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Comparison among different decommissioning funds methodologies for nuclear installations

Final Report

Final Report

on behalf of the European Commission
Directorate-General Energy and Transport, H2

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Contents

Tables

Figures

Executive Summary

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.

Member States oversee different regimes for estimating, collecting and managing decommissioning costs and there are significant differences in the operation, governance, investment and accessibility of the existing funds across the EU.

This report has undertaken an assessment of the different regimes and noted the following:

- The Polluter pays principle for decommissioning is widely accepted and needs to be the fundamental basis of the granting an operating **license**, as occurs in Finland and Sweden.
- 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 or facilities having experienced incidents or accidents.
- Costs estimates are subject to high degree of **risks and uncertainties**; expected costs have risen significantly in a number of countries while many estimates still contain a considerable range of possible costs.
- Differences in reported cost estimates occur due to varying **discounting** mechanisms and the timing of dismantling.
- Not all Member States require that funds be **managed** externally and segregated from the operator.
- 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)
- In most countries there are only limited rights for the public to **access information** on decommissioning costs and funds.
- Many operating companies and governments are **satisfied with the current situation** and have **concerns towards an EU harmonization process** of nuclear decommissioning financing.

A comprehensive assessment of the **financial consequences and risks** of the decommissioning funds from governance, accounting, valuation and investment perspectives has been undertaken in the course of this study.

From a **governance perspective**, the higher the **potential conflict of interests** within a particular decommissioning methodology, the greater the need for additional **checks and balances**. Externally managed funds have a lower risk of conflicts of interest. Given the many conflicts of interests embedded in decommissioning and the importance of the health and safety aspect over a long time horizon, a framework for best practice of decommissioning financing should be introduced, which goes beyond mere legal requirements. Therefore decommissioning financing projects should focus on the **independence** of the involved parties, avoid situations where the operator has power of authority to dispose of the decommissioning funds and aim at reducing any possible situation where financial funds obtained by the operator can be used for different purposes.

Using the **accounting perspective** leads to the conclusion that the **International Financial Reporting Standards (IFRSs®)** should be applied together with clarifications (EU interpretations and guidance) to improve reliability and comparability. Applying the "current budget" methodology doesn't meet the qualitative characteristics of modern accounting and is a possible source of failure in decommissioning financing.

The **valuation perspective** is particularly important to investors. A reliable valuation has to allow a comprehensive risk assessment. To enable this to happen **transparency** is paramount.

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. It is therefore recommended that **guidelines** are established. The long time scales potentially allow more allocating to shares (with a higher expected return) than shorter term portfolios, a process know as **asset and liability management.** However, this approach requires the establishment of a **guarantee scheme.**

The **legal aspects** of the report suggest that the legislative proposals and recommendations on the European level on the structure and availability of decommissioning funds in the respective Member States should not be solely based on the EURATOM Treaty but have to be based on the **Treaty of the European Communities**, especially Article 95 together with Article 175 on environmental grounds.

Based on the findings of the report a number of **recommendations** are made on how to ensure that adequate funds are available when necessary. These recommendations are made to **Member States** and to actions that could be undertaken now on the **European** level. Furthermore, the report makes suggestions on how **further harmonization** of could be achieved on the EU level if necessary. Along with these recommendations are suggestions for **information sharing and reporting** that should be undertaken across the EU to increase **transparency**.

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 "s*eparated 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 costs 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 shortcoming 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®).** 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® 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 it 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 extent 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 coved 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.

1 Introduction and overview

1.1 Background of the study

The **liabilities** of operators of nuclear installations for the storage, processing, conditioning and disposal of nuclear waste and spent fuel, as well as for the dismantling, decontamination and demolition of their nuclear facilities at the end of their lifetime are substantial and require carefully planned advance arrangements. This has to be done in order to ensure nuclear safety, and according to the broadly accepted 'Polluter Pays Principle'.

Furthermore, as the number of nuclear power plants (NPPs), research reactors and other nuclear facilities that are closed and are undergoing dismantling and decontamination or are planned to close is steadily increasing, **nuclear decommissioning** has become an increasingly important issue and will become even more so in the years ahead. The European Commission estimate that approximately one third of the 145 power reactors currently operating in the European Union will need to be shut down by 2025.

There are different methodologies deployed in the EU Member States for estimating costs and financially providing for future decommissioning including nuclear waste management and management of radioactive waste from dismantling. Moreover, there are significant differences in the operation, governance, investment and accessibility of the existing **decommissioning and waste management funds** in Europe. These differences can lead to the following problems:

- First, not all the existing financing methodologies can reliably ensure that funds for decommissioning purposes are available when needed and adequate enough in order to avoid negatively affecting the **safety of EU citizens**. The safety of the citizen is of paramount importance. Therefore, the availability of adequate financial resources, by the time the nuclear facility is permanently shut down, overshadows other concerns by the European Commission with regard to the decommissioning of nuclear installations.
- Second, not all the existing decommissioning financing systems ensure that the **'Polluter Pays Principle'** is applied as far as it is possible to foresee future costs and possible financial risks and uncertainties. The decommissioning financing system principally determines who has to pay for safe decommissioning at the time needed: the generation benefiting from the nuclear energy produced or future generations, when the decommissioning activities occur, the future taxpayers or the current operators ("polluters").
- And third, in 1998, the European Commission identified the issue of decommissioning funds as one, which could potentially lead to a **distortion of the single market for electricity**.

In part as a result of the latter, the European Parliament passed an amendment in its first reading of the Electricity Market Directive in 2002 calling for the separation of decommissioning and radioactive waste management funds from the accounts of utilities. This amendment was subsequently overturned, but resulted in a **joint institutional statement,** which called for the separate management of decommissioning and waste management funds (OJ 2003):

> *„The three institutions are strongly committed to the principal that the funds collected for the decommissioning and management for nuclear waste should be separated from the normal accounts and cash flow of an undertaking. 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 by using the cash flow of or the more favourable financial ratings due to potential access to the decommissioning funds for competitive purposes in the energy market."*

This statement in turn led to the **European Commission** preparing a draft directive under Article 31 of the **Euratom Treaty** on nuclear safety, which included recommendations on the financial management of decommissioning funds, with the main objective of ensuring safe decommissioning.

If adopted these would have required that the operators of nuclear facilities ensure that there were adequate funds to cover their future decommissioning activities and that under normal circumstances these should be retained in legally separate accounts from that of the operator and only used for the purpose for which they were accumulated. The **European Parliament** largely agreed with the recommendation of the Commission. However, discussions in the **European Council's Atomic Questions Working Group** resulted in the altering of the proposals so that the recommendation from the Council. These were subsequently adopted by the Commission in its redrafted directives in 2003, called for operators to ensure that there were adequate funds for decommissioning and waste management activities, but gave no recommendations on the ownership or management of these funds.

However, there was insufficient support from **Member States** to have the nuclear safety directive, which included the proposed text on decommissioning funds, (and a linked directive on nuclear waste management) adopted and the directive is now on hold within the institutions. As a consequence the European Council has established three working groups, including one on decommissioning funds, to the development of the pertinent policy initiatives.

Interest **groups representing the major electricity producers and the nuclear sector** lobbied to have the Commission's original proposal for legally separate decommissioning and waste management funds abandoned instead calling for Member States to decide the most appropriate mechanisms for fund management.

Member States representatives are also involved in an informal group organised by the European Commission called the **Decommissioning Funding Group (DFG)**. This group advises the Commission and shares information on the funding of decommissioning activities.

Against this background, based on previous studies and reports, and in addition to the work done in the groups mentioned above and in other projects initiated by the Commission, the European Commission initiated this **study on the different decommissioning financing methodologies for nuclear installations** within the Member States of the European Union (including Bulgaria and Romania). The information gathered and the analysis undergone for this project shall form one of the bases for future decisions in this area.

In addition, the study might also contribute to the discussion on decommissioning financing methodologies on the **national level**. The existing schemes and possible improvements have been increasingly discussed in Member States. In some countries, this discussion has already led to substantial changes of the decommissioning financing systems.

1.2 Objectives of the study

The **main objectives** of this project were:

- to increase **transparency** by taking stock of the approaches to quantify decommissioning costs and to finance decommissioning in Member States, based on existing documents and further data and information gathered in the course of this study;
- to analyse the **risks** relating to the various methods to set aside and manage financial resources for decommissioning purposes, in particular from the financial point of view;
- to identify the **stakeholders**, their roles and motivations with regard to the existing methodologies on quantifying decommissioning costs as well as constituting and managing decommissioning funds;
- to propose feasible steps of **optimising** decommissioning financing methodologies in the different Member States so that financial security is increased, i.e. that the financial risks identified are reduced;
- to discuss the **role of the European Commission** with regard to decommissioning financing in the Member States, to analyse how far the different financing methodologies deployed in the European Union should be harmonised;
- to propose **indicators** describing the differences and common features of the different national approaches and allowing a user-friendly comparison between them, which may subsequently be used for reporting purposes on the European level.

A **central question** of the country analyses and financial risk analysis on which the development of proposals for optimising decommissioning financing systems should be:

> *Is decommissioning financing (a) adequate, (b) available when needed, (c) secure and (d) well-managed in (e) a transparent way to ensure safe decommissioning based upon the 'Polluter Pays Principle', i. e. that the generation and actors benefiting from the nuclear energy produced will fully pay for safe decommissioning?*

The study does **not** analyse how far the **differences in decommissioning financing methodologies distort the single market for electricity**. However, if adequate decommissioning funding for a safe decommissioning and implementation of the 'Polluter Pays Principle' is ensured for all nuclear facilities throughout the European Union, this would reduce such possible distortions.

In principle, **all types of existing civil nuclear facilities** in the EU Member States were subject to the study. However, the focus of the study remained on major installations, from the point of view of decommissioning costs. Furthermore, due to the limited scope of the study and limited data and information available not all nuclear installations could be analysed in detail.

A main additional value of this study is a **comprehensive analysis of financial consequences and risks** of the existing decommissioning financing schemes from the perspective of an experienced financial expert.

Furthermore, **the consortium established for this study** was able to link the knowledge and experiences of

- national experts on nuclear energy
- specialists in financial risk assessment and
- legal experts

to carry out the study and to derive conclusions and recommendations from it.

1.3 Overview of the final report

In order to achieve these objectives, the **final report** of this study on decommissioning financing presented here on behalf of the European Commission includes

- Technical and financial definitions used for the purpose of this report (**Chapter 2**).
- The results of a comprehensive and deep analysis of the current (and planned) approaches of financing nuclear decommissioning of nuclear installations in those 16 countries in the EU-27 in which nuclear installations are currently operated (**Chapter 3**). This analysis took systematically stock of

  - the various general technical options and strategies of decommissioning nuclear facilities,
  - the approaches to quantify decommissioning costs,
  - the different methods of setting aside funds,
  - the different fund management practices,
  - the relevant stakeholders, their role and their motivations with regard to the existing decommissioning funding approaches and to the existing proposals of further developing them in the different Member States and on EU level.
- Based on these country analyses, the results of the analysis of financial consequences and risks of the different decommissioning financing schemes implemented (**Chapter 4**). The financial consequences can be divided into
  - the risks related to governance issues,
  - the risks related to accounting issues,
  - the risks related to financial valuation issues, and
  - the risks related to the investment policy.
- An overview of the legal framework for dealing with these financial risks in the European Union (**Chapter 5**). This chapter particularly gives an answer to the question on which legal basis the activities by the European Commission with respect to decommissioning financing systems in the Member States are justified.
- Conclusions and recommendations for the Member States and the European Union that are based on the analysis of financial consequences and risks of the existing decommissioning financing schemes, taking into account the legal possibilities for dealing with these risks, and what can be learned from non-EU countries and non-nuclear areas (**Chapter 6**).
- As a specific recommendation, a proposal for the future collection of data (indicators) and further information needed for the comparison of the different decommissioning financing approaches in place. This could form the basis of reporting requirements set by the European Commission to the Member States and to its own facilities (**Chapter 7**).

The **appendix** of this final report contains

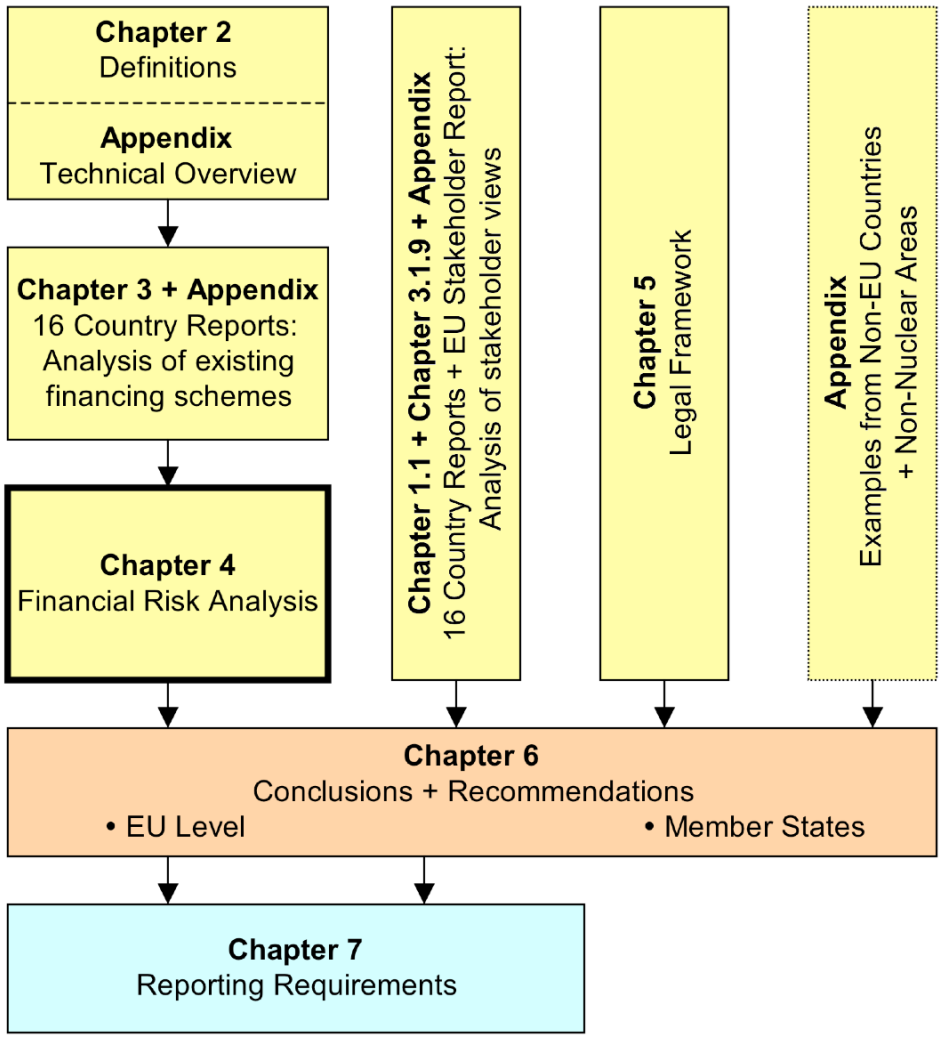
- a **stakeholder analysis on the European level;**
- 16 **country reports** describing the different approaches to decommissioning financing and the views of the different stakeholders in the respective countries in detail**;**
- a description of **decommissioning financing schemes in selected non-EU countries and in non-nuclear areas**. Examples described here are regulations on nuclear decommissioning financing in Canada, Switzerland, and the US, as well as

decommissioning financing rules for conventional waste disposal in Germany, coal mining and offshore petroleum sites in several countries;

- a **technical overview** on decommissioning of nuclear facilities in Europe, with a special focus on dismantling and decontamination;

The flow of work in this project and how the different chapters are interlinked within this final report is depicted in the following figure.

Figure 1: Flow of work and how chapters of this final report are interlinked



1.4 Roles of the project partners and subcontractors

The project team having developed this final report presented was a consortium headed by the Wuppertal Institute (project co-ordinator). The analysis of the framework conditions, decommissioning financing methodologies and stakeholder views on de-commissioning financing in the different countries was split among the partners and

subcontractors. The following table shows the roles and responsibilities of the different experts. The respective country reports (including stakeholder reports) are attached to this final report. The main results are summarised in Chapter 3 of this final report.

Table 1: Experts/Organisations responsible for the country analyses

Country	**Expert / Organisation**
Germany, The Netherlands, Italy and Slovenia	Wuppertal Institute, Germany
UK	PSIRU/University of Greenwich, UK
Finland, Sweden	VTT, Finland
France, Belgium, Spain	Mycle Schneider Consulting, France
Hungary	AEKI, Hungary
Lithuania	AAPC, Lithuania
Czech Republic	Öko-Institut e.V., Germany
Slovak Republic	Energia 2000 and its partner organisations Energia tretieho tisicrocia and Za Matku Zem, and with support from Luba Kupke-Siposova, Slovak Republic / Austria
Romania, Bulgaria	Ian Smith, Private Consultant, UK/Romania

In addition to the country analyses, the private consultant Antony Froggatt was responsible for the stakeholder analysis on the European level attached to this final report. The main results of this analysis are included in Chapter 1 of this final report.

Ameur Sciences et Techniques contributed to the technical nuclear aspects of the study and gave an overview on dismantling and decontamination techniques in the European Union, that has been attached to this final report.

Ellipson AG was mainly responsible for the analysis of financial consequences and risks based on the country analyses (Chapter 4).

Kuhbier Law Firms described the legal framework for dealing with these financial risks (Chapter 5).

Wuppertal Institute and Antony Froggatt were mainly responsible for the sections on decommissioning financing systems in non-European countries and non-nuclear areas that has been attached to this final report.

Furthermore, Wuppertal Institute and Antony Froggatt summarised the conclusions and recommendations (Chapter 6 and 7), and the executive summary and the extended summary of this final report.

The conclusions and recommendations were discussed with all partners and subcontractors, and with the European Commission. The project team is grateful to any comments and suggestions by other scientists, financial experts, operators of nuclear facilities, decommissioning fund managers and further stakeholders.

2 Technical and financial definitions used for the purpose of this report

In order to consistently and precisely analyse decommissioning financing, it is necessary to firstly describe in detail the definitions and implied understandings of different technical and financial key terms within the project. It should be noted that these definitions are not all assumed to be generally accepted ones but have been set in a practical way for the purpose of this report. With regard to the definition of "decommissioning" and "decommissioning fund", unnecessary ambiguities could be avoided and transparency improved in case a more comprehensive terminology could later be adopted, such as "decommissioning and waste management funds" in accordance with Commission's statement in (OJ 2003).

The definitions used in this report, particularly the definition of "decommissioning", are mainly based on definitions currently used by the European Commission, DG TREN, Unit H2. Other sources used for this list of definitions are the technical overview by Ameur Sciences et Techniques in the appendix to this report, and (BMU 2001).

Decommissioning	All activities covering the technical decommissioning of the nuclear installation (decontamination, dismantling and demolition) and waste management (management and disposal of radioactive waste and spent fuel) leading to the release of the nuclear installations from radiological restrictions.
Decommissioning Fund	Any type of financial resources intended specifically to cover the expenditure necessary for decommissioning nuclear installations.
Decontamination	Removal of fixed radionuclides. This serves radiation protection and is an important prerequisite for the eventual recycling of residual materials after clearance.
Demolition	Technical decommissioning concerning buildings.
Dismantling	Equipment disassembly.
Disposal / Repository	Waste/Material packages holding radioactive waste or other radioactive materials (e.g., spent fuel elements) are reliably isolated from the biosphere over very long periods of time.
Earmarking	Earmarked assets can only be used for a specific purpose, i.e. the fund manager is restricted in his/her investment decisions. A restriction (earmark) limits or directs the use or distribution of an asset. This wording is usually used with internally managed funds. Cf. also ‚Restricted Fund'.
Internal / External Fund	Internal means that the fund is part of the organisation operating the nuclear installation. External means that the fund is not part of the respective operating organisation. An internal/external fund can be a restricted or an unrestricted one. An external fund (i.e. not managed internally by the operator) can exist with or without transfer of liabilities (or transfer of ownership of radioactive waste or radioactive 'products') to the fund organisation, and with or without a short-fall guarantee by the operator or a group of operators.

