recommendations for action on the EU and Member State level. The study does not analyse how far the differences in decommissioning financing methodologies distort the single market for electricity nor to assess the validity of the cost estimates given.

### Decommissioning Financing Schemes in Member States

The first main part of the report covers the analysis of **current decommissioning financing approaches** (Chapter 3). It includes a comprehensive analysis of the current (and planned) approaches for financing nuclear decommissioning in the 16 relevant countries (i.e. those EU Member States that have or have had a commercial nuclear power programme). Also undertaken in the context of the study, and included in the

Annex, is a technical overview of the dismantling of nuclear facilities. The analysis of current decommissioning financing schemes involved an assessment of:

- the decommissioning liabilities, strategies and time schedules,
- the approaches to quantifying the decommissioning costs,
- the different methods for setting aside and managing funds including the accessibility of the operators of the nuclear installations to these funds,
- how the funding schemes deal with early plant closure or other unforeseen events,
- transparency of the schemes to the public, and
- stakeholders' opinion on the funding schemes in their countries.

The complete country and stakeholder reports are included in the annex to the report.

Nuclear decommissioning liabilities include dismantling, decontamination, demolition and site clearance of the nuclear facilities at the end of their lifetime as well as for the storage, processing, conditioning and disposal of nuclear waste and spent fuel. A main imperative for the distribution of liabilities is the '**Polluter Pays Principle**' which is broadly accepted but not fully implemented in every country. Only in some countries (e.g. Finland, Sweden), the 'Polluter Pays Principle' is a legal requirement. The principle assumes the operator of the nuclear facility to be the 'polluter' and to have the responsibility to finance and implement all decommissioning activities including nuclear waste management and final disposal operations. Furthermore, it implicitly assumes that the generation benefiting from a nuclear facility's production should pay for the decommissioning.

Analysis has shown that the estimates of decommissioning costs varies according to a number of factors including: the decommissioning strategy chosen; the cost items taken into account; the origin of the cost estimate; the methodology applied; the political-administrative framework; and the way risks and uncertainties are included.

Operators and decommissioning authorities in Member States deploy and propose different **strategies for decommissioning**, including:

- Immediate dismantling after the operational period until no more regulatory control is required; this is proposed in a number of countries, including France, Italy, Germany and Slovenia.
- Deferred dismantling requires that the facility is kept intact and placed in a protective storage state to enable the radionuclides to decay prior to eventual dismantlement. A number of countries have adopted this approach with the delay ranging from between 10 - 40 years in Sweden, to around 100 years in the UK.
- Entombment involves encasing the radioactive structures, systems and components in long lived substances, while ongoing monitoring is maintained. Currently, the approach is not proposed or undertaken by any Member State.

Some Member States have yet to determine their definite choice of strategy, e.g. Slovak Republic and Romania.

The strategy chosen will be impacted by and in turn affects the levels of: radiation protection; employment; financial and engineering costs; and the financial risks and uncertainties involved.

The cost estimates, for any decommissioning strategy, are arrived at by either making an estimate based on a generic rule (e.g., the cost of construction is used to estimate dismantling costs) or by making a more detailed 'bottom up' assessment, taking into account expected material, labour, engineering costs etc. Most Member States have moved or are moving towards the 'bottom-up' approach, with only Bulgaria currently fully formulating its decommissioning costs through the generic rule. The cost estimate methodologies and scope vary from country to country and even within countries. In general, the accuracy of cost estimates for the decommissioning of nuclear power plants is likely to increase over time as more facilities are decommissioned. However, currently, large risks and uncertainties remain, particularly with cost estimates for less standardized plants, such as reprocessing facilities. The cost estimates are based on technical and economic assumptions of future activities and therefore risks and uncertainties must be considered. Some of these uncertainties can have huge implications for the final cost. For example depending on the decommissioning strategy, some material which are not classified as waste today may in the future have to be disposed of, e.g. plutonium or depleted uranium.

Expected costs have risen significantly in a number of countries, for example the UK, while in others, for example France, there is still a considerable range of possible costs. Further costs adjustments are expected particularly for the dismantling of large facilities and with construction of final waste disposal facilities, due to the lack of experience in this field.

The **scope of cost assessments** must also be considered as it can vary between Member States, for example the decommissioning cost estimates for research facilities in Germany do not include the costs of final disposal. While some cost estimates for nuclear power plant decommissioning do not include costs of pre-decommissioning and facility shutdown activities.