Nuclear Facility / Nuclear Installation	Any civilian facility and its land, buildings and equipment in which radioactive materials are produced, processed, used, handled, stored or disposed, e.g. uranium mines or mills, enrichment facilities, conversion plants, fuel fabrication plants, nuclear power plants, research reactors and other research facilities, reprocessing plants, conditioning facilities, interim storages or final disposal facilities.
Operator	The legal person who operates the nuclear installation and has the prime responsibility for nuclear safety.
Public / Private	In the case of nuclear *liabilities*, public means that the state, a public entity or a state-governed organisation is responsible for covering them, and private means that an organisation owned by private owners has to deal with them. In the case of *legal context*, public means that an organisation has to comply with "public law", and private means that an organisation has to comply with "private law". In the case of *ownership*, public means that the organisation is owned by public entities (government, state-governed organisation), and private means that the organisation is owned by private owners (be it a quoted or an unquoted organisation). In the case of *fund management*, public means that a public entity (government, state-governed organisation) manages the decommissioning fund, and private means that the management is with an organisation owned by private owners.
Restricted Fund	The liable organisation responsible for decommissioning financing is not fully free in using the money accumulated, i. e. that specific legal requirements for nuclear decommissioning funds exist that go beyond general rules like general accounting principles, general tax law, etc. Restrictions by the state, state-governed organisations or other third parties can be imposed with respect to the accumulation, management and investment of the means of finance. In addition, restrictions can exist with regard to the payment of decommissioning activities. A restricted fund can be either internally or externally managed. Cf. segregated fund for one out of several possible restrictions.
Segregated fund	A decommissioning fund, either internal or external, which is identified separately. Segregation can be one out of several possible restrictions to a decommissioning fund.
Storage	Interim solution until the materials/waste can be disposed of in a suitable repository.

Waste

A widely used classification system separates radioactive waste into three classes: low-level waste (LLW), intermediate-level waste (ILW) and high-level waste (HLW). HLW is highly radioactive material arising from nuclear fission. LLW is mildly radioactive material, which does not require shielding during normal handling and transportation. ILW waste is waste exceeding the upper boundaries for low-level waste but which do not need heat to be taken into account in the design of storage or disposal facility.

It should be noted, that some materials not classified as waste today might have to be managed as waste in the future, for example, uranium extracted in reprocessing and depleted uranium, a portion of separated plutonium and spent fuel (in some countries high-level waste is recovered from reprocessing spent fuel, while other countries regard spent fuel itself as high-level waste). This has to be taken into account in the context of decommissioning financing which includes financing of radioactive waste management according to the definitions set for the purpose of this report.

3 Financing decommissioning in the EU-27

3.1 Current approaches in the EU Member States

3.1.1 Scope of analysis

The analysis covers the existing nuclear decommissioning financing schemes for all types of nuclear facilities in those **16 European Member States** which have nuclear installations under operation (including Bulgaria and Romania**)**. As far as information was available, recent or planned changes in these financing systems have been taken into account up to **October 2006**.

While taking **all types of nuclear installations** into account, the focus remains on major installations, from the point of view of decommissioning costs. Furthermore, due to the limited budget of the study and limited data and information available, decommissioning financing systems are analysed in detail only for some of the nuclear installations in more detail.

While the study analyses decommissioning financing schemes it has to take into account existing cost estimates and cost estimation methodologies because they determine financing needs. **However, it is not within the scope of this study to analyse and judge how far existing cost estimates are realistic or not.** This study can just report existing cost estimation figures and their relations to provisions made, and document the different cost estimation methodologies.

An important basis for the country analyses in this project were the questionnaires of the DG TREN project „Analysis of the factors influencing the selection of strategies for decommissioning of nuclear installations“ (Contract Number TREN/04/NUCL/S07. 40075) carried out by Colenco and Iberinco. They were available for all of the countries analysed except Bulgaria. However, the level of details provided differs from country to country. Furthermore, the level of co-operation with operators of nuclear facilities, managers of decommissioning funds and other relevant stakeholders varied from country to country, and thus the possibilities to receive data and information beyond the Colenco/Iberinco questionnaires. In conclusion, the level of data availability differed between the countries, which made the analysis and the comparability of results between the countries partly difficult.

Therefore, additional information was gathered and stakeholders interviewed. The information from the Colenco/Iberinco questionnaires and further literature formed the empirical basis to answer the following main questions and a list of sub questions related to them, developed at the start of the project as a kind of questionnaire or template to be filled in by every country expert of the consortium:

- Who is liable for decommissioning activities to what extent?

- What are the technical options used and the current and expected future strategies for decommissioning nuclear facilities in the respective countries?
- How are decommissioning costs quantified, and what are the costs estimated?
- What methods are used to set aside funds, and what are the funds provided?
- How is fund management implemented in practice, and what is the return on investment?
- In particular, how does the decommissioning financing system provides for unexpected events like early closure or transfer of ownership?
- Is the decommissioning financing system transparent to the public, and does the public have rights to information on decommissioning financing?
- Who are the relevant stakeholders, and what are their roles and motivations with regard to the existing decommissioning funding approaches and to the existing proposals of further developing them in the different Member States and on EU level?

3.1.2 Decommissioning liabilities

Nuclear liabilities include liabilities for the 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. They arise with the start of operation of a nuclear facility, i. e. as the first activation or contamination takes place, and usually increases with operation.

A main principle with regard to the distribution of liabilities is the **'Polluter Pays Principle'** which is broadly accepted but not fully implemented in every country. 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' requiring a clearly defined and full responsibility to plan, implement and finance all decommissioning including nuclear waste management and final disposal operations. This including being responsible for the coverage of associated costs, and with the producers' responsibility not ending until all waste has been finally disposed of and the safety authorities have accepted that the final closure of the final disposal facility has been concluded fulfilling the pertinent safety requirements for final closure. The operator can be

- a company owned by private shareholders from inside and/or outside the country,
- a company owned by the public, a public agency or another institution which is 100% owned by the state in which the facility is located or from another country, or
- a company with mixed public-private ownership.

However, it should be noted that full implementation of the **'Polluter Pays Principle' cannot be 100% secured in any decommissioning financing scheme**, because

even after the closure of the last final disposal facility, after all decommissioning activities have been carried out, there still remains a risk that radioactive materials can escape into the environment and induce environmental and health problems and costs to future generations.

Furthermore, according to international law, the state has the responsibility **for final disposal** of radioactive waste. Therefore, financial liabilities for final disposal (and partly waste management, too) are not always with the 'polluters' but in some cases transferred to a state-governed organisation after transferring the responsibility for radioactive waste to this organisation. For example, in the Netherlands and in Slovenia, the fees the operator pays for dealing with radioactive waste include the cost of final disposal and discharge the operator from any waste management and disposal liability. In the Dutch case, this also includes dealing with waste products returning to the Netherlands after spent fuel has been reprocessed and with final disposal (plutonium from reprocessing remains in France with AREVA). According to the law of April 2003, a similar regulation is in place for LLW and ILW waste in Belgium, but not for spent fuel disposal.

In other cases, the **state has partly taken over the liabilities of the operators, for example:**

- Responsibility of the state for all decommissioning activities in Spain
  In Spain, the state-governed radioactive waste management agency, ENRESA, is responsible for all decommissioning activities of nuclear facilities in Spain (except uranium mines started up after the foundation of ENRESA in 1984, research reactors and other research facilities) three years after the shut down of the nuclear installation, i. e. after removal of spent fuel. After this transfer of liabilities, the former operators do not have to further contribute to the decommissioning fund even if decommissioning costs exceed the provisions made.
- Nuclear phase-out: Former ENEL and ENEA facilities in Italy
  After the decision to close all nuclear power plants, and in the context of privatisation and liberalisation of the electricity market, liabilities of ENEL and ENEA facilities have been transferred to the company SOGIN which in turn has been transferred 100% to the Italian Ministry of Treasury.
- German unification
  In the course of German reunification the federal government has taken over decommissioning responsibilities for the nuclear facilities in the former German Democratic Republic.
- Privatisation in the Slovak Republic
  ENEL has not taken over any responsibility for decommissioning when taking over 66% of the power generating company in the Slovak Republic.
- Pilot projects like the reprocessing plant WAK, Karlsruhe, Germany
  Although the energy companies were the ones which aimed at benefiting from the

reprocessing plant in Karlsruhe, Germany, they only contributed to part of its decommissioning costs.

Finally, it should be noted that the **organisation being principally liable is not always the organisation which fully pays for decommissioning activities** which is demonstrated by the following examples:

- Early shut-down
  An example for a NPP with early shut-down is the THTR-300 in Hamm-Uentrop/Germany: The operating company does not possess the financial means to pay for decommissioning. Therefore, a special financing agreement between the federal government, the state of North Rhine-Westphalia where the site is situated, and the energy companies ensures that decommissioning costs of safe storage can be paid. However, this agreement is only valid until 2009, it is still not clear who will finance decommissioning activities after 2009.
- Accession to the European Union
  In the case of Bulgaria, Lithuania and Slovak Republic, there are agreements between the state governments, the European Union and some Member States about European contributions to financing decommissioning of the nuclear power plants in the context of the countries' accession to the European Union.
- Joint binational ownership
  There is the special case of Slovenia, where the Krsko NPP belongs jointly to a Slovenian and a Croatian company. In this case, formally, the liabilities are fully with the Slovenian operator of Krsko NPP because the plant is situated on Slovenian ground, while in practice - due to a Slovenian-Croatian contract – decommissioning is a bilateral obligation.

For a very few publicly owned nuclear installations and the majority of nuclear research facilities, it is **not decided yet who will have to pay for future decommissioning activities**. This is because for research reactors it is assumed that

- the state will have to pay
- contributions collected from industry for specific research projects carried out in the facility are not calculated in such a way that future decommissioning activities are taken into account, and
- the research organisations (universities) themselves will not possess the financial means to substantially contribute to decommissioning activities.

3.1.3 Technical decommissioning strategies and time schedules

In principle, there are three technical decommissioning (decontamination and dismantling) strategies (for more information see the technical overview in the appendix to this report):

- **Immediate decontamination and dismantling**
  Decontamination and dismantling immediately after operation period. All contaminated material is cleaned until no more regulatory control is required. It is then dismantled as soon as the end of operation period.
- **Deferred decontamination and dismantling (safe enclosure / safe storage)**
  The nuclear plant is kept intact and placed in protective storage to enable the radionuclides activity to decay until it reaches levels that reduce difficulties of handling. First, spent fuel is removed from the facility. The plant is then put and kept in a safe and stable state, until actual decontamination and dismantling. During this period, all remaining fluids are drained from the systems and adequately treated.
- **Entombment**
  This option involves encasing radioactive structures, systems and components in a long-lived substance, such as concrete. The encased plant would be appropriately maintained, and surveillance would continue until the radioactivity decays to a level that permits termination of the plant's license and end any regulatory control. Most nuclear plants will have radionuclide concentrations exceeding the limits for unrestricted use even after 100 years. Therefore, special provisions would be needed for the extended monitoring period this option requires. To date, no facility owners have proposed the entombment option for any nuclear power plants undergoing decommissioning. In fact, this is more an emergency option than a strategy option, so far used only in the case of Chernobyl.

A **mix of parts of these strategies** is, however, possible in practice. For example, starting the technical decommissioning activities immediately after the end of operation but spreading the decontamination, dismantling and demolition phases over several decades.

The choice of strategy depends on several parameters and framework conditions, the decontamination, dismantling and demolition stage aimed at, and the planning for the future use of the site. Operators of nuclear facilities usually take into account the following criteria when deciding on a dismantling strategy (cf. also NEA 2006):

- **Radiation protection**
  From the perspective of radiation protection, there is one major argument for deferred decontamination and dismantling which is radioactivity decay, as it will ensure lower dose rates for workers.
- **Employment**
  From the perspective of employment, there are major arguments for immediate decontamination and dismantling which is to use the knowledge of the employees

having operated and designed the facility, and to ease a socially acceptable reduction in employed and contracted staff at the site of the nuclear facility after the installation has been shut down (cf. Irrek 2005 for an example of an employment scenario for an immediate decommissioning strategy in Germany). On the other hand, deferred decontamination and dismantling might make it easier to outsource dismantling activities at cheap labour costs because of existing wage differentials between employees in the nuclear sector and employees of contractors.

- **Financial benefits**
  From the perspective of income there is a major argument for deferred decontamination and dismantling: The longer the provisions accumulated can be invested before the money is used to pay for decommissioning activities, the longer this money can yield interest, thereby either increasing the operator's profits or reducing requirements of further contributions to the fund or credit borrowing for investments.
- **Costs**
  A thorough evaluation and comparison of different strategies is needed in order to assess which strategy will be the least-cost while achieving all the nuclear safety obligations. For example, for the deferred decontamination and dismantling strategy, it has to be taken into account in how far ancillary equipment can be used for decommissioning activities decades after the end of operation. A general question is how much cheaper is it to outsource decontamination and dismantling activities or to carry them out in-house. Furthermore, total costs also depend on the availability of waste management, storage and disposal options, and on the decision about the use of the site for other purposes after its release from radiological restrictions. However, such cost estimation is not an easy task. Different assumptions on the underlying decontamination and dismantling processes, on the technical feasibility of possible technical solutions and technical developments, on person-years needed, on labour, material/equipment and capital costs, on time horizons, and on developments of the labour market and the general economic environment can lead to different strategic choices.
- **Financial risk aspects**
  Risks and uncertainties of changes in benefits and costs have to be adequately taken into account because of all these possible influences, time horizons of several decades are considered. For example, a long period of deferment not only gives the chance to yield interest over a longer period of time, but includes also a higher risk that the funds will be lost or will significantly lose value.

In most cases, **economic arguments** with respect to expected financial benefits and costs as well as perceived financial risks are the decisive arguments for the operators to choose a specific decommissioning strategy, particularly for privately owned facilities. However, there are also **strategic or tactical arguments** for particular decommissioning strategies. One example is the announcement by operators of NPP in Germany to switch from the currently preferred immediate dismantling option to deferred dismantling if the government does not decide on a final disposal site for HLW

soon enough. This will put pressure on the government to choose the Gorleben site as final repository instead of evaluating other possible sites according to (AKEnd 2002).

The preferred decommissioning **strategy** can differ from case to case, even within the same country. In addition, while decommissioning strategies for NPPs are often widely discussed, decommissioning strategies for other facilities are usually not a topic of discussion at all. For several research reactors (e. g., FRM-II/Germany), no decommissioning plans or cost estimates exist. In the case of uranium mines and mills, other front-end and back-end facilities of the nuclear fuel chain, decommissioning strategies usually depend on the owner of the facility. With regard to reprocessing plants, site restoration of the complex Sellafield site is scheduled to be completed in 2120; the La Hague plants UP2-800 and UP 3 are expected to be shut down in 2025 and decommissioned between 2040 and 2060.

Table 2: Overview on strategies currently preferred for future decontamination and dismantling of commercial nuclear power plants in the EU Member States

Immediate dismantling	**Deferred dismantling**		**No preference yet**
Countries	Countries	Duration of safe enclosure	Countries
B[1]	BG	35 years	SK
D[1]	CZ	35 – 50 years	RO[4]
E	FIN (Olkiluoto)	30 years	
F[2]	HU	70 years	
FIN (Loviisa)	NL (Dodewaard)	40 years	
IT[3]	S	10 – 40 years	
LT	UK	up to > 100 years	
NL (Borssele)			
SI[5]			

1 However, deferred dismantling has not been ruled out, at least for some facilities. Furthermore, mixed strategies are discussed, too, in order to optimise employment of labour and costs.
2 Until the end of the 1990s, deferred dismantling was the preferred option (30 to 50 years).
3 In fact, there is a delay of more than 15 years since the last shut-down of NPPs in 1987. This delay is due to the change in strategy from deferred dismantling to immediate dismantling decided on in 1999. Decommissioning shall now be completed by 2024.
4 Agreement on decommissioning strategies for the CANDU type reactors planned to be reached by end of 2006.
5 Decommissioning of Krsko NPP starts immediately after its shutdown. However, dry storage of spent fuel elements will last for around 60 years, and the time period of storing activated components until 2119.

Table 2 shows which strategies are currently preferred for future decontamination and dismantling of **commercial nuclear power plants** in the countries analysed. It should be noted that this overview does not take into account the different reactor types.

On the one hand, a **trend towards immediate or accelerated deferred dismantling** of commercial NPPs can be perceived in some countries (cf., e.g., the discussions in France, Italy, Spain, the Netherlands or in Bulgaria, the latter being influenced by the

European Commission) (cf. also NEA 2006). Even the discussion in the UK goes into such a direction (25 years after shut down of a NPP as suggested by NDA, compared to about 100 years as it has been assumed so far). Nuclear safety authorities are mostly in favour of immediate dismantling. The reasons given for this include the consideration that the risk of the loss of memory on the conception and operation of a facility are significant.

While on the other hand, operators and governments **in some other countries do not seem to question long term timeframes for decommissioning**. Therefore, the tendency reported above is not one which can be generally perceived.

3.1.4 Estimating decommissioning costs

3.1.4.1 Identifying future decommissioning costs

In 1999, NEA/IAEA/EC published "A Proposed Standardised List of Items for Costing Purposes in the Decommissioning of Nuclear Installations". This interim technical document recommends categorising the cost items (restricted to decontamination and dismantling stage and the management and disposal of wastes arising from these stages) into the following eleven groups (NEA/IAEA/EC 1999):

- Pre-decommissioning actions
- Facility shutdown activities
- Procurement of general equipment and material
- Dismantling activities
- Waste processing, storage and disposal
- Site security, surveillance and maintenance
- Site restoration, cleanup and landscaping
- Project management, engineering and site support
- Research and development
- Fuel and nuclear material
- Other costs.

However, the cost estimation methodologies applied for the different nuclear facilities analysed for this report mostly do not follow this classification. This will be mainly due to the fact that the decision on the cost estimation methodology of the facilities analysed is mostly older than this standardised list. For example, at Delft University in the Netherlands, they have just started developing cost estimates, and there, it is planned to follow this NEA/IAEA/EC list. As another example, in Slovenia, a scenario study on cost estimates of the year 2004 recommends to follow this list in the future.

Furthermore, not all the cost items of the NEA/IAEA/EC list are considered in all the cost estimates available. Therefore, a more comprehensive cost estimation for the whole of decommissioning needs to cover stages other than decontamination and dismantling (e.g. management and disposal of HLW or spent nuclear fuel).

The 'scope' of cost items taken into account differs from facility to facility. For example, the official tables of decommissioning cost estimates of research facilities in Germany partly do not include the costs of final disposal. Some cost estimates for NPP do not include costs of pre-decommissioning and facility shutdown activities, or they are only added if explicitly asked for. Another example is that depending on the decommissioning strategy, some nuclear materials which are not classified as waste today are not taken into account in some decommissioning cost estimates. However, they might have to be managed as waste in the future, for example, uranium extracted in reprocessing and depleted uranium, a portion of separated plutonium and spent fuel (in some countries high-level waste is recovered from reprocessing spent fuel, while other countries regard spent fuel itself as high-level waste). In contrast, in Lithuania, cost estimates exist for Ignalina NPP which do not only consider the NEA/IAEA/EC items mentioned above but also costs for social measures, costs for regional development, and indirect losses of approximately 8 billion Euro.