The discussions on decommissioning funds have focused on nuclear power plants. Decommissioning of **other facilities** must not be overlooked, in particular for high cost facilities, such as reprocessing plants (the estimated cost of decommissioning the Sellafield plant in the UK is € 58 billion) or facilities having experienced incidents or accidents (e.g. the A1 unit at Jaslovske Bohunice, in Slovak Republic).

The long time scales involved, between estimating the expected cost of decommissioning activities and carrying out the actual work, increase the need to consider the impact of risks. For commercial nuclear power plants, the highest risks and uncertainties for decommissioning costs include; incidents and accidents during operating and during decommissioning; political decisions which change the framework conditions; availabil-

ity of nuclear knowledge at the time of the decommissioning activities; unexpected evolution of radioactive waste management, storage and disposal costs; and the general economic development. **Decommissioning projects ‘regularly produce the unexpected’.**

Consequently, it might be assumed that analysis would be based on decisions not only on one deterministic cost estimate, but instead sensitivity or scenario analyses or simulations carried out in order to identify the least-cost solution. However, such analyses are either not been published, with some exceptions, or they do not exist.

The **funding** schemes usually require the operator to **set aside** an amount according to the years of operation and/or the electrical energy produced. However, in Sweden and Finland, the full undiscounted decommissioning costs have to be provided for or to be guaranteed from the beginning of operation of a facility. While in France, a system has been recently introduced which requires the operator to provide for the full amount of undiscounted decontamination and dismantling costs, after a five years transition period.

A fundamental methodological difference between Member States is whether or not future decommissioning provisions are based on undiscounted costs (whereby the full estimated costs must be accrued) or on discounted costs (whereby funds are assumed to grow, though investment, over and above the rate of expected inflation). Given the long timescales involved this makes a significant difference to the funds that the operators must set aside. For some nuclear installations in Germany, Czech Republic, Slovak Republic, Italy, Finland and Lithuania, no discounting occurs. In those Member States that discount expected costs, the real discount rate ranges from 1.5% in Spain to 5.5% for some NPP in Germany. In the UK, for the Magnox plants a ‘on budget’ scheme is adopted (the Government uses its annual budget for expenditures) and in Romania no fund has been established.

Decommissioning funds are either **managed internally or externally** to the operator’s accounts. External funds differ in regard to their degree of independence from the operator and/or Government. For example, in the UK and Spain a public sector company manages the fund, while in the Slovak Republic a fund is managed by a Board of Trustees appointed by the Ministry of Economy.

Payment from current budget	Internal		External	
	Unrestricted	Restricted	Unrestricted	Restricted
UK (NDA)	D, B, NL, IT (SOGIN-ENEL), CZ	F, CZ	IT (CCSE)	FIN, LT, S, UK (NLF: British Energy), SK, E, BG, HU, SI

Further **restrictions** are placed upon the mechanism by which the funds are accumulated, the types of investments and the oversight mechanisms also display considerable difference between Member States. In Sweden, for example, assets must be

deposited in interest bearing accounts at the National Debt office or invested in promissory notes issued by the State, while in Spain there are only general guiding principles. The table above indicates the range of mechanisms used for decommissioning funds for different Member State's NPPs.

It is therefore clear that there are very different governance schemes of fund management, different investment rules, and variable access of operators of nuclear facilities to the funds. However, a number of Member States seem to be moving towards the increased restriction of funds. This development might be further accelerated by pressure from the financial markets (analysts and auditors).

Recent legislation in some Member States, e.g. Czech Republic or UK, has increased citizens **access to information** in general and this has been applied to decommissioning and radioactive waste management issues. However, in general, information to the public is restricted in a number of key areas, including: estimates of total decommissioning costs; details of cost estimation methodology; provisions accumulated per plant; investment strategy of decommissioning funds; and details of payments from decommissioning funds for decommissioning activities.

Many stakeholders, largely operating companies and Governments, are quite satisfied with the present situation in their countries and believe that adequate funds will be available when necessary. Furthermore, they largely have concerns about a process of harmonizing decommissioning financing on the European level and substantially changing the present system. However, some of these stakeholders stressed the importance of introducing some kind of general requirements or common criteria on producers of nuclear energy to ensure a level playing field in the EU.