In conclusion, the differences in the cost items taken into account in cost estimates make a comparison of cost estimates between facilities quite difficult.

3.1.4.2 Methodologies of estimating future decommissioning costs

Not only does the 'scope' of cost items taken into account differ between facilities but also the methodologies of estimating the costs, which further hampers comparability.

The following table tries to give an overview on the different types of cost estimation methodologies for future decommissioning of **commercial nuclear power plants** in the different countries. It should be noted that the level of detail of information gained on these methodologies differs between the countries. For single installations, deviations from the approaches presented here might be possible. Furthermore, the way decommissioning costs of other nuclear installations are estimated often differ from the methodologies used to estimate costs of commercial NPP. Finally, as soon as the shutdown of a plant becomes clear, the cost estimation methodologies become more sophisticated ('definitive estimates' according to the categories in IAEA 2005).

Table 3: Overview on accessible information on cost estimation methodologies currently applied for estimating decommissioning costs of operating commercial nuclear power plants in the EU Member States

Country	Type of cost estimate[1]	Remarks
B	Budgetary estimate	According to art.12 of law of April 2003, Synatom and the NPP operator have to provide the monitoring committee with a proposal on revision of methodology for provision of decommissioning, including scenario for decommissioning of NPPs and management of spent fissile materials, a detailed cost estimation and planning of expenses (article 12.2). However, so far, cost estimates have not been made publicly available.
BG	Order-of-magnitude estimate	Deterministic cost estimate based on study in 1994-95, comparison with similar studies in countries operating WWER-440 reactors and international figures from (NEA 2003).
CZ	Budgetary estimate	Deterministic cost estimates based on standardised work breakdown, price lists, catalogue prices, data provided by contractors and expert estimates. Estimates done by engineering companies commissioned by CEZ. Revised every five years. Approval by RAWRA needed.
D	Budgetary estimate	For dismantling/decontamination/demolition and management of waste from dismantling, as far as known, use of NIS-STILLKO software, with estimates in analogy to a detailed deterministic cost estimate of a BWR and a PWR, further developed taking experiences with decommissioning activities in practice and site-specific design aspects into account. For other radioactive waste and spent fuel management activities, cost estimates are mainly based on existing contracts with reprocessing or storage facilities, and contracts with transport firms. Furthermore, expected costs of conditioning and packaging and contributions to the construction and operation of final disposal facilities according to the operator's share in expected waste volumes have to be taken into account.
E	Budgetary estimate	Accessible information on decommissioning costs and cost estimation methodologies is limited. Deterministic cost estimates are based on reference cases (anterior projects), studies of ENRESA, comparison of calculations made with those in other countries or by international organisations. Estimates of final disposal costs based on conceptual engineering project. No algorithms or special software used.
F	Used to be order-of-magnitude estimates (15% of construction costs); some budgetary estimates since the 1990s	Accessible information on decommissioning costs and cost estimation methodologies is limited. EDF bases provisions on unpublished exemplary cost study for one reactor site. CEA's statutory auditors have repeatedly attracted attention to a lack of concordance between technical and financial planning of CEA's decommissioning projects.

Table 3 (continued): Overview on accessible information on cost estimation methodologies currently applied for estimating decommissioning costs of operating commercial nuclear power plants in the EU Member States

Country	Type of cost estimate[1]	Remarks
FIN	Budgetary estimate	Deterministic cost estimates on the basis of proposed plans and estimates of workload. Purchasing costs are estimated based on empirical data gathering and cost estimates obtained from equipment suppliers. Cost estimates have to be confirmed by Ministry for Trade and Industry ('setting the fund target') on the basis of evaluations commissioned by the ministry.
HU	Previous order-of-magnitude estimate modified to budgetary estimate	Before 2003: Just analogies and expert opinion based on (NEA 1993) and (NEA 1994). Temporary decommissioning plan elaborated in 2003 by DECOM company (SK) contains cost estimation by the same methodology as applied for Slovak Republic Accuracy and precision of data are not known.
IT	Budgetary estimate, partly defined estimates (no NPP under operation)	Yearly updated decommissioning plans and deterministic cost estimates by SOGIN on the basis of achieved goals and projected technical activities in compliance with guidelines provided by Ministry of Productive Activities and controlled by the National Authority for Electricity and Gas.
LT	Budgetary estimate	Deterministic cost estimates based on a PHARE project in 2001, updated by local and foreign experts. Two scenarios for different labour cost increases. NIS-CALCOM tool used.
NL	Budgetary estimate	Deterministic cost estimates based on studies commissioned by the operators (e.g., for Dodewaard carried out by NIS and Delft University). Price basis is updated regularly.
RO	Budgetary estimate planned for end of 2006	Will be based on technical and economic studies by NuclearElectrica and reference cases from Canada (CANDU reactor waste profiles) and (NEA 2003).
S	Budgetary estimate	Deterministic cost estimated based on fixed assumptions, with differentiation into quantity-related costs (based on design specifications, unit prices, etc.), non-quantity related costs (based on experience with other projects) and secondary costs (based on experiences in construction phase). In addition, probabilistic cost estimates are performed to analyse the uncertainties involved.
SI	Budgetary estimate	Deterministic cost estimates for seven decommissioning scenarios, of which two were singled out. Evaluation of negative and positive risks identified. First calculations by NIS.
SK	Budgetary estimate	There are algorithms and generally accepted software for the deterministic decommissioning cost estimates by the state fund for disposal of nuclear facilities
UK	Budgetary estimate	There has not been any accessible information on decommissioning cost estimation methodologies in UK.

1 Categories of cost estimation methodologies according to (IAEA 2005)

International studies by OECD-NEA are often used for comparison purposes. As can be seen from the table, in few cases they are even the main basis for cost estimates. The budgetary, deterministic cost estimates are usually bottom-up ones based, among others, on an estimation of workload.

3.1.4.3 Validity of cost estimates: dealing with economic risks and uncertainties

As with other complex construction or deconstruction or other engineering projects, cost estimates are based on a number of technical and economic assumptions, and on assumptions influenced by the political-administrative framework conditions. Therefore, there are, of course, financial risks to be taken into account in any ex ante-evaluation of decommissioning project costs. In order to provide for this, for example, in France, national regulation demands dismantling cost estimates to be conservative ones.

However, there are further extraordinary economic risks and uncertainties which are specific to the nuclear industry, and which are explained in the following. For commercial NPPs and partly also research reactors and uranium mines, the validity of cost estimates increases over time, with more and more facilities being decommissioned, with the list of cost items included in the cost estimates becoming more and more complete, and, recently, with even larger commercial NPPs being in the process of decommissioning. For these installations, the highest risks and uncertainties with regard to decommissioning costs remain those

- of incidents and accidents during operation and during decommissioning,
- of wrong pre-evaluation of contamination levels of facility components and the environment,
- of political decisions which change the framework conditions for decommissioning activities,
- of the availability of nuclear knowledge at the time decommissioning activities should be implemented,
- of unexpected evolution of radioactive waste management, storage and disposal costs, and
- of general economic development.

(Pfeifer/Gordelier/Drake 2004) expect that such risks, for which probabilities are known or can be estimated, and uncertainties, which cannot be estimated, regularly appear in decommissioning projects: Decommissioning projects would “regularly produce the unexpected”.

In this context, it should be noted that political decisions and expectations cannot only increase but also reduce economic uncertainties and risks. For example, in Italy, the decision to complete dismantling of all NPPs by 2024 sets a clear timeframe for decommissioning activities and respective cost estimates. Another example is the decision in Germany to phase-out nuclear energy and the limitation of nuclear energy

allowed to be produced by each NPP, and in Belgium after a limited operational lifetime. The mutual agreement between the German government and the energy companies - combined with the current preference for the immediate dismantling solution - narrows the possible timeframes for the start of dismantling activities. The situation is similar in Belgium.

However, for many other facility types, economic risks and uncertainties are substantially higher, particularly since there is little experience with plants already being decommissioned or currently undergoing decommissioning. This is particularly true for cost estimates of (decommissioning of) back-end facilities like reprocessing plants, conditioning plants or the installation of final disposal facilities for which various technical options are still under discussion.

Again, political decisions can contribute to an increase or reduction in such financial risks and uncertainties. For example, the German decision not to allow the reprocessing option for spent fuel after 1 July 2005 not only directly reduced back-end costs in Germany but also the large financial uncertainties and risks associated with the reprocessing option. This decision was part of the agreement between the federal government and the energy companies of 14 June 2000. Another example is the decision in Italy to move away from the previous waste management strategy of performing the interim dry storage of the spent fuel on the plant sites, waiting for the availability of a national repository. A decree in the year 2004 now gives SOGIN, the state-owned company in charge of dismantling all NPP and five fuel cycle plants, the freedom to consider the reprocessing option. This increases the range of possible cost estimates and risks and uncertainties linked to them.

Risks and uncertainties not dealt with in available cost estimates are risks of terrorist assaults on nuclear facilities under decommissioning, or of transport of radioactive waste.

Against this background, it is surprising that hardly any of the existing cost estimates of decommissioning of nuclear facilities in Europe deals with economic risks and uncertainties, at least not explicitly and not in an appropriate way. In few cases, there are sensitivity or scenario analyses with respect to different input factors or framework conditions. Examples are

- the case of Lithuania where different wage levels have been assumed for decommissioning workers in two different scenarios,
- the above mentioned case of ANDRA's scenario calculation of geological disposal costs in France,
- EDF's and CEA's separate estimates of Marcoule decommissioning costs in France where the differences could well be due to different company interests in the cost evaluation,
- Probabilistic cost estimates performed in Sweden in addition to deterministic ones.

However, it might be assumed that, in a competitive environment, many decision makers in operating companies will base their decisions not only on one deterministic cost estimate. Instead, they will more and more have to carry out sensitivity or scenario analyses or even simulations in order to identify the least-cost solutions. However, such analyses are either not published (except for some installations like the ones listed above), or they do not exist.

3.1.4.4 Decommissioning cost estimates in practice

The analysis has shown that decommissioning cost estimates differ according to

- the **political-administrative framework** for decommissioning,
- the **decommissioning strategy** chosen,
- the cost **items** taken into account ('scope' of the cost estimate),
- the **origin** of the cost estimate,
- the **methodology** applied, and
- the way **risks and uncertainties** are taken into account.

Another problem of comparability between cost estimation figures published is that some of them are **undiscounted costs**, some are **discounted cost** estimates.

Although the numbers are hardly comparable with each other, the decommissioning cost estimates collected in the course of the country analyses are listed in **Table 6** (for other cost estimates, cf., e.g., NEA 2003 which was already mentioned as a basis used for analogy cost estimation techniques in few countries; for more details cf. the country reports in the Appendix to this final report). It is not within the scope of this study to compare and evaluate these cost estimates with respect to the question in how far they are realistic or appropriate.

However, the following examples give an impression of the broad range of available cost estimates:

- Decommissioning of the research reactor TR Budapest in Hungary is expected to cost 1 million Euro.
- Decommissioning of the uranium mill Saelices el Chico in Spain is expected to cost 5.5 million Euro.
- On average, undiscounted decommissioning costs for the four NPPs in Dukovany, Czech Republic, are estimated at 145 million $Euro_{2003}$ per plant, not including spent fuel and radioactive waste management.
- According to information by the operator E.ON of 2004 and 2006, decommissioning of the German NPP Würgassen will probably cost about 700 million Euro in total, not including radioactive waste and spent fuel management during operation.

- On average, discounted decommissioning costs for the NPPs in Doel, Tihange, Belgium, are estimated at 1,393 million Euro per plant, including spent fuel management.
- On average, undiscounted decommissioning costs for the two INPP units in Lithuania are estimated at $1,850_{2003}$ million Euro per plant, not including final disposal costs.
- Decommissioning of the uranium mine Wismut in Germany is expected to cost about 6.2 billion Euro, not including any compensation for cancer of uranium miners.
- Remaining decommissioning costs of the complex Sellafield site, UK, are expected to amount to more than 52 billion Euro.

With respect to the decommissioning financing system, it is important to keep in mind the different factors influencing the cost estimates, and the large risks and uncertainties associated at least with part of them.

3.1.5 Setting aside funds

After the costs have been estimated, it has to be determined, if, when and how funds should be set aside before and/or during plant operation.

Accruals are usually set up in regular instalments or according to the electrical energy produced. However, in France, with the new legislation of June 2006, provisions for dismantling and decontamination (technical decommissioning in a narrow sense) of a nuclear facility have to be fully collected already with start of operation. However, EDF is granted a transition period until 2010 to build up provisions according to this legislation. In Sweden and Finland, special requirements exist which demand to cover full liabilities already at the start of operation by special financial securities (cf. Chapter 3.1.7.1).

How the provisions are collected, when the option ‘regular instalments’ is used, depends, among other things, on the assumptions (expectations) about the lifetime of a nuclear installation during which revenues can be generated and provisions set up, and, most important, on the discount rate used.

With the net present value method, a positive discount rate is used, with the current value method, the discount rate is assumed to be zero. The determination of the rate of discount is a central problem of any kind of project evaluation (cf., e.g., [Oelert/Auer/Pertz 1988] or [Hennicke/Becker 1995]). Depending on the perspective of analysis adopted (e.g., micro- or macroeconomic view), on the system boundaries drawn and on the availability of alternatives, on the time preferences and expectations on inflation assumed, and on the marginal utilities of the decision makers, a different discount rate can be applied.

With the current value method or a low rate of discount, the provisions have to be accumulated more rapidly than with the net present value method or a high discount rate. The net present value method is extremely sensitive to assumptions regarding the precise timing of future liabilities and to the discount rate used. The real discount rate assumed usually takes inflation (expected decommissioning cost escalation) and nominal interest rates (interest from investing the money collected in the decommissioning fund until it is needed for paying decommissioning activities) into account. The scheduled timing of future decommissioning and waste management activities, i. e. the target year from which liabilities are discounted, thereby varies from country to country (cf. the chapter on decommissioning strategies). Furthermore, in countries, in which the provision of accruals relies upon the accounting standards prevailing in the industry for reporting liabilities, the accounting method depends on the accounting standard used (e.g. US-GAAP, IAS, national commercial code).

The following table gives an overview of typical procedures of how funds are collected in the different countries differentiating between provisions based on discounted and undiscounted (‘overnight’) costs. This table is not exhaustive but all important installations are covered.

Table 4: Overview on procedures how decommissioning funds are set aside in the EU Member States and Romania.

Kind of facility	**No provisions made**	**Provisions based on discounted costs**				**Provisions based on undiscounted costs**
	Country	Country	Nominal discount rate applied	Inflation rate	Real discount rate	Countries
Uranium mine/mill[1]	most countries	E F	IPC[9] 5.0%	IPC[9] 2.0%	0.0% 2.94%	
Research reactors	D IT NL RO HU UK	S F B	 5.0% ?	 2.0% ?	various[8] 2.94% ?	CZ FIN
NPP	RO UK[13]	D[2] F S E NL SI LT[12] HU B UK[14] UK[15]	5.5% 5.0% 4.0% 4.29% ? 	Indirectly[3] 2.0% Indirectly[3] 0.73% ? 	5.5% 2.94% various[8] 1.5% 4.0% 3.53% 3.0% 3.0%[10] ? 2.2% 3.0%	D[4] CZ SK IT FIN LT[12]
Uranium conversion, enrichment and fuel fabrication plants	RO UK	NL, D F	IAS 37[5] 5.0%	Indirectly[3] 2.0%	IAS 37[5] 2.94%	
Reprocessing plants	B[11]	UK[14] F	 5.0%	 2.0%	2.2% 2.94%	
Storage, disposal	UK	CZ[6] HU B NL	? ? 	? ? 	? 3.0%[10] ? 3.0%	CZ[7]

This selection is not meant to be exhaustive. Information for Bulgaria could not be gained in the course of this study.

1 Most of the uranium mines in Europe are shut down, decommissioned or in the process of decommissioning.

2 German tax balance sheets (quite similar but not necessarily identical in balance sheets according to IFRS/US-GAAP: cf. IAS 37, IFRIC 1)

3 Updates of cost estimates from time to time taking price increases into account.

4 Balance sheets according to German commercial code

5 According to IFRS (IAS 37), liabilities have to be discounted taking market interest rates and liability risks into account (cf. Chapter 4 for more details on the IFRS).

6 Repository Dukovany, CZ

7 ISFSF Dukovany, CZ

8 Depending on the respective period (2005-2020; after 2020) different *real* discount rates are applied (3.25%; 2.5%)

9 Consumer price index (ENUSA is a public sector company).

10 Recalculated every year based on interest gained and inflation rate.

11 Decommissioning activities are financed via an annual federal government contribution until the year 2008.
12 Discount rate used only when calculating costs for choosing decommissioning strategy. 3.0% for dismantling only.
13 Magnox and NDA plants.
14 NDA plants' discounting of costs; however, there are no provisions really made.
15 British Energy's plants; however, in fact, provisions depend on ability to pay.

The following table which is not meant to be exhaustive gives an overview on decommissioning funds accumulated in relation to expected total costs of future decommissioning of nuclear installations in the European Member States, as far as this information could be received in the course of the country analysis. The comparison of the ratio of provisions accumulated to expected costs with the ratio of years of operation to expected lifetime clearly indicates, in most cases, the **collection of provisions lags behind the accumulation of liabilities**. This is despite a large fixed part of the nuclear liabilities already arises with start of operation. However, it should be noted that, by its nature, discounting of provisions, where applied, strongly contributes to this lag.

Possible sources of decommissioning financing as identified in the different countries are

- income of the operator from selling electricity or other operator's income; fees paid by the operator to the fund
- general levy (surcharge) on the electricity tariff
- donations from other countries, international organisations, the European Union or financial institutions
- contributions (subsidies) by national or regional governments
- interest / profits from the financial operations of the fund
- benefits from estate or equipment sold before or during decommissioning
- penalties imposed by the nuclear authority according to special regulations.

Table 5 Decommissioning funds accumulated in relation to expected total costs of future decommissioning of nuclear installations in the European Member States.