### **Analysis of Financial Consequences and Risks**

The **second main part of the report** includes a comprehensive assessment of the financial consequences of the decommissioning funding schemes from accounting, valuation, governance and investment perspectives (Chapter 4). This is necessary to take into account both the economic pressure from the liberalized energy markets and financial markets and the nuclear safety requirements.

There are three underlying principles governing the financial risk analysis which are: the 'polluter pays principle' must apply as far as possible, with the operators of the nuclear installation regarded as the polluter; that 'transparency is an important requirement'; and a high level of quality (best practice) of fund management is vital.

### **Governance Perspective**

This section of the study has analysed and assessed the different financial risks relating to the various methods to set aside and manage the financial resources for decommissioning. The ideal outcome would have been to identify a preferred methodology.

However, a perfect solution which can be recommended to all countries and facilities does not exist, but it can be concluded that the current budget methodology has many shortcomings and cannot be regarded to be an appropriate solution. Different strengths and weaknesses can be attributed to internal and external decommissioning methodologies. Therefore, it is possible to define the important criteria which characterise a preferred solution, which should:

- Ensure that decommissioning funds should not be in the general accounts of the operator, be they private or government authorities. Funds assets should be separated or legally separated from other assets and liabilities.
- Focus and increase the independence of the seven elements identified in the Governance chain namely, the parties responsible for: regulating and monitoring decommissioning finances; paying for decommissioning activities; holding the funds in the general accounts; creating the investment policy and guidelines; managing the fund; authorising the payments for decommissioning; and the party who monitors and controls the decommissioning finance and can authorise sanctions in the case of non-compliance.
- Avoid situations where the operator has the power of authority to dispose of decommissioning funds.

Almost all weaknesses of the specific funding systems are linked to the potential degree of the **conflicts of interests** and occur in both internal and external funding methodologies as well for private or public operators. Conflicts of interests do not automatically disqualify a solution. However, they necessitate accompanying control measures, in order to avoid negative effects stemming from conflicts of interests. In governance language, “**checks and balances**” have to be established.

As a general rule, it can be said that the higher the possible conflict of interests linked to a particular decommissioning methodology, the higher the need for additional checks and balances or measures. This should assure good decommissioning practice by providing appropriate fences (as „**risk reducers**“). The need for additional checks and balances increases with internal solutions.

The higher weight of conflicts of interests in the case of internal methodologies together with the higher barriers for beneficiaries to legally claim assets when necessary are the main arguments, which speak for **preferring external solutions** where assets are separately accumulated and managed.

In order to ensure that a specific level and quality of generally agreed and monitored principles of additional measures (“risk reducers”, “fences”) will be applied, it would be reasonable to create a kind of European “oversight board” or at least a kind of “decommissioning financing committee” or “council”. Such a public board or committee or council would set principles and framework guidelines and would also monitor them. The general principles and framework guidelines should improve the well functioning of



systems. Moreover, the board or committee could propose methodology-specific additional measures (fences).

### Accounting Perspective

Accounting frameworks are arranged in a pyramid hierarchy. On the top is the objective of accounting principles, followed by underlying assumptions, qualitative characteristics, elements of financial statements and the criteria for recognition, measurement and disclosure. The accounting approach defines which costs have to be **recognised and measured** and is the over-riding perspective. Different sets of accounting standards already exist which address the key issues for decommissioning activities; of particular relevance are the **EU Directives** (the Fourth Council Directive 78/660/EEC of 25 July 1978 and the Seventh Council Directive 83/349 EEC of 13 June 1983) or the **International Financial Reporting Standards (IFRSs<sup>®</sup>)**. From the accounting perspective, there should be common “**Generally Accepted Accounting Principles (GAAP)**” applied to every installation. Therefore, it is not only a question of which internationally accepted standards should be applied but that all operators consistently apply the same GAAP and that this will be confirmed in the auditors’ report to increase transparency. The report recommends to apply IFRSs<sup>®</sup> together with clarifications (EU interpretations and guidance) in order to improve reliability and comparability. Applying the “current budget” methodology as it is done, e.g. for research facilities in many countries, does not meet the qualitative characteristics of modern accounting and is a possible source of failure in decommissioning financing.