Country	Name of nuclear facility	Kind of facility	Total decommissioning costs estimated [Mio. EUR]	Provisions accumulated by 31-12-2004 [Mio. EUR]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime [%]
BE	Doel, Tihange	7 NPPs + spent fuel management	2,300 (discounted) 7,450 (discounted)	1,376 2,540	60% 34%	various
BE	EUROCHEMIC	Reprocessing Plant	203.3 (EUR2004, discounted)			100
BG	Kozloduy unit 1	NPP	2.6 billion Euro	550 million Euro from EU + 280 million Euro in decomm. funds + 69 million Euro in radioactive waste management funds	35%	21/30 as a rough weighted average of the 6 plants.
BG	Kozloduy unit 2	NPP				
BG	Kozloduy unit 3	NPP				
BG	Kozloduy unit 4	NPP				
BG	Kozloduy unit 5	NPP				
BG	Kozloduy unit 6	NPP				
BG	Uranium mine	Uranium mine				
BG	IRT Sofia	RR				
CZ	Dokovany 1	NPP	> 580 (price basis 2003) (the 580 do not include any costs for waste management and disposal)	137	24%	48
	Dokovany 2					
	Dokovany 3					
	Dokovany 4					
CZ	Temelin 1	NPP	> 480 (price basis 2004) (the 480 do not include any costs for waste management and disposal)	28	6%	10
	Temelin 2					
CZ	LVR-15	Research reactor	4.4 (price basis unclear)	2.5	55%	61.5
CZ	ISFSF Dukovany	Interim storage	0.4 (price basis 2004)	0.018	4%	11
CZ	Repository Dukovany	Repository (above ground)	23 (price basis unclear)			

Country	Name of nuclear facility	Kind of facility	Total decommissioning costs estimated [Mio. EUR]	Provisions accumulated by 31-12-2004 [Mio. EUR]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime [%]
CZ	RAWRA activities	Waste management	1,490 (own estimate of all activities related to Dukovany and Temelin based upon 40 years lifetime and current contribution of 50 CZK/MWh to Nuclear Account)	211	14%	n.a.
DE	E.ON Corporate group	Several NPP (41.7% of total German NPP capacity in 2006)	Information on site-specific provisions is not accessible	12,907	Information on site-specific provisions is not accessible	
DE	RWE corporate group	Several NPP (27.1% of total German NPP capacity in 2006)		9,473		
DE	EnBW corporate group	Several NPP (21.4% of total German NPP capacity in 2006)		3,920		
DE	Stadtwerke München	Share in KKI 2		679		
DE	GKN 1	NPP		Information on site-specific provisions is not accessible		81.8
DE	GKN 2	NPP				44.1
DE	KKP 1	NPP				72.7
DE	KKP 2	NPP				55.9
DE	KKG	NPP				66.7
DE	KRB-B	NPP				51.4
DE	KRB-C	NPP				48.7
DE	KKI 1	NPP				74.3
DE	KKI 2	NPP				46.9
DE	KWB A	NPP				82.9
DE	KWB B	NPP				69.2

Country	Name of nuclear facility	Kind of facility	Total decommissioning costs estimated [Mio. EUR]	Provisions accumulated by 31-12-2004 [Mio. EUR]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime [%]
DE	KKE	NPP		1,709		39.5
DE	KWG	NPP		1,401		55.9
DE	KKU	NPP		Information on site-specific provisions is not accessible		73.5
DE	KBR	NPP		1,577		51.5
DE	KKB	NPP		1,354		79.4
DE	KKK	NPP		1,806		58.8
DE	KWO	NPP		880		94.6
DE	KKS	NPP		1,204		100
DE	KMK	NPP		Information on site-specific provisions is not accessible		100
DE	KWW	NPP	(> 700)	Information on site-specific provisions is not accessible	According to E.ON, provisions should be more or less sufficient	100
DE	KKR	NPP	3,200	No nuclear provisions because liability is with the Federal government and not with EWN GmbH	0%	100
DE	KGR 1	NPP				100
DE	KGR 2	NPP				100
DE	KGR 3	NPP				100
DE	KGR 4	NPP				100
DE	KGR 5	NPP				100
DE	AVR	NPP	ca. 500	Paid out of public budget, therefore 0	0%	100
DE	KKN	NPP	150			100

Country	Name of nuclear facility	Kind of facility	Total decommissioning costs estimated [Mio. EUR]	Provisions accumulated by 31-12-2004 [Mio. EUR]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime [%]
DE	THTR-300	NPP	(444)	?		100
DE	MZFR	NPP	275	Paid out of public budget, therefore 0	0%	100
DE	KNK-II	NPP	291			100
DE	FRM-II	RR	?			?
DE	FRJ-1	RR	26			100
DE	FRJ-2	RR	100			?
DE	FRG-1	RR	100			?
DE	FRG-2	RR				100
DE	FR-2	RR	55			100
DE	URENCO	Enrichment	No site-specific data accessible. Only data for the URENCO group as a whole: By the end of 2005, URENCO's provisions in the company's balance sheet for all the URENCO sites in total amount to 129 Mio. Euro for tails disposal, 157 Mio. Euro for dismantling of plant and machinery and 19 Mio. Euro for other, also non-nuclear purposes.			
DE	ANF	Fuel fabrication	Information not accessible			
DE	WAK	Reprocessing, complex site	2,230	Paid out of public budget, therefore 0	0%	100
DE	ITU-JRC	Research facilities	389	Paid out of the EC budget, therefore 0	0%	
DE	Wismut	Uranium mine				100
ES	Lobo (La Haba, Badajoz) Mina and Planta Lobo-G	Mine and Mill (no separated costs for m available)	8,4 (2006 estimate)	N/A	100%	100
ES	Fábrica de Uranio de Andujar (FUA) (Andujar Uranium Mill-AUM)	Uranium Mill	-	-	-	-

Country	Name of nuclear facility	Kind of facility	Total decommissioning costs estimated [Mio. EUR]	Provisions accumulated by 31-12-2004 [Mio. EUR]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime [%]
ES	Saelices el Chico (Salamanca) Planta Elefante	Uranium Mill	5,5 (2006 estimate)	-	-	-
ES	Saelices el Chico (Salamanca) – Planta Quercus	Uranium Mill	4,6 (2006 estimate)	-	-	-
ES	Saelices el Chico (Salamanca) – La mina	Uranium Mill	58,7 (2006 estimate)	-	-	-
ES	Arbi Experimental reactor Bilbao	Research reactor	N/A	N/A	N/A	N/A
ES	Vandellos 1	NPP	> 224.3 (stage 3; 2006 estimate)			
ES	José Cabrera	NPP	>130.8 (spent fuel + stage 3; 2006 estimate)			
ES	Ascó I	NPP	>206.5 (spent fuel + stage 3; 2006 estimate)			
FIN	OL 1+2 (TVO)	NPP	827 (2005 estimate)	827		42
FIN	Lo 1+2 (FPH)	NPP	618 (2005 estimate)	618		50
FIN	FiR 1 (VTT)	RR	5.3 (2005 estimate)	5.3		88
FR	EDF	NPPs and waste	48,187 (2006 estimate)	24,705	51%	Various
FR	CEA	Research, fuel cycle and waste	13,211 (2006 estimate)	8,602	65%	Various
FR	AREVA	Fuel cycle and waste	8,258 (2006 estimate)	4,332	52%	Various

Country	Name of nuclear facility	Kind of facility	Total decommissioning costs estimated [Mio. EUR]	Provisions accumulated by 31-12-2004 [Mio. EUR]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime [%]
FR	SOMANU Maubeuge	Nuclear Maintenance	10 (2006 estimate)	6	66%	33
HU	NPP Paks	NPP	2,523 (2005 estimate)	261	11	46
HU	ISFSF Paks	SF storage site	Together with NPP	Together with NPP	Together with NPP	10
HU	BRR Budapest	RR	4.7 (2005 estimate)	Will not be financed from CNFF	-	<72
HU	TR Budapest	RR	1 (2005 estimate)	Will not be financed from CNFF	-	<61
IT	SOGIN facilities	Diverse	4,029 (EUR 2004) (w/o costs of final disposal)	570 still in the balance sheet, 800 in total transferred from ENEL (SOGIN) n.a. (CCSE)	ca. 20% (ENEL->SOGIN) n.a. (CCSE)	100
IT	ISPRA – JRC facilities	RR	645	Paid out of the EC budget, therefore 0	0.0%	100
IT	LENA Triga II	RR	No decommissioning plan, no cost calculations, no provisions yet.			
LT	INPP Unit 1 and 2	NPP	~ EUR 3700 million ~ EUR 2020 million for immediate dismantling strategy (see also Table 3) and EUR 600 million for waste management (except of final disposal) (EUR 2002)	By 2006: EUR 560 million from all sources	28% of immediate strategy costs 15% of overall decommissioning costs	Unit 1 – 100% (premature closure at 31 12 2004) Unit 2 – 74% (expected premature closure at the end of 2009)
NL	Dodewaard	NPP	175 (undiscounted) 75 (discounted)	114 (for all remaining decommissioning liabilities)	100% (compared to remaining liabilities	100

Country	Name of nuclear facility	Kind of facility	Total decommissioning costs estimated [Mio. EUR]	Provisions accumulated by 31-12-2004 [Mio. EUR]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime [%]
NL	Borssele	NPP	700 (undiscounted) 145 (discounted)	163.6	23.4% (undiscounted) 100.0% (discounted)	51
NL	URENCO Almelo	Enrichment facility	No site-specific data accessible. Only data for the URENCO group as a whole: By the end of 2005, URENCO's provisions in the company's balance sheet for all the URENCO sites in total amount to 129 Mio. Euro for tails disposal, 157 Mio. Euro for dismantling of plant and machinery and 19 Mio. Euro for other, also non-nuclear purposes.			
NL	Petten nuclear reactor (HFR) (JRC Site)	RR	69	5 (2003)	7.2%	Not decided yet, maybe 83%
NL	HOR-RID, TU Delft	RR	Not calculated yet	0	0.0%	Not decided yet
NL	COVRA	Waste management & disposal	1,270 (disposal only)	85.3	6.7%	ca. 10% – 20%
RO	Cernavoda 1	NPP	N/A	0	0	2.7
RO	Cernavoda 2	NPP	N/A	0	0	-
RO	Horia Hulubei, Magurele, Bukarest	RR	16	0	0	100
RO	TRIGA, Mioveni, Pitesti	RR	100	0	0	49
RO	CNU Bihor	Uranium mine	N/A	0	0	100
RO	CNU Banat	Uranium mine	N/A	0	0	100
RO	CNU Suceava	Uranium mine	N/A	0	0	N/A
RO	CNU Feldioara	Milling facility for uranium ore	N/A	0	0	N/A
RO	FCN, Mioveni, Pitesti	Fuel fabrication plant	N/A	0	0	N/A

Country	Name of nuclear facility	Kind of facility	Total decommissioning costs estimated [Mio. EUR]	Provisions accumulated by 31-12-2004 [Mio. EUR]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime [%]
SE	B1, B2	NPP	510 (EUR 2004)	510	100%	100
SE	F1, F2, F3	NPP	1,180 (EUR 2004)	1100	93%	53-78
SE	O1, O2, O3	NPP	890 (EUR 2004)	850	97%	53-85
SE	R1, R2, R3, R4	NPP	1,250 (EUR 2004)	1210	96%	58-78
SI	Krško Nuclear Power Plant	NPP	1,149.3 (undiscounted) 338.5 (EUR 2002) (discounted)	115	10.0% (undiscounted) 34.0% (discounted)	52.5
SI	TRIGA Mark II	RR	Not calculated yet	0	0.0%	Not decided yet
SI	Central interim storage of radioactive waste in Brinje	storage of radioactive waste	Not calculated yet	0	0.0%	Not decided yet
SI	Zirovski Vrh Uranium Mine and Milll; Waste Pile Jazbec	Uranium Mine and Mill	Not known	0	0.0%	100
SK	A1 J. Bohunice	NPP	378 (EUR 2004)	324	ca 6 %	5 years, 25
SK	V1 J. Bohunice	NPP	1,884 (EUR 2004)			28 years 75
SK	V2 J. Bohunice	NPP	1,620 (EUR 2004)			28 years 75
SK	JE Mochovce 1,2	NPP	1,620 (EUR 2004)			5 years 14
UK	British Energy facilities	8 NPP sites (9,892 MWe)	about 12,900 in total	1,137 (NLF) (31 March 2005)	?%	various
UK	All other civilian facilities	Diverse facilities		0 (NDA)	0.0%	various

Source: Cf. the country reports attached to this final report for additional information, assumptions made and the sources used for this table. This selection is not meant to be exhaustive and only covers the facilities analysed in more detail in the course of this study. If no other information is given, cost estimates listed will be undiscounted costs.

3.1.6 Management and investment of funds

3.1.6.1 Overview on fund management systems

Basically, decommissioning financing schemes can be differentiated into

- payment of decommissioning activities from the current budget of public authorities;
- internal unrestricted fund of private licensees;
- internal restricted fund;
- external unrestricted fund;
- External restricted fund.

Furthermore, it can be differentiated between funds management by public or private fund managers. Table 6 gives an overview on decommissioning financing systems of private and public licensees in Europe. Payment from current budget can be understood as a kind of internal unrestricted fund of a public licensee.

Table 6: Overview on decommissioning financing systems in Europe.

Kind of facility	**Payment from current budget**	**Internal**		**External**	
		Unrestricted	Restricted	Unrestricted	Restricted
Uranium mine/mill[1]	e.g., D, CZ		e.g., F		
Research reactors	e.g., D, E, UK, IT, B	e.g., CZ	e.g., F, CZ		
NPP	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
Uranium conversion, enrichment and fuel fabrication plants	UK	D, NL	F		
Reprocessing plants	D, UK		F		
Storage, disposal	e.g., D, UK		e.g., E, F, NL (COVRA)		e.g., FIN, S, CZ

This selection is not meant to be exhaustive. There are no provisions for decommissioning in Romania yet.

Source: Wuppertal Institute, et al., 2006

3.1.6.2 Internally and externally managed funds

As mentioned in the previous chapter, funds can be differentiated into internal and external ones, with payment of decommissioning costs from current budget as a special

kind of internal financing scheme. For most of the non-NPP facilities, such **internal financing systems** exist – particularly for several research facilities - without setting aside any provisions at all, and with payments from the current budget (and maybe from additional annual income from operation). In few countries, internal funds exist for NPPs, too (internal funds managed by the operator in Belgium, France, Germany, Netherlands; payment from current budget and from income from operation at NDA in UK; part of the provisions accumulated with SOGIN in Italy – former ENEL provisions).

With regard to the **external funds**, the degree of independency from the operators or the government by law or in practice differs from case to case as well as the role of the Parliament, of scientists, and of the municipalities concerned. In several cases, the external fund is solely controlled by the government. In all cases of external funds, **government has a very strong position**. This is shown by the following examples:

- In the Slovak Republic, the 'National Fund for Decommissioning of Nuclear Facilities and for Radioactive Waste and Spent Fuel Management' is managed by the government. Members of the Board of Trustees are appointed by the Ministry of Economy. Members of the Supervisory Board are a deputy of the Authority for Nuclear Supervision and four members designated by different ministries.
- In Spain, the fund is managed by the public sector company ENRESA fully controlled by the government. As is the 'Nuclear Liabilities Fund' in the UK which covers liabilities of British Energy plants.
- In Italy, part of the means of finance to cover decommissioning costs comes from the state-governed 'Cassia conjugation per ill set tore electric (CCSE)' which allocates surcharges on the electricity price for several purposes, among others, decommissioning. The CCSE is an external unrestricted fund of the state, i.e. that the money not directly needed to pay the organisation (SOGIN) responsible for decommissioning activities is used by the state for other purposes of public interest that are not possible to identify analytically. However, the state remains responsible for guaranteeing the pertinent cost coverage during all phases of decommissioning.
- In Bulgaria, the 'Nuclear Facilities Decommissioning Fund' and the 'Radioactive Waste Management Fund' are managed by the Bulgarian National Bank and fully controlled by the Bulgarian government. The 'Kozloduy International Decommissioning Support Fund' is to all intents and purposes an EU fund governed by contributors and managed by the European Bank for Reconstruction and Development's nuclear safety team.
- In Lithuania, the 'State Enterprise Ignalina NPP Decommissioning Fund' is managed by governmental authorities in the 'National Fund-Council of the Fund'. Its members are representatives of the state, municipal and scientific institutions and the operating company. Changes in the management of the fund will come into force in 2007. For example, it will be introduced that Parliament will have to approve annual budget and report of the fund. The 'Ignalina International Decommissioning Support Fund' is to all intents and purposes an EU fund governed by

contributors and managed by the European Bank for Reconstruction and Development's nuclear safety team.

- In Hungary, the Atomic Energy Authority (which is supervised by the Ministry of Justice and Law Enforcement in terms of its budget) manages the fund which is a dedicated State Treasury account. The value of the annual accruals is influenced by Parliament through a annual budgetary Act.
- In Slovenia, the independent state-governed funding organisation 'Financial Fund for Financing of Krsko NPP' is controlled by the Slovene Parliament as well as by the Slovene Government. According to stakeholders interviewed, Parliament's influence should not be neglected.
- In the Czech Republic, there is a difference between reserves in internal restricted funds owned by the energy companies ('blocked accounts'), provisions paid to the Nuclear Account and internal unrestricted funds of CEZ and UJV Rez. The Radioactive Waste Repository Authority annually reviews the internal 'blocked accounts' and has to approve any withdrawal of funds. The external Nuclear Account is managed by the Ministry of Finance.
- In Finland, the members of the board of the 'State Nuclear Waste Management Fund' are nominated by the government. The fund has two auditors, one of whom is selected by the operators of the NPP.
- Two of the up to seven members of the board of the Nuclear Waste Fund in Sweden, all nominated by the government, are proposed by reactor licensees or by a body representing them.

3.1.6.3 Restricted and unrestricted fund management

In some countries and for some facilities, specific **restrictions** (special legal requirements for nuclear decommissioning funds exist that go beyond general rules like general accounting principles, general tax law, etc) are imposed on managers of internal or external funds, for example, with regard to

- the way funds have to be accumulated
- the investment of the financial means collected until they are used to pay for decommissioning activities
- the payment for decommissioning costs
- the regular reporting on funds and fund management
- the control by the public (e.g., government, parliament, special boards, information rights of the public).

Typical examples of **investment restrictions and guarantees required for internal or external funds** in practice are:

- Borrowing against securities in Finland: The part of liability that is not covered by the financial means in the fund must always be fully guaranteed. License holders are entitled to borrow back 75% of the capital of the fund against securities and at current interest rates.
- In Sweden, assets of the Nuclear Waste Fund are to be deposited in interest bearing accounts at the National Debt Office or invested in promissory notes issued by the state.
- In Slovenia, it can be invested
  - not less than 30% in state bonds
  - not more than 5% in stock
  - not more than 15% in other bonds
  - not more than 5% in stocks of one issuer
  - approximately 10% in securities on foreign financial markets.
- In the Czech Republic, the funds at the Nuclear Account can only be invested into liquid government bonds, bonds of the Czech National Bank, bonds of the Czech National Bank, state guaranteed bonds or in securities of issuers with high rating level. The internal blocked accounts have to be managed with a bank which has to ensure persistent liquidity (savings accounts with fixed rates of interest).
- In the Slovak Republic, there are several restrictions with regard to the use of the financial means, for example, credits or loans to the operator cannot be provided.
- In Spain, there is only a general principle that the ENRESA fund should be managed with respect to the guiding principles of security, profitability and liquidity.
- In France, assets of the internal restricted funds are protected by law and have to present a „sufficient degree of security and liquidity in order to serve their objective“.
- In the Netherlands, there is a new regulation since October 2006 stating that operators of new NPP, from the first loading of the core, are required to lower financial risks of decommissioning by setting up provisions for the entire decommissioning cost. This could be via insurance, a bank guarantee, a dedicated fund or other instrument offering equal safeguards (e. g., by using bank products).

3.1.6.4 Performance of nuclear decommissioning fund management

The performance of nuclear decommissioning fund management is usually not known for internal unrestricted funds, but even not known for all restricted or external funds. Some information on interest gained by asset management of financial means of external funds and further information on fund management and investment is depicted in Table 8:

- In Finland, performance in 2004 was 2.7%/year.
- In Slovenia, performance in 2004 was 9.6%/year (8.56%/year on average between 2000 and 2004).
- In Sweden, average performance between 2000 and 2004 was 6.9%/year.

Table 7 Internal or external management of decommissioning funds in the European Member States.

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which has been accumulated within the own assets of the operator of the facility or its mother company [Mio. EUR]	… of which has been accumulated by the operator of the facility or its mother company within a separated account / fund [Mio. EUR]	… of which has been accumulated in an external fund under public control [Mio. EUR]	… of which has been accumulated in an external fund under mixed private-public control [Mio. EUR]	Share of funds the operator of the facility can access for other activities until the funds are needed for their original decommissioning purpose [%]
BE	Doel, Tihange	7 NPPs + spent fuel management	1,376 2,540	1,376 2,540 (within daughter company)				75%
BG	EBRD funds for Kozloduy unit 1 to 4	NPP	550			550		0
BG	Decomm- Funds for Kozloduy 1 to 6	NPP	280		280			0
BG	Radwaste Man. Funds for Kozloduy 1 to 6	NPP	69		69			0
BG	IRT Sofia	RR						
BG	Uranium mine	Uranium mine						
CZ	Dokovany 1-4	NPP	137	101.7	34.9			74%
CZ	Temelin 1-2	NPP	28	7.4	20.7			26%
CZ	LVR-15	Research reactor	2.5	2.44	0.06			98%
CZ	ISFSF Dukovany	Interim storage	0.018	0.006	0.0126			31%
CZ	RAWRA activities	Waste management	211			211		

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which has been accumulated within the own assets of the operator of the facility or its mother company [Mio. EUR]	… of which has been accumulated by the operator of the facility or its mother company within a separated account / fund [Mio. EUR]	… of which has been accumulated in an external fund under public control [Mio. EUR]	… of which has been accumulated in an external fund under mixed private-public control [Mio. EUR]	Share of funds the operator of the facility can access for other activities until the funds are needed for their original decommissioning purpose [%]
DE	GKN 1	NPP	Information on site-specific provisions is not accessible	100%				100%
DE	GKN 2	NPP		100%				100%
DE	KKP 1	NPP		100%				100%
DE	KKP 2	NPP		100%				100%
DE	KKG	NPP		100%				100%
DE	KRB-B			100%				100%
DE	KRB-C	NPP		100%				100%
DE	KKI 1	NPP		100%				100%
DE	KKI 2	NPP		100%				100%
DE	KWB A	NPP		100%				100%
DE	KWB B	NPP		100%				100%
DE	KKE	NPP	1,709	100%				100%
DE	KWG	NPP	1,401	100%				100%
DE	KKU	NPP	Information on site-specific provisions is not accessible	100%				100%
DE	KBR	NPP	1,577	100%				100%
DE	KKB	NPP	1,354	100%				100%
DE	KKK	NPP	1,806	100%				100%
DE	KWO	NPP	880	100%				100%

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which has been accumulated within the own assets of the operator of the facility or its mother company [Mio. EUR]	… of which has been accumulated by the operator of the facility or its mother company within a separated account / fund [Mio. EUR]	… of which has been accumulated in an external fund under public control [Mio. EUR]	… of which has been accumulated in an external fund under mixed private-public control [Mio. EUR]	Share of funds the operator of the facility can access for other activities until the funds are needed for their original decommissioning purpose [%]
DE	KKS	NPP	1,204	100%				100%
DE	KMK	NPP	Information on site-specific provisions is not accessible	100%				100%
DE	KWW	NPP		100%				100%
DE	THTR-300	NPP	?					
DE	URENCO	Enrichment	No site-specific data accessible. Only data for the URENCO group as a whole: By the end of 2005, URENCO's provisions in the company's balance sheet for all the URENCO sites in total amount to 129 Mio. Euro for tails disposal, 157 Mio. Euro for dismantling of plant and machinery and 19 Mio. Euro for other, also non-nuclear purposes.					
DE	ANF	Fuel fabrication	Information on site-specific provisions is not accessible	100%				100%
ES	Lobo (La Haba, Badajoz) Mina and Planta Lobo-G	Mine and Mill	Already decommissioned	-	-	-	-	-
ES	Fábrica de Uranio de Andujar (FUA) (Andujar Uranium Mill-AUM)	Uranium Mill	Already decommissioned	-	-	All	-	All because ENRESA was operator and is fund manager.
ES	Saelices el Chico Planta elefante	Uranium Mill	Already decommissioned	All	-	-	-	All

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which has been accumulated within the own assets of the operator of the facility or its mother company [Mio. EUR]	… of which has been accumulated by the operator of the facility or its mother company within a separated account / fund [Mio. EUR]	… of which has been accumulated in an external fund under public control [Mio. EUR]	… of which has been accumulated in an external fund under mixed private-public control [Mio. EUR]	Share of funds the operator of the facility can access for other activities until the funds are needed for their original decommissioning purpose [%]
ES	Saelices el Chico (Salamanca) – Planta Quercus	Uranium Mill	NA – no separate account	All	-	-	-	All
ES	Saelices el Chico (Salamanca) – La mina	Uranium mine	NA – no separate account	All	-	-	-	All
ES	Arbi Experimental reactor Bilbao	Research reactor	Decommissioned	N/A	N/A	N/A	N/A	N/A
ES	Vandellos 1	NPP	1	-	-	100%	-	0%
ES	José Cabrera	NPP	1	-	-	100%	-	0%
ES	Asco	NPP	1	-	-	100%	-	0%
FIN	OL 1+2 (TVO)	NPP	826.6	-	-	826.6	-	75%
FIN	Lo 1+2 (FHP)	NPP	618	-	-	618	-	75%
FIN	FiR 1 (VTT)	RR	5.3	-	-	5.3	-	Not applicable
FIN	Olkiluoto 3	NPP	0	-	-	0	-	-
FR	EDF	NPPs and waste	24,705		24,705	/	/	/
FR	CEA	Research, fuel cycle and waste	8,602		8,602	/	/	/
FR	AREVA	Fuel cycle and waste	4,332		4,332	/	/	/
FR	SOMANU Maubeuge	Nuclear Maintenance	6	6		/	/	?
HU	NPP Paks	NPP	261	-	-	261	-	0%

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which has been accumulated within the own assets of the operator of the facility or its mother company [Mio. EUR]	… of which has been accumulated by the operator of the facility or its mother company within a separated account / fund [Mio. EUR]	… of which has been accumulated in an external fund under public control [Mio. EUR]	… of which has been accumulated in an external fund under mixed private-public control [Mio. EUR]	Share of funds the operator of the facility can access for other activities until the funds are needed for their original decommissioning purpose [%]
HU	ISFSF Paks	SF storage	Together with NPP					
HU	BRR Budapest	RR	-					
HU	TR Budapest	RR	-					
IT	SOGIN facilities	Diverse	n.a. (ENEL/SOGIN+CCSE)	570 still in the balance sheet, 800 in total transferred from ENEL (SOGIN)		n.a. (CCSE)		as much as needed to SOGIN neither making any loss nor any profit
IT	ISPRA – JRC facilities	RR	Paid out of the EC budget, therefore 0	Paid out of the EC budget, therefore 0				
IT	LENA Triga II	RR	0	0	0	0	0	
LT	INPP Unit 1+2	NPP	By 2006 EUR 560 million from all sources including commitments		National Fund - ~ EUR 107 million	EUR 420 million in the International Ignalina Decommissioning Support Fund		Legally 0%, but practically there may be cases when accumulated funds are used not for direct decommissioning purposes.
NL	Dodewaard	NPP	114	114				
NL	Borssele	NPP	164	164				
NL	URENCO Almelo	Enrichment facility	No site-specific data accessible. Only data for the URENCO group as a whole: By the end of 2005, URENCO's provisions in the company's balance sheet for all the URENCO sites in total amount to 129 Mio. Euro for tails disposal, 157 Mio. Euro for dismantling of plant and machinery and 19 Mio. Euro for other, also non-nuclear purposes.					

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which has been accumulated within the own assets of the operator of the facility or its mother company [Mio. EUR]	… of which has been accumulated by the operator of the facility or its mother company within a separated account / fund [Mio. EUR]	… of which has been accumulated in an external fund under public control [Mio. EUR]	… of which has been accumulated in an external fund under mixed private-public control [Mio. EUR]	Share of funds the operator of the facility can access for other activities until the funds are needed for their original decommissioning purpose [%]
NL	Petten nuclear reactor (HFR) (JRC Site)	RR	5 (2003) 0					
NL	HOR-RID, Delft	RR	0					
NL	COVRA	Waste management & disposal	85	85				
RO	Cernavoda 1	NPP	0	0	0	0	0	-
RO	Cernavoda 2	NPP	0	0	0	0	0	-
RO	Horia Hulubei, Magurele, Bucharest	RR	0	0	0	0	0	-
RO	TRIGA, Mioveni, Pitesti	RR	0	0	0	0	0	-
RO	CNU Bihor	Uranium mine	0	0	0	0	0	-
RO	CNU Banat	Uranium mine	0	0	0	0	0	-
RO	CNU Suceava	Uranium mine	0	0	0	0	0	-
RO	CNU Feldioara	Milling facility for uranium ore	0	0	0	0	0	-
RO	FCN, Mioveni, Pitesti	Fuel fabrication plant	0	0	0	0	0	-
SE		All nuclear facilities	3750			3750		*0%*

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which has been accumulated within the own assets of the operator of the facility or its mother company [Mio. EUR]	… of which has been accumulated by the operator of the facility or its mother company within a separated account / fund [Mio. EUR]	… of which has been accumulated in an external fund under public control [Mio. EUR]	… of which has been accumulated in an external fund under mixed private-public control [Mio. EUR]	Share of funds the operator of the facility can access for other activities until the funds are needed for their original decommissioning purpose [%]
SE		All nuclear facilities	No information readily available on the total sum of costs paid directly by the utilities (outside the funding system)					
SI	Krško Nuclear Power Plant	NPP	115			115		0%
SI	Research reactor TRIGA Mark II	RR	0	0	0	0	0	0
SI	Central interim storage of radioactive waste in Brinje	storage of radioactive waste	0	0	0	0	0	0
SI	Zirovski Vrh Uranium Mine and Milll; Waste Pile Jazbec	Uranium Mine and Mill	0	0	0	0	0	0
SK	A1 J. Bohunice	NPP	324 +	?	?	324	?	We did not manage to find the data
SK	V1 J. Bohunice	NPP		?	?		?	
SK	V2 J. Bohunice	NPP		?	?		?	
SK	JE Mochovce 1,2	NPP		?	?		?	
UK	British energy facilities	8 NPP sites (9,892 MWe)	1,137 (NLF)				1,137	0%

Source: Cf. the country reports attached to this final report for additional information and the sources used for this table. This selection is not meant to be exhaustive and only covers the facilities analysed in more detail in the course of this study.

Table 8 Investment of financial means of decommissioning funds in the European Member States, until they are used for payment of decommissioning activities.

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which have been invested in secure state bonds [Mio. EUR]	… of which have been invested in other assets with fixed interest rates [Mio. EUR]	… of which have been lent to associated or joined companies or to third parties [Mio. EUR]	… of which have been invested in other means (shares, mergers & acquisitions, etc.) [Mio. EUR]	Interest on invested financial means from decommissioning funds in 2004 [%]	Interest on invested financial means from decommissioning funds in period 2000-2004 [%]
BE	Tihange, Doel	7 NPPs	3,916			75%			
BG	EBRD funds for Kozloduy 1 to 4	NPP	550						
BG	Decomm. Funds for Kozloduy 1 to 6	NPP	280						
BG	Radwaste Man. Funds for Kozloduy 1 to 6	NPP	69						
BG	IRT Sofia	RR							
BG	Uranium mine	Uranium mine							
CZ	Dokovany 1-4	NPP	137		34.9	?	?	?	?
CZ	Temelin 1-2	NPP	28		20.7	?	?	?	?
CZ	LVR-15	RR	2.5		0.06	?	?	?	?
CZ	ISFSF Dukovany	Interim storage	0.018		0.0126	?	?	?	?
CZ	RAWRA activities	Waste management	211	211				2%	
DE	GKN 1	NPP	Information on site-specific provisions is not accessible	Internal unrestricted funds with no investment requirements. In contrast to pension funds of some of the corporate groups with nuclear facilities in Germany, nuclear provisions are not internally segregated. A direct link from provisions / liabilities made on the right side of the balance sheet to assets on the left side of the balance sheet cannot be drawn.					
DE	GKN 2	NPP							
DE	KKP 1	NPP							
DE	KKP 2	NPP							
DE	KKG	NPP							

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which have been invested in secure state bonds [Mio. EUR]	… of which have been invested in other assets with fixed interest rates [Mio. EUR]	… of which have been lent to associated or joined companies or to third parties [Mio. EUR]	… of which have been invested in other means (shares, mergers & acquisitions, etc.) [Mio. EUR]	Interest on invested financial means from decommissioning funds in 2004 [%]	Interest on invested financial means from decommissioning funds in period 2000-2004 [%]
DE	KRB-B	NPP							
DE	KRB-C	NPP							
DE	KKI 1	NPP							
DE	KKI 2	NPP							
DE	KWB A	NPP							
DE	KWB B	NPP							
DE	KKE	NPP	1,709						
DE	KWG	NPP	1,401						
DE	KKU	NPP	Information on site-specific provisions is not accessible						
DE	KBR	NPP	1,577						
DE	KKB	NPP	1,354						
DE	KKK	NPP	1,806						
DE	KWO	NPP	880						
DE	KKS	NPP	1,204						

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which have been invested in secure state bonds [Mio. EUR]	… of which have been invested in other assets with fixed interest rates [Mio. EUR]	… of which have been lent to associated or joined companies or to third parties [Mio. EUR]	… of which have been invested in other means (shares, mergers & acquisitions, etc.) [Mio. EUR]	Interest on invested financial means from decommissioning funds in 2004 [%]	Interest on invested financial means from decommissioning funds in period 2000-2004 [%]
DE	KMK	NPP	Information on site-specific provisions is not accessible						
DE	KWW	NPP							
DE	THTR-300	NPP	?						
DE	URENCO	Enrichment	Information on site-specific provisions is not accessible						
DE	ANF	Fuel fabrication							
ES	Lobo (La Haba, Badajoz) Mina and Planta Lobo-G	Mine and Mill	Already decommissioned	-	-	-	-	-	-
ES	Fábrica de Uranio de Andujar (FUA) (Andujar Uranium Mill-AUM)	Uranium Mill	Already decommissioned	-	-	-	-	-	-
ES	Saelices el Chico Planta elefante	Uranium Mill	Already decommissioned	-	-	-	-	-	-

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which have been invested in secure state bonds [Mio. EUR]	… of which have been invested in other assets with fixed interest rates [Mio. EUR]	… of which have been lent to associated or joined companies or to third parties [Mio. EUR]	… of which have been invested in other means (shares, mergers & acquisitions, etc.) [Mio. EUR]	Interest on invested financial means from decommissioning funds in 2004 [%]	Interest on invested financial means from decommissioning funds in period 2000-2004 [%]
ES	Saelices el Chico (Salamanca) – Planta Quercus	Uranium Mill	NA – no separate account	-	-	-	-	-	-
ES	Saelices el Chico (Salamanca) – La mina	Uranium mine	NA – no separate account	-	-	-	-	-	-
ES	Arbi Experimental reactor Bilbao	Research reactor	Already decommissioned	N/A	N/A	N/A	N/A	N/A	N/A
ES	Vandellos 1	NPP	1	-	-	-	-	-	-
ES	José Cabrera	NPP	1	-	-	-	-	-	-
ES	Asco	NPP	1	-	-	-	-	-	-
FIN	OL 1+2 (TVO)	NPP	826.6	-	594.5		-	20.2 2.7%	
FIN	Lo 1+2 (FHP)	NPP	618	-	450		-	15 2.7%	
FR	AREVA's facilities	Fuel cycle facilities	2,798	1,126	973	129	570		
HU	NPP Paks	NPP	261	261	-	-	-	Not defined	Not defined
HU	ISFSF Paks	SF storage	Together with NPP Paks	Together with NPP Paks					
HU	BRR Budapest	RR							
HU	TR Budapest	RR							

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which have been invested in secure state bonds [Mio. EUR]	… of which have been invested in other assets with fixed interest rates [Mio. EUR]	… of which have been lent to associated or joined companies or to third parties [Mio. EUR]	… of which have been invested in other means (shares, mergers & acquisitions, etc.) [Mio. EUR]	Interest on invested financial means from decommissioning funds in 2004 [%]	Interest on invested financial means from decommissioning funds in period 2000-2004 [%]
IT	SOGIN facilities	Diverse	570 still in the balance sheet, 800 in total transferred from ENEL (SOGIN) n.a. (CCSE)	ca. 423 (including receivables from SICN)		ca. 2	ca. 145	ca. 3.0% (before taxes)	
IT	ISPRA – JRC facilities	RR	Paid out of the EC budget, therefore 0						
IT	LENA Triga II	RR	0	0	0	0	0	0%	0%
LT	INPP Unit 1+2	NPP	By 2006: EUR 560 million from all sources including commitments, of which approximately EUR 170* have been already used.	In 2004 – LTL 6.9 million or EUR 2 million					LTL 7.8 million or EUR 2.25 million up to 2006
NL	Dodewaard	NPP	114	Internal unrestricted funds, with no investment requirements and no information					

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which have been invested in secure state bonds [Mio. EUR]	… of which have been invested in other assets with fixed interest rates [Mio. EUR]	… of which have been lent to associated or joined companies or to third parties [Mio. EUR]	… of which have been invested in other means (shares, mergers & acquisitions, etc.) [Mio. EUR]	Interest on invested financial means from decommissioning funds in 2004 [%]	Interest on invested financial means from decommissioning funds in period 2000-2004 [%]
NL	Borssele	NPP	164	Internal unrestricted funds, with no investment requirements and no information					
NL	URENCO Almelo	Enrichment facility	No site-specific data accessible. Only data for the URENCO group as a whole: By the end of 2005, URENCO's provisions in the company's balance sheet for all the URENCO sites in total amount to 129 Mio. Euro for tails disposal, 157 Mio. Euro for dismantling of plant and machinery and 19 Mio. Euro for other, also non-nuclear purposes.						
NL	Petten nuclear reactor (HFR) (JRC Site)	RR	5 (2003)						
NL	HOR-RID, TU Delft	RR	0						
NL	COVRA	Waste management & disposal	85	62	11		12		
RO	Cernavoda 1	NPP	0	0	0	0	0	-	-
RO	Cernavoda 2	NPP	0	0	0	0	0	-	-
RO	Horia Hulubei, Magurele, Bucharest	RR	0	0	0	0	0	-	-
RO	TRIGA, Mioveni, Pitesti	RR	0	0	0	0	0	-	-
RO	CNU Bihor	Uranium mine	0	0	0	0	0	-	-
RO	CNU Banat	Uranium mine	0	0	0	0	0	-	-
RO	CNU Suceava	Uranium mine	0	0	0	0	0	-	-
RO	CNU Feldioara	Milling facility for uranium ore	0	0	0	0	0	-	-
RO	FCN, Mioveni, Pitesti	Fuel fabrication plant	0	0	0	0	0	-	-
SE		All nuclear facilities (except SFR-1)	3750	3565					6.9% (average fort he period 1996 – 2005)

Country	Name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. EUR]	… of which have been invested in secure state bonds [Mio. EUR]	… of which have been invested in other assets with fixed interest rates [Mio. EUR]	… of which have been lent to associated or joined companies or to third parties [Mio. EUR]	… of which have been invested in other means (shares, mergers & acquisitions, etc.) [Mio. EUR]	Interest on invested financial means from decommissioning funds in 2004 [%]	Interest on invested financial means from decommissioning funds in period 2000-2004 [%]
SI	Krško Nuclear Power Plant	NPP	115 (105.2 in 2003)	56	53	0	6	9.60%	8.56%
SI	Research reactor TRIGA Mark II	RR	0	0	0	0	0	0	0
SI	Central interim storage of radioactive waste in Brinje	storage of radioactive waste	0	0	0	0	0	0	0
SI	Zirovski Vrh Uranium Mine and Milll; Waste Pile Jazbec	Uranium Mine and Mill	0	0	0	0	0	0	0
SK	Nuclear power plants	NPP	324+	?	?	?	?	?	
UK	British energy facilities	8 NPP sites (9,892 MWe)	1,137 (NLF)	There is no information available on the investment policies of the trustees of the NLF					

Source: Cf. the country reports attached to this final report for additional information and the sources used for this table. This selection is not meant to be exhaustive and only covers the facilities analysed in more detail in the course of this study.