### Valuation Perspective

A reliable valuation has to allow a comprehensive risk assessment (of all risks linked to the investment). Decommissioning funds methodologies are not the key driver for the financial value and valuation process as long as appropriate information is given. Transparency is paramount as key to minimising all effects linked to various factors of uncertainty and to assuring that investors receive a true and fair view of the financial position and performance. Transparency helps to prevent wrong investment decisions and thus inefficient allocation of financial resources.

The most important issue from the valuation perspective is the disclosure of both, discounted and undiscounted amounts of decommissioning provisions/debts. All other issues relating to valuation are already included in the governance and accounting perspectives.

### Investment Perspective

Decommissioning costs affect the competitive position of an operator in the energy market as they create potentially large and possibly unexpected expenditures. Therefore the incentive to finance part of future decommissioning costs through a high **investment performance** is evident. However, high performance investments can conflict with the **prudence principle**, which plays an important role in the field of financial asset management. Due to the scale of the funds involved and the long time peri-

ods it is recommended that '**guidelines**' be established that describe the framework for investments as well as required qualifications of the investment managers, to ensure they have a sufficient track record and that they are independent from the operator. In this context, an oversight board or decommissioning financing committee could provide such guidance.

The long time scales potentially allow more allocating to shares (with a higher expected return) than shorter term portfolios, a process known as **asset and liability management**. However, this approach requires the establishment of a **guarantee scheme** to cover decommissioning costs in the event of early closure of the facility or other unexpected cost increase.

### **Legal Aspects**

Chapter 5 of the report looks at the legal aspects of decommissioning and future legislation. The chapter shows that past and current efforts of the European Commission to harmonize the system of decommissioning funding regulations were and are all based on articles of the **EURATOM treaty**, especially article 31.

This creates a **dilemma** for a real regulatory process in the European Union, as the EURATOM Treaty does not provide any direct legal bases for legislative action in the field of financing of decommissioning. Consequently, it conflicts with international rules of general interpretation to extend the competences of the EURATOM treaty beyond the limits the treaty founder have given to it. It is especially invalid to try to extend by the simple means of interpretation a new competence to EURATOM which is clearly regulated under the Treaty of the European Communities but which is not covered by the EURATOM treaty.

Therefore all legislative proposals and recommendations on the structure and availability of decommissioning funds in the respective Member States cannot be based on the EURATOM treaty but need to be based on the **Treaty of the European Communities, especially Article 95 together with Article 175** on environmental grounds.

### **Conclusions and Recommendations**

#### **How can Member States improve their decommissioning financing systems?**

Member States must ensure that adequate funds will be available when necessary, and that – using the 'Polluter Pays Principle' – risks and uncertainties are eliminated as far as possible. These steps are outlined in Chapter 6 and include:

- The **identification of risks** such as the changing of ownership of utilities or the existence of two or more different decommissioning financing schemes in one market.

- Increasing **transparency**; experience shows that transparency is a key issue for any internal or external fund. Given this, an operator has to define and establish a procedure which is effective, clear and transparent.
- Assuring a high degree of **independence** between actors in the governance chain is crucial. This must include organisational and structural independence of the different organisation as well as personal independence.
  - The independence of the licensing authority is central. In this context, it is recommended that there will be cooling off periods for employees transferring between the licensing authority and other actors in the governance chain.
  - It is recommended that there is full independence of the decommissioning fund manager from the operator. Analysis shows that internal and external funds need different checks and balances. Additional measures can cause additional costs and carry inherent risks of inefficiency. In principle external funds ensuring the independence of decommissioning fund management from the operator reduce the need for additional checks and balances.
  - Internal unrestricted decommissioning financing schemes, public or private, do not secure the minimum degree of independence necessary and increase the likelihood of a conflict of interest.
  - Internal unrestricted financing schemes should be changed into restricted funds, with a measurable degree of separation.
- It is necessary to separate the **power of authority** of the bodies responsible for collection from that of **disposal of the funds**, while at the same time not reducing any **incentive to reduce costs** of decommissioning activities.
- Introduction of a uniform accounting system, ideally one based on the **International Financial Reporting Standards (IFRSs®)** for both public and private licensees is necessary. Applying the ‘current budget’ methodology doesn’t meet the qualitative characteristics of modern accounting and is a possible source of failure in decommissioning financing. Therefore, **public licensees** should not pay decommissioning costs from the current budget, but build up separated provisions.
- **Additional guarantees** to cover unplanned eventualities to ensure that under all circumstances the polluter pays principle is adhered too should be undertaken. This would require:
  - The relationship between mother and daughter companies has to be clarified, so that the corporate group will cover all liabilities of the limited company in any case of bankruptcy of the daughter company („deep pocket liability“)
  - Guarantees should be introduced that cover the financial risk of an early shut down.
  - Guarantees to cover the eventuality of insufficient funds available after final shutdown, due to unexpected cost increases or fund mismanagement.