3.1.7 Special cases

3.1.7.1 Early shutdown ('Fall-back option')

In case a nuclear facility should, for any reason, stop its operation earlier than planned for in decommissioning cost estimates and decommissioning funding schemes, the money accumulated might not be sufficient to provide for all the decommissioning costs.

In the case of the demonstration plant THTR-300 in Hamm-Uentrop/Germany early shutdown has lead to the problem that the stakeholders involved in this project (federal government, state of North Rhine-Westphalia, consortium of several energy companies) had protracted negotiations over the level of each contribution to cover actual decommissioning costs. Currently, payments have only been determined for the first period of the safe enclosure until 2009 but not for all the dismantling and further decommissioning activities which will follow.

The following table shows how far the decommissioning financing schemes for commercial NPP in the different countries propose to deal with an early shutdown. Only the decommissioning financing systems in Sweden and Finland and the insurance contract of the Belgonucleaire MOX-plant in Belgium fully consider such a case; the scheme in France will at least partly cover such a case after the five-year transition period from 2006 onwards.

Table 9: Overview on the ways decommissioning financing schemes in the EU Member States account for an early shutdown of a commercial NPP

Country	Early shutdown accounted for?	Remarks
B	No, except in the case of the MOX-plant of Belgonucleaire	In the worst case, the taxpayer would have to pay. In the case of the MOX-plant, expected costs of decommissioning are covered by a contract Belgonucleaire has concluded with an insurance company.
BG	Not for plants under operation beyond 2006	The taxpayer would have to pay in case of early shutdown of operating NPP. In the case of Kozloduy units 1-4, the European Union and other western European donors that expressed concerns about the safety of the reactors, have provided supplementary funds to assist with early shut-down.
CZ	Not really	The plant operator is required to bear all remaining cost after early shut-down. In worst case (e.g. in the case of bankruptcy), the taxpayer would have to pay.
D	No	Corporate groups operating NPP usually affirm in public that in the case of an early shutdown of one of its NPP, the corporate group would fully take care of the liability. However, in worst case, the taxpayer would have to pay.
E	Not really	In the new law, with contributions to the fund being considered as tax payments, the Treasury is the first institution to be compensated in case of bankruptcy. In worst case, the taxpayer would have to pay.
F	Yes, but dis-counted and after 5 years transition period	The full amount of dismantling costs has to be provided for with the start of operation of the facility. However, this regulation is new (of 2006), and a 5 years transition period has been granted. Furthermore, provisions are based on discounted costs.
FIN	Yes	Part of the assessed liability that is not covered by money in the fund must be covered by securities (credit insurances, liability bank guarantees, real estate mortgages or liability guarantees by a Finnish association, with mortgages on a NPP not being accepted) furnished by the license-holder, and given to the Ministry of Trade and Industry which has to separately accept each. As an additional precaution against unforeseen events, supplementary securities are required by the Government to take into account any effects of incidents and costs. These additional securities cover up to 10% of the assessed liability.
HU	No	In worst case, the taxpayer would have to pay.
IT	Not relevant	No operating NPP since 1987.
LT	Not really	Ignalina unit 1 is closed and unit 2 will be shut down early in 2010. Until May 2006, only about 15% (28%) of decommissioning (dismantling) costs have been accumulated.

Table 9 (continued): Overview on the ways decommissioning financing schemes in the EU Member States account for an early shutdown of a commercial NPP

Country	Early shutdown accounted for?	Remarks
NL	No	An amendment of the Nuclear Energy Act is under preparation which concerns the obligation for licensees to make sure that there is a certainty that there are sufficient means for decommissioning. However, due to the recent fall of the government, it is not sure what will happen to this. With regard to radioactive waste management, the taxpayer would have to pay in case the fees paid by the operator are not sufficient.
RO	No	No decommissioning financing schemes in place, and fund operational mechanisms not yet precisely defined. In case the operator is unable to pay the 'National Agency for Radioactive Waste' will take responsibility.
S	Yes	Two types of guarantees by the operators: Guarantee I covers early closure; guarantee II covers lack of funds in the event that the fund balance should be found to be inadequate in the end. In March 2006, the government proposed improved and more flexible possibilities of requiring securities and handling the remaining risk born by the state.
SI	No	It can be assumed that the Slovenian state (and maybe Croatia, too) would have to pay for decommissioning in case of an early shutdown.
SK	No	In case of early closure the state will take responsibility.
UK	No	No commitment to ensure the Nuclear Liabilities Fund will be adequate to meet all the liabilities it is eligible to pay.

3.1.7.2 Unexpected cost increases

As already pointed out in Chapter 3.1.4.3, there are many economic risks and uncertainties associated with the different technical decommissioning options of the nuclear fuel chain.

A specific economic decommissioning problem is unforeseen events or unexpected cost increases which might happen during operation or decommissioning of a nuclear facility, and which can have a substantial impact on decommissioning costs. They can be, e. g., due to incidents or even accidents (like in the case of Bohunice A1 in Slovak Republic, which had accidents in 1976/77, and where decommissioning financing is not secured), or caused by unforeseen scientific, economic or political developments.

In the reference (NEA/IAEA/EC 1999) it is recommended to take account of such possible developments by including the following in their suggested list of cost items.

- **insurances** including liability insurance and pollution liability insurance
- **contingencies** including

– risk, financial assurance versus inherent uncertainties in the scope, regulatory involvement, local and federal politics and waste disposal options,

– escalation of waste disposal charges, and

– general inflation over the period of performance

However, it could not be found out in the course of this study how far these cost items are included in cost estimates and provisions in practice. Evidence collected so far suggests that, in most countries, decommissioning financing schemes do not adequately account for such possible developments (cf. also the previous subchapter on the early closure case).

Sweden and **Finland** seem to be notable exceptions where unforeseen events are at least partly accounted for according to the **‚Polluter Pays Principle'**:

- In Finland, as an additional precaution against unforeseen events, supplementary securities are required by the Government. They can cover up to 10% of the assessed liability, and have to be given to the Ministry.
- In Sweden, the regulation is even stronger: Guarantee I covers early closure, guarantee II covers lack of funds in the event that the fund balance should be found to be inadequate in the end.

3.1.7.3 Transfer of ownership

If all liabilities are transferred and all provisions as well as the respective assets remain available to their full extent, transfer of ownership will not affect the way the decommissioning financing system is functioning. This is the usual case, e. g., when E.ON took over Sydkraft plants in Sweden, or when Vattenfall took over HEW in Germany. In general, a transfer of ownership between privately owned companies should not affect decommissioning financing, as long as the risks of bankruptcy of the owners do not differ from each other. However, this can be different in case of transfer of ownership from private to public, or vice versa, or in case of transfer of ownership from one publicly owned organisation to another.

For example, in the course of privatisation of shares in electricity supply companies in the new Member States, special agreements were made. For example, ENEL which took over 66% of the Slovakian electricity company Slovenske Elektrarne, did not take over any responsibility for decommissioning besides having to pay a fixed amount as set by law during operation of its NPPs to the National Nuclear Fund, although this amount is less than would be needed to fully pay expected decommissioning costs.

Another example is the UK. The history of decommissioning provisions in the UK presented in the following table clearly shows how changes in the decommissioning financing schemes reduced available financial means for decommissioning several times. Currently the only tangible funds are the previous provisions made by British Energy to the Nuclear Liabilities Fund (NLF). These will be supplemented by future payments to the NLF and any payments to the NLF made under a 'cash sweep' (a pro-

portion (about 65%) of British Energy's profits is paid into the NLF. The entitlement could be converted into shares in British Energy, which could be sold to the private market: the UK government has considered selling the shares but it has not committed to pay any sale proceeds into the fund; cf. the respective country report in the annex to this final report for more details).

Table 10: History of decommissioning provisions in the UK

Scheme	Facilities covered	Owner	Provi-sions	Form	Remaining funds
Until 1990	9 civil Magnoxes & 7 AGRs	CEGB/ SSEB	£3.8bn	Internal accounting provisions	£0
1990 - 1996 FFL	8 civil Magnoxes, 5 AGRs and 1 PWR	Nuclear Electric	£6bn	Cash-flow to Nuclear Electric	£2.7bn to Magnox Electric & £228m to British Energy
1996 - 2005 NLIP	11 civil Magnoxes & other BNFL facilities	BNFL	£4016m	Internal fund	£0
1998 - 2006 Secretary of State's Under-taking	All facilities owned by BNFL	BNFL	£5956m	Government undertaking	£0
1996 - 2005 NDF	7 AGRs & 1 PWR	British Energy	£440m	External segregated fund	£440m to NLF
Since 2005 NLF	7 AGRs, 1 PWR and spent fuel from Sizewell B	British Energy	£782m + 'Cash Sweep'	External segregated fund	£782m + 'Cash Sweep'
Since 2005 Statutory seg-regated account	All liabilities except those owned by Brit-ish Energy	NDA	£0	Government commitment	£0

Source: Research by Steve Thomas, PSIRU, University of Greenwich, Greenwich. Cf. the respective country report for more details.

3.1.7.4 Special funding arrangements with new Member States

In the course of the accession negotiations, special funding arrangements had been found for the closure of reactors that could not be economically upgraded to a required level of safety. Major costs of technical decommissioning, but also security of supply, energy efficiency and regional development issues are addressed through international decommissioning support funds, managed by the EBRD in London, to which the EU is the major (but not the sole) contributor:

- Ignalina International Decommissioning Support Fund (IIDSF), Lithuania: 529 million Euro EU assistance received between 1999 and 2006.

- Bohunice International Decommissioning Support Fund (BIDSF), Slovak Republic: approximately 600 million Euro EU assistance expected for the period 1998 – 2013.
- Kozloduy International Decommissioning Support Fund (KIDSF), Bulgaria: 550 million Euro assistance agreed on for the period 2000 - 2009.

Additional assistance has been provided through the PHARE programme.

3.1.8 Transparency to the public - Information rights of the public

In several countries, changes in **consumer protection law** have, at least slightly, increased citizens' information rights. For example, while carrying out the research in UK in the course of this project, the Nuclear Decommissioning Authority (NDA) answered questions by one of the project team members while referring to the 'Freedom of Information Act' of the year 2000. Another example is the authorities in the Czech Republic. They are required by Czech law to provide information in response to queries from the public regarding decommissioning strategies and costs.

However, information rights of the public are usually restricted. Furthermore, in the liberalised market, **facility-specific information** on the following are not available for all countries and usually not available in decommissioning financing systems with unrestricted internal funds.

- estimates of total decommissioning cost
- cost breakdowns by cost items
- details of cost estimation methodology
- provisions accumulated
- investment of financial means allocated until the money is used for payment of decommissioning activities, and
- details of payments from decommissioning funds for decommissioning activities

In some cases, even the respective **aggregated information on the level of the corporate group operating nuclear facilities or on the country level** is not fully open to the public. Country-specific, operator-specific or even some facility-specific information publicly available can be found in the following areas:

- Legislation
- Decommissioning plans (at least in some countries like, e. g., in Hungary)
- Annual reports, balance sheets and income statements of external fund managing organisations with own legal personality. However, the numbers and information in these reports are usually not differentiated by the different nuclear facilities
- Annual reports, balance sheets and income statements of most of the privately owned companies or corporate groups owning nuclear facilities directly or via subsidiaries or associated companies. Again, the numbers and information in these re-

ports are usually not differentiated by nuclear facilities. However, it should be noted that the switch to IFRS standards has forced several operators to release at least some additional information on the decommissioning financing issues.

- JRC reports on the nuclear facilities Ispra (Italy), IRMM – Geel (Belgium), ITU – Karlsruhe (Germany), IE – Petten (Netherlands)
- Publicly available literature giving a rough overview on the situation in several countries, like (NEA 1996), (NEA 2003) or (European Commission 2004), or national reports to the Joint Convention (mostly country-specific only; some facility-specific information)
- Reports by public (nuclear) authorities (e. g., reports by the National Court of Accounts in France)
- Websites and brochures (for example, in the UK, the creation of the NDA represented a major step forward in bringing different information material together and making it accessible through the website),

Further information can also be found in documents published and hearings carried out in the course of environmental impact assessment and subsequent decision in principle processes at nuclear facilities. Finally, some additional oral and additional written information can be usually received from responsible public authorities. In contrast, privately owned organisations may be less willing to provide any additional data or information.

3.1.9 Stakeholder views on the current systems, on possible changes, and on the discussed harmonisation on EU level

The identification of the relevant stakeholders in the different countries and on the European level, their role and their motivations with regard to the existing decommissioning funding approaches and to the existing proposals of harmonising the methods of financing nuclear decommissioning and their own proposals for possible changes is an important basis for the development of possible steps of optimisation and harmonisation of decommissioning financing schemes in Europe and in the different Member States.

There are five bodies that have a role in developing the EU's views on decommissioning financing:

- European Commission
- European Parliament
- European Council
- European Economic and Social Committee
- Article 31 Expert group.

Important developments and statements published by these stakeholders have been already described in Chapter 1.1 (for more information of those and other stakeholders on EU level see the EU stakeholder report in the appendix). Further important stakeholders at the European level are:

- EURELECTRIC and FORATOM: The electricity industry association and the European Atomic Forum similarly state that there must be adequate financing for decommissioning and that the funds must be available when needed but that Member States must have the ability to develop their own ways of reaching these goals.
- Greenpeace International: The environmental NGO proposes that separate and transparent decommissioning funds should be set up, with no exceptions to allow operators to use the funds as a source of cheap financing.

Main stakeholders in the 16 countries considered in the course of the country analyses are:

- Operators of nuclear facilities
- Managers of decommissioning funds
- National government (different ministries)
- National parliament
- Nuclear safety authorities
- Electricity market regulators
- Trade unions
- Municipalities and regional governments where nuclear facilities are sited
- Environmental and consumer protection NGOs
- Nuclear consultancy firms and independent experts
- Banks, financial analysts and auditors
- European Commission (at least in some countries)
- European Community and European Bank for Reconstruction and Development (at least in some countries).

Not all these stakeholders could be interviewed in every country. In some countries, stakeholders refused to discuss the relevant topics with the authors of this report and to provide any additional data or information (for more information on these issues see the stakeholder analysis in the country reports in the appendix).

Operators, decommissioning fund managers, national governments and nuclear safety authorities usually regard the existing, laws and regulations on decommissioning financing in their country as sufficient. For example, ENRESA, ENUSA, UNESA, the MITYC and all nuclear power plant licensees in Spain assume that theoretically the methodologies of estimating decommissioning costs are sufficient, that the provisions

are adequate and that the funding will be available when the money is needed. An exception is the respective stakeholders in Romania where a decommissioning financing system has not been implemented yet and should be implemented as soon as possible according to a number of stakeholders. In the Netherlands, changes in the national decommissioning financing scheme are proposed and supported by some of the stakeholders.

When it comes to the question of harmonisation on EU level, opinions are split. While some operators, regulators and governments generally welcome harmonisation in principle (cf., e.g., the country reports for the Czech Republic and Hungary), others fear that harmonisation steps would intervene too much into their own freedom of decision or would not adequately take account of the special situations in the different countries (cf., e.g., the country report on Romania). In particular, in countries where the decommissioning financing system has undergone recent changes (e. g., Spain); there is the wish for some degree of stability of the system in the coming years. In Finland and Sweden, where these stakeholders have long experience and are quite satisfied with the system of a separate publicly-controlled funding system, harmonisation of details of the decommissioning financing systems is not considered necessary. However, in these countries, it is seen important to introduce general requirements on producers of nuclear energy to allocate appropriate financial means for future decommissioning to ensure a fair competitive market while leaving the Member States freedom to apply their own national system provided that they fulfil certain important general principles (minimum requirements/criteria) to be agreed between them.

On the other hand, many NGOs claim that the existing decommissioning financing schemes are not transparent, adequate, well-managed and secure enough. Furthermore, the independency of nuclear regulators from the nuclear industry has been questioned; public control would not be functioning well enough, and participation of the public would be limited too much (cf., e.g., the criticism by NGOs in the Slovak Republic, in Lithuania). The main fear is that the 'Polluter Pays Principle' would not be implemented fully, and that the taxpayer and the next generation would have to pay for decommissioning of nuclear facilities, from which the current generation and the operators and their shareholders currently benefit. Therefore, they welcome attempts at the European level to harmonise decommissioning financing schemes.

In parliaments, different views on the existing decommissioning financing schemes, their possible changes and a possible harmonisation on EU level exist, ranging from the operators' to the NGOs' view (cf. the country reports for France and the Slovak Republic).

Municipalities are often neglected in the governance schemes. Those municipalities included in this stakeholder analysis (e. g., in Germany) asked for an earlier consultation and participation in the course of decommissioning processes, including considerations on financing social and regional development measures in the course of facility shut down and decommissioning.

3.2 Main observations based on the country analyses

3.2.1 Overview

Before starting to analyse the financial consequences and risks of the decommissioning financing systems in the EU-27 in Chapter 4 in detail, main observations stemming from the country analyses are summarised in the following:

- In existing decommissioning financing schemes, with the exception of few countries like Sweden, non-NPP facilities are often neglected although costs are partly higher than decommissioning costs of NPPs.
- Cost estimates vary substantially depending on several factors and the methods applied.
- Risks and uncertainties are not adequately addressed in most of the cost estimates.
- Although the 'Polluter Pays Principle' is widely accepted, it is not always implemented to its upmost possible extent.
- Different expectations of contributors to decommissioning financing in new Member States can lead to a partly unclear situation with regard to future decommissioning financing.
- There are different degrees and ways how the public is involved in controlling decommissioning financing, and what information rights the public has.
- There are several barriers towards improvements of the current decommissioning financing schemes in the Member States and towards harmonisation on EU level.
- A trend towards an increased restriction of decommissioning funds might be perceived.

3.2.2 Non-NPP facilities often neglected although costs are partly higher

Until today, in most countries (except, e. g., Sweden), the discussion on decommissioning funding has mainly concentrated on commercially used nuclear power plants and has quite often neglected other facilities like

- uranium mines and mills which, in Europe, are largely no longer in operation, and where the expected decommissioning costs of all these mines and mills total considerable amounts,
- uranium conversion, enrichment and fuel fabrication plants,
- (complex) spent fuel reprocessing plants with the highest estimated decommissioning costs among all nuclear facilities,

- other waste management and interim storage facilities (however, usually, the funding schemes for these facilities are principally the same as for nuclear power plants)
- research reactors and other nuclear research facilities (with the exception of JRC facilities for which reports on decommissioning status and cost estimates including budgetary plans are regularly made) and small demonstration plants.

Costs for decommissioning of commercial nuclear power plants are higher than for several other types of nuclear facilities. However, this is not true for plutonium bulk-handling facilities / reprocessing plants (e.g., decommissioning costs of WAK Karlsruhe are estimated at 2.2 billion Euro, and for Sellafield at about 58 billion Euro) or for facilities where accidents have taken place (e. g., A1 in Jaslovske Bohunice/Slovak Republic).

3.2.3 Varying cost estimates

Differences in the decommissioning strategies pursued (deferred vs. immediate solutions for decontamination and dismantling; different waste management strategies) and in technical methodologies of dismantling and storage and final disposal of waste mainly depend on differences in the geological situation and in the nuclear history, on the safety concepts applied, and on economic factors. The technical standards, procedures and obligations in a country finally reflect the degree of risks accepted and borne by present generations, with this decision of present generations affecting also future generations.

After the technical methodologies and obligations have been specified, the future costs of following these technical concepts have to be estimated. The present monetary value of the liabilities of the energy companies has to be determined from the beginning of installation operation. This is subject to high levels of uncertainties. While there is at least some decommissioning experience with uranium mines, research reactors and first commercial NPP, there is almost no experience at all with decommissioning of large NPP, reprocessing plants or the installation of a final disposal facility for high-level radioactive waste. Furthermore uncertainties are created because of the long time delay between the generation of revenues during plant operation, and the payment of liabilities generated during operation. Risks and uncertainties are often insufficiently dealt with in cost estimation.

The technical strategies, methodologies and obligations and the cost items taken into account (“scope” of the estimate), the respective time horizon for decommissioning and the inflation rate and discount rate applied as well as the degree to which risks and uncertainties are taken into account largely determine the size of the estimated future costs and their present value. Furthermore, it makes a big difference if:

- cost estimates are developed by taking some international standard values from literature, and applying these numbers to the situation in the respective country (or-

der-of-magnitude estimate), thereby neglecting, among others, the specific situation of the respective facility, differences in decommissioning strategies and technologies, share of workers and wages, purchasing power parities, and exchange rates,

- or are derived from a critical and thorough analysis of:
  - some reference cases of nuclear facilities in a country, with analysis of transferability of the results to other cases in the country,
  - each facility in the country separately.

In most cases, deterministic methods for estimating decommissioning costs are used. However, cost estimation methodologies differ significantly. There are cost estimation tools available (e.g., STILLKO by NIS, Germany), which are applied in several countries. In some countries, for some facilities, very detailed methodologies using scenario analysis have been used with comparison of different possible decommissioning paths and sensitivity analyses (cf., e. g., the methodology used in Lithuania), while in other countries there seem to be only rough estimates (e. g., Bulgaria and Romania, previously in Hungary).

3.2.4 Risks and uncertainties have not been adequately addressed

For several nuclear installations, particularly for all decommissioning activities in the context of waste management and disposal, only broad ranges of expected decommissioning costs can be calculated, for example:

- the 7 + 2 scenarios calculated in Slovenia in 2004, with cost estimates for decommissioning of Krsko NPP between 1,118.5 and 1,796.1 million Euro, and
- the cost estimate for final disposal in an underground repository in France ranging between 13,500 and 58,035 million Euro.

Examples like these both show the large risks and uncertainties associated with the identification and estimation of future costs of decommissioning which depend on the assumptions taken, the decommissioning strategy chosen, and thereby also on societal and political factors (cf. also NEA/RWM/WPDD 2006, 25f., for the weight of such factors). Risks can be partly taken into account by scenario or sensitivity analyses. However, in most cases they are not adequately dealt with. Nevertheless, professional or scientific cost estimation models (software) are starting to be extended and further developed respectively, like it is currently under development at NRG in the Netherlands.

However, even if there is a range of cost estimates available for a plant showing different sensitivities or scenarios, provisions are usually just made by referring to one of the cost estimates (like in the Slovene case of choosing ‘SID-45’ as the basis for determining the surcharge on the electricity price to be paid into the fund).

Moreover, even if attention is paid to detailed and regularly updated cost estimates is paid that take financial risks into account, decommissioning projects regularly produce the unexpected (cf. Pfeifer/Gordelier/Drake 2004). Although regular cost estimation

reviews and consequently adapted provisions can partly cure this problem, a risk remains that, in the end, the 'polluter' will not be able to pay for all the decommissioning costs, particularly if costs start increasing only after end of facility operation due to unforeseen events or developments which can come up in the course of the long time periods associated with decommissioning (cf. also Monnier/Steel/et al. 2006, p. 5).

3.2.5 Varying implementation of ‚Polluter Pays Principle'

The broad acceptance and applicability of the 'Polluter Pays Principle' for nuclear decommissioning financing relies on (cf. Chapter 5.3.2 and Chapter 5.3.3 for more details on this principle and its applicability in the context of decommissioning financing in the EU; cf. also NEA 2006a)

- The special risks to environment and health involved in the nuclear process chain, which justify to particularly address the operator of a nuclear facility by special regulation and the demand to adequately provide for future decommissioning in order to ensure safe decommissioning.
- Intergenerational equity values: The generation benefiting from the output of the nuclear facility should pay for all consequences related to the production of this output.

Although the 'Polluter Pays Principle' is widely accepted in principle, and although this term has been increasingly used in official documents (e. g., by the European Commission), it is not implemented to the upmost possible extent in every country. Examples have been given in Chapter 3.1.2.

Fulfilment of the liabilities (operational and financial) related to nuclear waste management and disposal as well as dismantling, decontamination, etc. (technical decommissioning) is an absolute condition to the continued validity of the operating licences of nuclear facilities in some countries. For example, in Finland, according to the Nuclear Energy Act (section 26), the Government must cancel the operating licence wholly or partly, if the licensee is omitting to fulfil the financial provision obligation for nuclear waste management and decommissioning.

Regulation can assure that the ‚Polluter Pays Principle' will be followed also in special cases like early shutdown, major incidents or accidents, unexpected cost increases, bankruptcy of the operator, or other unforeseen events. This should receive particular attention as the collection of provisions lags behind the accumulation of liabilities for many facilities under routine operation.

3.2.6 Different degree and ways of public control - Differing public information rights

It can be basically differentiated between internal and external funds according to the degree of independence of the fund organisation from the facility operator. Further-

more, there are different roles for the public, government, parliament and nuclear safety authority in the different decommissioning financing schemes.

In countries with external funds, the national government has a strong or even solely dominating position. The influence of the national parliament is limited or even not existing in practice. In countries with internal unrestricted funds, there is little or no public control of decommissioning funds. The effectiveness of restrictions posed on operators and fund managers in restricted funding schemes could not be completely evaluated in the course of this project. It probably largely depends also on how the regulations are implemented and on the degree of independence and competence of the parties involved (cf. Chapter 4 for further analysis of the problem of independence within the analysis of financial risks from the governance perspective).

Against this background, it is interesting to see the recent development in France, where – according to the new law of June 2006 - a National Commission will be installed that will evaluate the decommissioning financing system every three years. Members of the Commission are designated by the National Assembly, the Senate and the Government.

In all countries, there are only very limited rights for the public to receive detailed information on decommissioning financing schemes. Furthermore, the municipalities concerned interested in a socially and environmentally acceptable decommissioning process only have a weak position.

This is the case although the impact on safety of the public, and particularly of the regions where the facilities are located, could be substantial during decommissioning or in absence of decommissioning activities due to lack of finance.

3.2.7 Harmonisation on EU level only with regard to general criteria to be fulfilled by national decommissioning financing schemes?

As documented in Chapter 3.1.9, on the one hand, many stakeholders (operating companies, governments, etc.) are quite satisfied with the present situation in their country, because they think that funding would be adequate and available when needed, and have concerns towards a process of harmonising decommissioning financing on the European level and substantially changing the present systems. On the other hand, some of these stakeholders stressed the importance to introduce some kind of general requirements or common criteria on producers of nuclear energy to ensure a level playing field in the European Union.

In conclusion, there is a strong preference to ensure freedom to apply an own national system in a Member State provided that this fulfils certain important general principles (minimum requirements/criteria) to be agreed on a European level. Following this argumentation would mean that possibilities for detailed regulation on European level would be significantly opposed, and thus are politically limited.

3.2.8 Trend towards increased restriction of funds?

There are very different governance schemes of fund management, different investment rules, and variable access of operators of nuclear facilities to the funds.

A number of Member States seem to be moving towards the increased restriction of funds (cf., e. g., the changes in legislation in Czech Republic, Sweden, Finland, and France). This development towards increased restriction of funds might be further accelerated by pressure from the financial markets (analysts and auditors).

3.2.9 Different expectations of contributors to decommissioning financing in new Member States

In the new Member States, based on the stakeholder interviews carried out, it can be observed that

- The European Commission expects its financial assistance of decommissioning and accompanying measures in the new Member States to be limited. The European Commission, e.g., does not plan to extend the assistance to Bohunice in the Slovak Republic beyond 2013.
- In contrast, some representatives from governments and other stakeholders in the new Member States interviewed expect to receive EU contributions beyond what has been agreed on up to now.

These different expectations can lead to a situation, in which it is unclear how future decommissioning activities will be paid for.

3.3 Identification of typical examples of decommissioning financing methodologies

3.3.1 Criteria for differentiating between typical financial schemes

The country analysis has revealed substantial differences between the decommissioning financing systems in the EU-27. It would be beyond the scope of this project to analyse the financial consequences and risks involved in all these financing schemes in detail. Therefore, the analysis in Chapter 4 has to concentrate on specific types of decommissioning schemes. Several criteria might be applied to differentiate between typical decommissioning financing schemes:

- Liable organisation / Distribution of liabilities
  - private: quoted companies / other companies
  - public (national, international, EU)
  - mixed public-private

- Ownership of operating company
  - private: quoted companies / other companies
  - public (national, international, European Commission)
  - mixed public-private
- Fund management
  - private: quoted companies / other companies
  - public (national, international, EU)
  - mixed public-private
- Independence of fund organisation from facility operation
  - internal fund within liable organisation (e.g., on-balance-sheet recognition of liabilities, or internal restricted fund),
  - external fund separated from operator, e.g. state company or agency (with or w/o transfer of liabilities and assets; with or w/o operator short-fall guarantee)
- Restriction to management, investment and use of the funds
  - no limitation; operator has full access to the funds
  - some restrictions, e.g. assets earmarked formally against liabilities, or only limited borrowing from external fund, or authorisation needed before decommissioning activities are paid out of the fund
  - strictly separated (“segregated”, “blocked”) fund
- Rules for securing sufficient funds in case of short-falls, e. g. caused by insolvency and transfer of ownership
  - no rules / coverage
  - group solidarity of operators
  - insurance
- Public control / reviews / audits / sanctions
  - internal / external
  - involvement / no involvement of third parties (Board of Auditors, Court of Audit, consultants)
  - regular / from time to time
  - obligatory / non-obligatory
  - decommissioning funding requirements have or have not to be fulfilled to receive operating license
  - no sanctions / sanctions in case of non-compliance

  - no / weak / strong role for Parliament in public controlling / authorisation process
- In particular: Role of nuclear safety regulator
  - requirement to develop a decommissioning plan
  - requirement to develop a decommissioning cost plan
  - low / high quality requirements
  - low / high competence of regulator
  - involvement / no involvement of third parties (e. g., consultants)
- Right of the public to have access to information:
  - private information: only annual reporting according to trade/commercial law
  - information partly public or only to a specific board
  - information fully public
  - low / high quality of information
- Different sources of fund contribution
  - explicit tax or levy
  - part of electricity price
  - interest generated by the fund
  - penalties imposed by nuclear regulator
  - grants from national government and/or EU
  - part of general public budget
- Dismantling (technical decommissioning) strategies
  - immediate
  - deferred
  - mixed
- Cost estimates
  - quality of data base
  - order-of-magnitude estimate (rough calculation without detailed engineering data, e. g. by taking some cost figures in international literature for granted and only slightly adapting them to the situation in the country, i. e. by scaling up or down factors and approximate ratios) / budgetary estimate (based on the use of flow sheets, layouts and equipment details, where the scope has been defined but the detailed engineering has not been performed, e. g., modelling based on reference cases or differentiated modelling for every individual facility) / defini-

tive estimate (one where the details of the project have been prepared and its scope and depth are well defined)

  - deterministic / taking uncertainties and risks into account (e. g. by sensitivity or scenario analysis)
  - regular review of cost estimates / reviews only from time to time
  - using inflation indexes or concrete prices to update costs
  - competence of organisations / persons carrying out the cost estimates
- Amount of decommissioning costs and (financial) risks
  - Extremely high costs and risks: e.g. reprocessing plants, some uranium mines
  - High costs and risks: e.g. commercially used NPPs, some uranium mines
  - low to medium costs and risks: e.g. enrichment, conversion and fuel fabrication plants, research reactors, interim storages, small demonstration plants, some uranium mines and mills
- History of building up a fund
  - From the beginning of operation of facilities (usually in old Member States) with or without changes in funding methodology
  - Having started after several years of operation (often in new Member States)
  - No changes / changes in funding methodology after several years of operation (several old and new Member States)
- Importance of decommissioning financing regulation for future nuclear facilities
  - Already all plants shut down; no plans / legal possibilities to construct new plants
  - Ongoing nuclear phase-out; no plans / legal possibilities to construct new plants
  - Plants in operation; and plans / legal possibilities to construct new plants
- Scope of provisions / constructive obligations / contingent liabilities / covenants made (different degree of asset cover)
  - covering all decommissioning costs / covering only part of decommissioning costs or even no provisions at all
  - covering on-site / on-site and off-site decommissioning costs
- Accounting method / standard
  - international (IAS/IFRS, US-GAAP)/ national standards
  - undiscounted costs (overnight costs) / discounted costs (interest rate)
  - depreciation
  - expense / activate

  - consolidation
- Investment
  - operating / financial assets / specific financial asset portfolio
  - voluntary / mandatory financial-asset cover
  - different share of secure government bonds, equity, other non-government securities

3.3.2 Types of decommissioning financing schemes chosen for deeper analysis of financial consequences and risks

The long list of possible criteria shows that the identification of types of decommissioning financing schemes is a multi-dimensional decision-making process. It does not seem to be possible to design complex types which can be clearly differentiated and at the same time to take into account all these relevant criteria and their possible parameter values. Therefore, and with regard to the financial risk analysis that follows in Chapter 4, it seems to be more appropriate to focus on particularly important criteria. Criteria selected from this perspective are the ones identified already in Chapter 3.1.6.1 as the ones being basic criteria for the identification of fund management systems (cf. the definitions in Chapter 2):

- The differentiation between internal and external decommissioning financing solutions (where internal means that the decommissioning funds/financial assets are part of the respective organisation and in the general accounts of the operator; external, in contrast, means that the decommissioning funds/financial assets are not part of the respective organisation and are not in the general accounts of the operator);
- The differentiation between restricted and unrestricted funds;
- The differentiation between public and private licensees being liable for decommissioning cost.

Therefore, the typical schemes analysed in more detail in the following are

- Internal unrestricted fund;
- Internal restricted fund;
- External unrestricted fund;
- External restricted fund;
- Moreover, some public operators pay decommissioning costs from the current budgets, which, in fact, is a kind of public internal unrestricted fund.

4 Analysis of financial consequences and risks

4.1 Introduction into the financial risk analysis

4.1.1 Overview on the four perspectives: accounting, valuation, governance, investment

An analysis of financial consequences and risks of the existing decommissioning financing schemes is particularly needed with respect to large quoted companies active or having a share in the nuclear business, but also with respect to other private or public organisations being liable for nuclear decommissioning. They have to take both into account

- **economic pressure** from the liberalised energy markets and the (national and international) financial markets,
- nuclear **safety requirements**.

The **financial risk analysis** divides the financial consequences into

- the risks related to governance issues,
- the risks related to accounting issues,
- the risks related to financial valuation issues and
- the risks related to the investment policy.

The **governance perspective** discusses

- the risks relating to the organisational solution chosen for the decommissioning funds, the internal control systems, boards etc;
- the adequacy of managerial responsibility for operating costs associated with the different decommissioning funding methodologies applied;
- the financial risks associated with the different decommissioning funding methodologies;
- how, depending on the decommissioning funding scheme applied, the financial risks shift between different stakeholders;
- how strategic decisions can be impacted by different decommissioning funding methodologies.

The **accounting perspective** treats

- how the different decommissioning funding methodologies can impede the comparability between countries and how this can influence the usefulness of the information provided of users making economic decisions;

- the impact of the different decommissioning funding methodologies to the pricing policy (power generation costs);
- the consequences relating to the methods of accumulating the funds, taking regard, among others, of the differences between the different accounting standards used (national standards, IFRS/IAS, US-GAAP);
- the impact of the different decommissioning funding methodologies to efficient use of capital.

The **valuation perspective** describes

- the impact of different decommissioning funding methodologies to the financial valuation of power generation plants and their financing potential;
- the impact of different decommissioning funding methodologies to the risk-adjusted average cost of capital.

The **investment perspective** discusses

- the risks relating to the rules and methods of investing the funds provided and of the current investment portfolios chosen;
- the risks relating to the differences in accessibility of the energy companies to the funds.

4.1.2 Specifications and underlying principles

When **specifying a decommissioning funding system**, it has to be differentiated between

- the entity being liable for providing for decommissioning financing,
- the entity which accumulates the fund and
- the power of authority to dispose of the decommissioning funds which itself comprises of the activities of managing and controlling the funds investment and authorising payments for decommissioning. If the power of authority to dispose is with a third party, the degree of independence between the third party and the operators can significantly vary. Therefore, in each case, the degree of independence has to be separately assessed.

Underlying principles governing the financial risk analysis are the assumptions that

- the ‚Polluter Pays Principle' must apply as far as possible, and the operators of the nuclear installations are regarded as ‚polluters'
- ‚transparency is an important requirement and
- a high level of quality (best practice) of fund management is vital.

4.2 Governance Perspective

4.2.1 Citizen's health and safety, polluter pays principle

Assuring the health and safety of citizens in all European countries is the overriding tenet of decommissioning. Authorities/regulators have to protect citizens from radioactive emissions caused by the operation of and the different types of radioactive wastes generated by a nuclear facility. Therefore, all nuclear facilities have to be decontaminated and dismantled and the arising nuclear waste has to be managed and disposed of. For safety reasons, these activities must be carried out in any case. The safety regime should ensure that decontamination and dismantling and management and disposal of all sorts of arising radioactive wastes are timely executed, that unsafe technical procedures are not carried out, and that someone is going to pay for it. Therefore, authorities should require the accumulation of financial resources for decommissioning as a condition of receiving an operating license.

Under the assumption of the "polluter pays principle" decommissioning has to be paid by the operator of the nuclear installation. This reflects the policy (attitude) that the generation benefiting from the nuclear energy produced, and not future generations, should pay for decommissioning.

The objective of "decommissioning funding systems" is to ensure the availability of an adequate amount of financial resources (based on reliable and consistent cost calculations) for decommissioning by the time decommissioning activities have to be carried out. The availability and the adequate amount of financial resources for decommissioning are a key factor if the target of releasing a nuclear power installation (and its operator) from restrictions should be achieved.

4.2.2 Decommissioning governance

Operators, be they public or private, obtain cash inflows from their nuclear activities during the designed lifetime in the form of net sales (revenues). Part of this cash inflow has to be allocated to decommissioning funds (set up of provisions) because, after the shutdown of a nuclear installation, decommissioning activities will absorb a substantial amount of an operator's financial resources (past inflows).

Decommissioning expenditure can be understood as part of the capital expenditures of constructing a nuclear installation which, contrary to a classical investment pattern, arise/accrue not before the cash inflow period through sale of energy but when the use of the nuclear installation has come to an end (no further sale of energy and thus no further cash inflows). Therefore, the operator of a nuclear installation should set aside an adequate amount of financial resources (decommissioning funds) in order to pay the capital expenditures when shutting down the nuclear installation. The existence of this "inverse investment pattern" embodies an inherent governance conflict (cf. Chapter 4.2.3.2).