Such guarantees could be achieved through the pooling between licensees within a country or region, thus creating a collective financial guarantee fund, as with additional insurance or bank guarantee.

- Establishment of investment guidelines to address the trade-off between high performance and high security of funds and describing the required **qualifications of investment managers**. A professional **asset & liability management** framework should be implemented for all private and public facilities, with matching durations of liabilities and assets. A periodic evaluation of the financial risks rating of the operator (for both the mother and subsidiary company) should be undertaken. **Audits** by certified auditors on the state of the provisions, the state of the decommissioning funds and the investment policy should be undertaken.

### **Increasing transparency and oversight - First steps proposed at EU level**

Action will also be needed on the EU level to increase both **transparency and oversight**. It is recognised a number of processes already existing such; within the Council's working group and the Decommissioning Funding Group; the implementation of the October 2006 recommendation on Decommissioning from the European Commission.

However, in order to further improve transparency **regular uniform reports** should be produced **by Member States**. The transparency process should be further enhanced by the establishment of a **Council (of trustees) of European Nuclear Decommissioning Funds (CENDF)** on the European Level. This independent body should: -

- Act as a focal point for contacts between Member States on decommissioning issues.
- Become an interface on the European Level between Member States and the EU institutions.
- Agree on best practice and consequently contribute to improving the existing systems.
- Contribute to a higher degree of harmonisation of decommissioning financing methodologies in the EU.

### **Regulation of decommissioning financing at EU level? – Outlook on possible future steps**

According to the experiences with the European Commission's draft directives of 2003 under Article 31 of the EURATOM Treaty on nuclear safety and radioactive waste management (the "nuclear package") and discussions with stakeholders in the course of this project, further legal steps on the European level are not envisaged at the moment.

However, if the European institutions considered using the **Treaty of the European Communities**, as argued in chapter 5, as a legal base for potential action, **further regulation** of decommissioning financing at EU level would be justified. Further harmonisation in the EU would be achieved by the introduction and implementation of **binding legislation** by Member States. Its legal base could focus on the impact of differences in decommissioning financing schemes on the energy market and/or environmental protection, neither of which are adequately addressed through the EURATOM Treaty.

Such a directive would only be necessary if the current processes were not fully implemented.

Further legislation harmonisation would be achieved through the establishment of a **European Nuclear Decommissioning Oversight Board (ENDOB)** replacing or complementing the Council (of trustees) of European Nuclear Decommissioning Funds (CENDF). Contrary to the CENDF that concentrates on increasing transparency and recommending best practice, the ENDOB would have **authority to introduce general principles and guidelines** as well as the ability to **monitor their implementation**.

### **Reporting requirements to increase transparency across the EU**

To increase **transparency** across the EU Chapter 7 makes precise recommendations of the reporting that should be undertaken to the European Commission so that a detailed annual report to the Parliament and Council can be undertaken. This **reporting** would require **three levels of information**:

**Primary level:** Comprising of five indicators which reflect the overall financing of decommissioning and waste management activities in each Member State. These are the: sum of the estimated undiscounted decommissioning costs for all installations; sum of the provisions for decommissioning; sum of possible costs covered by guarantees; sum of assets in separate dedicated funds; and the average sum of payments per year for decommissioning over the previous three years. This would enable comparison between Member States as to the degree to which funds are been collected and guarantees provided as well as indicators of the measures taken to ensure separation of the funds from the regular activities of the utility.

**Secondary level:** Will demonstrate the state of financing for each individual nuclear facility (which should have been gathered in collecting the primary level information). This should reflect both the differences between different types of facility and between different designs and become the basis for facility type specific benchmarking.

**Tertiary level:** This will provide more detailed information on the framework, procedure and rules for the financing of decommissioning.