The core issues in “decommissioning governance” therefore are questions such as:

- Can, in a competitive environment, the operation of a nuclear installation generate sufficient financial resources (cash inflows) to cover all costs, inclusive decommissioning?
- How can it be assured that the adequate amount of financial resources will be set aside?
- How can it be assured that the financial resources (funds set aside) will be managed in a way that the financial resources are available at the time when needed:
  - after the permanent shut down at the end of the planned lifetime or
  - after an earlier shut down induced by an incident or accident during the planned lifetime?
- How can it be prevented that the financial resources set aside for the decommissioning are used for other purposes than for decommissioning?
- How can “decommissioning” be prudently organised/structured, which means to assure the fulfilment of the key objective of citizen’s health and safety and thereby leaving sufficient decision-making ability to entrepreneurial operators of nuclear installations?

In order to achieve the objective of decommissioning, different “decommissioning funds methodologies” have evolved and are applied throughout Europe. The adequacy of different methods relating to the objective of decommissioning is the core of the governance perspective. In other words: How stringent are the different methods in the context of the temptation and the possibility not to set aside adequate financial resources and/or to use the financial resources set aside for other purposes.

To understand these concerns first the roots of a possible use for other purposes or a possible renouncement of setting aside provisions will be described; after this the different methodologies will be assessed in the context of the governance perspective.

4.2.3 Roots of conflicts

The operators of a nuclear installation assume, besides the responsibility for a safe operation, the responsibility for the financial balance and success. The pressure of achieving financial objectives (benchmarks) will grow in line with the ongoing deregulation, which on its side will further intensify the competition (cf. Chapter 2 in IAEA 2006).

4.2.3.1 Operators: Conflicting use of financial resources

The main source of financial funds (cash inflows) of nuclear power plant operators is

- Net sales/revenues received by the sale of energy.

It is generally assumed that the revenues will flow on a stable basis until the end of operation (however, this assumption could be questioned in line with an increasing

degree of market deregulation). It is, only for the explanation of all financial purposes, further assumed that there will be no accident driven shut down during the lifetime. The accident case will be described in a separate chapter.

The main root lies in the conflicting use of financial resources. Operators of a nuclear installation like a nuclear power plant not only need and use financial resources for the accumulation of decommissioning funds but also for many other purposes. Operators have also to incur expenses. Not all expenses constitute a direct cash outflow. In general, expenses occur for the following main purposes:

- Current costs (including maintenance, administration, salaries, nuclear fuel elements, insurance, material and services purchased, others);
- Depreciation of the nuclear power plant;
- To set aside and accumulate decommissioning funds in line with cost calculations and the guaranteed requirements within the limits of the licensing procedure;
- Taxes
- Interest and dividends (for private companies)

Moreover, operators have to use (allocate) financial resources for

- investments (capital expenditures) to renew the nuclear power plant (in order to maintain the operating license or to expand the lifetime) and
- to redeem debt.

4.2.3.2 Inverse investment pattern

Entrepreneurs who want to implement a specific strategy have to finance this strategy. Hence they have to convince the capital markets to provide financial means (be it equity or debt). Financial markets are though referees as they diligently assess and analyse a strategy before financing it. Through this process, a disciplinary effect is imposed to managers.

Now, if an enterprise such as an operator of a nuclear power plant accumulates substantial amounts of financial resources, which are only used in the distant future (time horizon of up to forty or more years), it could be tempted to use these financial resources to finance strategies (e.g. acquisitions, investment in business segments not fitting to the overall strategy, etc.), which would not pass the stringent control of capital markets.

The availability and the power of authority of decommissioning means of finance therefore constitute a considerable strategic risk of investing in possibly value decreasing strategies. Thus, the governance perspective should not only care about the risk of not disposing of financial resources for decommissioning at the time when needed but also at not giving wrong strategic incentives to operators. There is a similar strategic risk for governments (see 4.2.3.5).

In a positive economic environment, cash inflows will be sufficient to meet all present and future cash requirements/outflows. However, in a negative/unfavourable economic environment, cash outflows can be higher than inflows. Operators can quickly find themselves in conflicts of interest as they are, in such a situation, compelled to decide how to use the scarce financial resources (or to tap the capital markets).

Such conflicts force them, in the financial and economic interest of their enterprise, to ponder different conflicting objectives and measures. Conflicting objectives could arise between the accumulation of decommissioning funds and the redemption of debt or renewal investments (capital expenditures).

If banks and bondholders urge redemption of debt in a period where the cash inflows are insufficient, the management could be tempted to defer the feeding of decommissioning funds (which would lead to an under funded situation) or even to use the existing decommissioning funds (if they have the power of authority) as financing source. Or, an operator could, based on economic difficulties, be forced to require an extension of the lifetime of his plant in order to prolong the cash inflow period. If, in such a case, the licensing authorities push for a huge renewal program, the same temptation of deferring decommissioning duties could emerge.

Or, there could arise a conflict between setting aside decommissioning provisions or paying out dividends to shareholders. In such a situation, the prudence principle would require that dividend payments should only be allowed if and when all necessary decommissioning provisions are built (cf. KPMG/NRG 2006, p.50).

As the increasing competition (on market shares) among nuclear energy providers and nuclear energy providers and providers of other energy sources is likely to increase, the need to cut the energy price could emerge. Decommissioning is part of the operating costs and thus also has an impact on the level of energy prices that can be offered to clients. This could lead to a conflict between feeding decommissioning funds and cutting the energy prices in order to maintain market shares. What should an operator, in an increasingly competitive environment and under increasing investor pressure, decide if he/she feels that the yield of an enlargement /renewal investment is higher than the performance of the fund.

The roots of conflicting interests not only are conflicting uses of cash flows. They also arise in cases where an under funded situation already exists. In such a situation, enormous pressure could be imposed on decision makers to postpone decommissioning. It is more likely than not that under funded situations accrue because only part of decommissioning costs being accounted for (compare country reports; e.g. UK where the scope of the segregated fund, NLF, did not cover all stages of decommissioning) and because of the cost estimates and calculations remaining extremely difficult as long as the technical, political and industrial solution for final nuclear waste disposal is not generally accepted (more see chapter on the accounting perspective).

A big responsibility is imposed to external certified auditors in the context of the correct amount of funds set aside. However, they verify if the calculations are in line with the

stipulated principles, they are not able to verify the accuracy of existing assumptions and cost calculations models. The audit reports on the adequacy and availability of financial resources always have to be read with this qualification in mind.

4.2.3.3 Transfer of liabilities in case of change in ownership or bankruptcy of an entity

The discussion on adequacy and availability of decommissioning funds must also contain the question of what happens in the case of a change in ownership or bankruptcy of an entity.

It must be prevented that the responsibility for decommissioning is separated from the nuclear power plant owner through a change in ownership (cf. country report Germany, Chapter 3.3: Fall-back option and transfer of ownership). Therefore, it must also be assured that, in the case of a change of ownership or bankruptcy, all decommissioning liabilities are transferred to a new owner or that the liabilities are secured by other measures.

Very high attention has to be paid to this problem in the case of internal funds. The question is if an internal fund can be sufficiently secure given the assumption that there exists a risk of bankruptcy for all companies over a period of at least 60 years, which is a minimum operating life and time to complete decommissioning.

In no case a situation should evolve where no financially sound/solvent legal entity remains responsible for the liabilities or where the beneficiaries cannot claim the assets set aside for decommissioning.

4.2.3.4 Conflicting interests and stakeholders

The degree of conflict and the possible management decision depend on the position of power of involved stakeholders. The measure or solution the operators will be inclined to realise/implement is co-driven by the behaviour and position of power of the concerned stakeholders. Which of the stakeholders disposes of the best degree of organisation in order to exert the most direct and strongest influence (power)? It can be assumed that debtors (banks, bondholders) have, based on direct contractual relations, a stronger position to achieve redemption than citizens (or even more importantly future generations), who are interested in adequate decommissioning funds, but who have not a direct written contract with the operators.

Table 11: Flows of funds and involved/concerned stakeholders (operators)

Source of Funds	**Stakeholder**
Net sales/revenue received by the sale of energy	Client, Operator
Use of Funds	**Stakeholder**
Current operating costs	Employees, Suppliers, Auditors
Depreciation	Owner, Operator, Auditors
Decommissioning Funds	Citizens, Public, Competitors (not NPP, other energy producers), Auditors
Taxes	Government, Public
Interests	Debtors (Banks, Bondholders)
Dividends	Owner, Investors
Investments (capital expenditures)	Owner, Operator, Clients, Citizens (safety aspect)
Redemption of Debt	Debtors (Banks, Bondholders)

4.2.3.5 Governments: Conflicting use of financial resources

There also exist conflicting interests to which, in particular, governmental authorities managing decommissioning funds are exposed to.

Both, public and private operators, encounter the problem of possibly conflicting use of scarce financial resources. The country reports contain different examples where decommissioning funds, managed by governmental authorities, have been used for other than exclusively for decommissioning purposes (cf. country report UK). However, in the case of private operators, it is clear that they have imperatively to set aside provisions during the operating period (lifetime). The financial resources have to be available when the facility is shot down.

Contrary to this, public owners can abstain from building up provisions and pay all decommissioning costs from the current budgets (examples: Germany or to a huge extent UK NDA). This approach embodies a strategic risk (cf. the analysis of strategic risk of private operators in chapter 4.2.3.2).

Governments, respectively public owners, who do not build up provisions but prefer to pay decommissioning from their current budget, are tempted to use the financial resources for other purposes, where they expect higher social and political benefits. The UK government argues that it is not reasonable to put money in a segregated fund, because the social benefits of using this money for other public projects in the meantime (e.g. health) might be higher (cf. country report UK). This view embodies a strategic risk, not only because the evaluation of the benefits is difficult, but more importantly because decommissioning has to be paid some day. If there will not be an adequate

amount of financial means set aside, a budget conflict can evolve, all the more most governments carry already today a huge debt burden.

Paying decommissioning costs from current budgets means that the polluter pays principle is overruled/suspended. In other words: those benefiting today from nuclear energy produced and creating decommissioning obligations do not have to pay all costs related to the production of nuclear energy. This hurts the principle of the intergenerational justice and restricts autonomy of action of future generations because they will be compelled to first pay open bills from their parents before being able to plan and implement their own strategies (cf. also chapter 4.3.6).

4.2.3.6 Dual system in one market

So far the comments have been made relating to one methodology of providing for future decommissioning costs or the comparison among different methodologies. However, a very important aspect of the assessment is the fact, that in the European market, and even within one country, some operators of nuclear facilities have to set up provisions while others are not affected by such a requirement. For example, in the UK, private operators are obliged to set aside decommissioning funds whereas public operators can pay decommissioning costs form the current budget.

Such principal differences mean an economic disadvantage for private operators in the liberalised market competing with public licensees, which becomes evident in the course of privatisation or preparation for possible privatisation of public operators as it can be seen in France and in some of the new Member States.

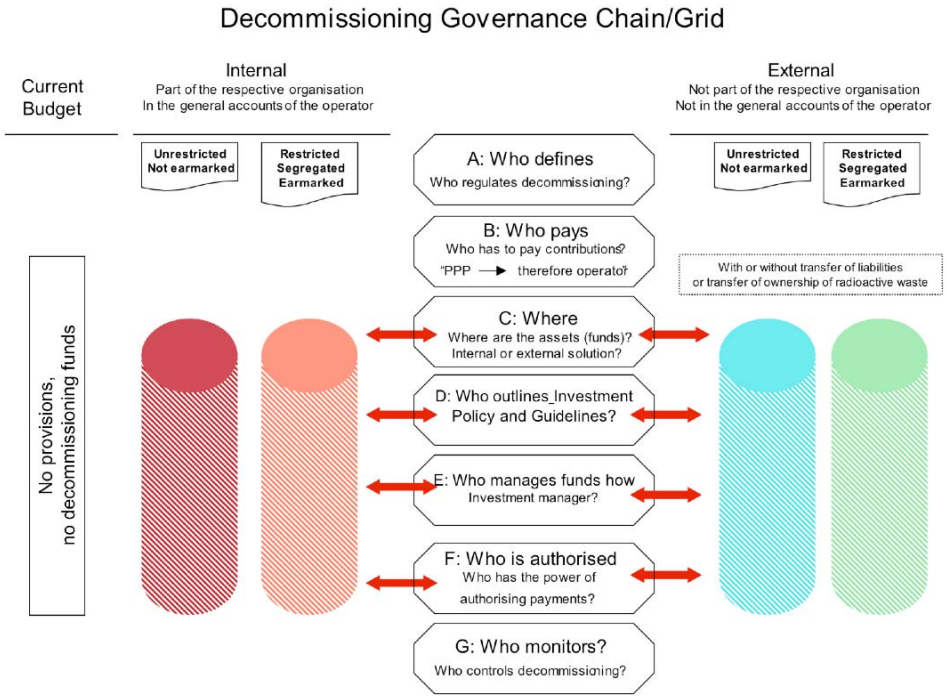
Furthermore, the existence of such a dual system in the European market can become a threat to the decommissioning objective because wrong incentives are set. If decommissioning funds of private operators are under funded, responsible boards/committees (national energy policy) could be tempted to shift private decommissioning liabilities to a public entity and thereby eliminating the imminent financing gap. However, this would not solve the problem, it would only postpone it.

4.2.4 Different Decommissioning Funding Methodologies

4.2.4.1 The Governance Chain of Decommissioning Funding Methodologies

The five basic decommissioning funding methodologies identified in Chapter 3.3 can be classified/analysed according to seven key components, which govern decommissioning funding methodologies. These seven components are illustrated in the decommissioning governance chain in the table below. The governance chain (vertical reading of the table) contains the seven components where, in each part of the chain, and between different parts, governance aspects are embedded. The governance grid (horizontal reading of the table) illustrates that the single parts of the chain can be differently assessed according to internal and external funding methodologies.

Figure 2: Decommissioning governance chain



Source: Wuppertal Institute, et al., 2006: The governance chain contains seven basic components and five basic methodologies. Each basic methodology depicts a basic model, which can be supplemented by many different additional specifications, which are discussed in more detail in the chapters on the accounting, valuation and investment perspective. Typical examples would be the degree of transparency or the applied accounting treatment or the degree of independence of involved parties and others (also see chapter on "criteria for identifying typical financial schemes 3.3.1).

The first component [A] of the governance chain is the question of who defines or who regulates and monitors decommissioning (financing).

- In most cases, this task is assigned to public licensing authorities (government level).
- Key issues are:
  - The independence of the authority, which has to align different objectives from different stakeholders.
  - Independence criteria for executive employees of an authority. They should dispose of sufficient personal independence from the operators and, if the operators are public entities, from the government.

The second component [B] is the question of who is liable or who has to pay the decommissioning activities? Due to the "polluter pays principle" assumption, the operators of nuclear installations have to carry all decommissioning costs. They pay through a decommissioning funding system, which urges them to financially contribute to a designated decommissioning fund.

– This issue is not discussed in detail because the polluter pays principle is an underlying assumption.

The third component [C] is the entity, which holds the fund in its general accounts.

– Various methodologies are possible. The scope includes different solutions between internal unrestricted to external restricted .

– The issue is strongly linked to the sixth component (power of authorising payments for decommissioning).

The fourth component [D] is the question of who outlines the investment policy and the investment guidelines.

– This aspect will be discussed in more detail in the chapter on the investment perspective.

The fifth component [E] is the question of who manages the fund.

– This aspect will also be discussed in more detail in the chapter on the investment perspective.

– Key issue is: The degree of independence between the operators (as polluters and thus contributors to the funds) and the investment managers.

The sixth component [F] is the question of who disposes of the power of authorising payments for decommissioning.

– The key issue is: The degree of independence between the operators (as polluters and thus contributors to the funds), the fund management and the position disposing of the power of authorising payments.

– The conflict potential always remains with the entity that has access to the decommissioning funds (power of authority).

– If the operator disposes of the power of authority he could be tempted to defer payments in periods where the fund is underperforming (under funded).

– If the government disposes of the power of authority it could be tempted to defer payments in periods where it wishes to use the financial resources for other purposes (e.g. health, defence, agriculture etc.)

The seventh component [G] is the question of who monitors or controls decommissioning (financing) and who has the authority for sanctions in the case of non-compliance.

– The same considerations as for component (A) are relevant.

4.2.4.2 Restrictions and earmarking

The internal restricted and the external restricted decommissioning methodologies are characterised by restrictions imposed on the accumulation, management and use of financial means.

A restriction (earmark) imposed on a financial asset limits or directs the use of the financial assets for a clearly defined purpose (in the case of decommissioning for paying decommissioning costs and nothing else).

Earmarked assets have to be disclosed separately in the balance sheet. If there are restricted or earmarked decommissioning assets, the directors of the nuclear power plant or the fund manager act as trustees and they cannot independently decide to use it for other purposes.

However, earmarking alone doesn't effectively protect decommissioning funds (assets) from use for other purposes. Earmarking only increases transparency and elevates the barrier for alternative use. In addition, in case of misuse, it clarifies legal assessments in case of complaints (and facilitates prosecution) (cf. Chapter 4.3.5.8; gross or net presentation).

Fund assets have to be available at the time when needed. This implicates that the beneficiaries must be able, in all circumstances (change in ownership, bankruptcy and others), to legally claim the assets. This is not fully guaranteed just by earmarking. Additional restrictions/regulation is needed to ensure this.

4.2.5 The inherent conflict potential of different funding methodologies

4.2.5.1 Governance in general

The "governance" assessment of different decommissioning funding methodologies always has to be carried out from the perspective of achieving the necessary health and safety for citizens and the final objective of decommissioning, which is the release of a nuclear power plant from any nuclear restrictions.

Moreover, country specific aspects have to be taken into consideration (see country reports). For example, the assessment of an applied methodology also depends on the amount of nuclear entities in a country. A country with only one nuclear entity has, at least in some aspects, to be differently analysed than a country with thirty nuclear entities.

Basically, it can be said, that there is nothing like a one-and-only solution for decommissioning financing. In principle, a bundle of decommissioning solutions assuring the health and safety of citizens and being within the legal boundaries of a country are valid and can be applied. Within the legal boundaries means, that the solutions comply with all stipulations from relevant laws and regulations. Thereby, international and national laws and regulations are important (cf. Chapter 5 for relevant international regulations).

However, the governance debate goes beyond mere compliance with relevant regulations. A legalistic view hardly guarantees an efficient management of complex situations. Complex situations are characterised by many different risks. Governance contains legal aspects but also goes an important step further. It provides a balanced

and structured setup of a dependable system of checks and balances, which facilitates the risk management and contributes to achieving the key objectives of an entity.

The importance of governance in the context of decommissioning, which goes beyond mere compliance with existing laws and regulations, is similar to the well-known classical debate on corporate governance. There too, it could be (and it has been) argued that a strict application of laws and regulations is sufficient. However, the development in all countries worldwide has proven that a good governance system is key to a sustainable economic success of companies and their investors. All countries know many examples where insufficient checks and balances are a main reason for severe company failures going from crashes up to total breakdowns (losses). Examples are: the Swissair grounding; in Germany Flowtex, Holzmann, Vulkan, in France Vivendi, etc.

Therefore, almost all European countries and also international organisations such as the OECD (2004) have developed Codes of Best Governance Practice aiming at enforcing confidence in the well functioning of the market economy. These codes focus on and give recommendations for questions such: How can transparency be improved, how can an equal treatment of shareholders be achieved, how can the exercise of shareholders right be improved, how can the interests of different stakeholders (mainly shareholders and managers) be aligned, how can the organisational structure be optimised, how can independence be assured, which are appropriate control mechanisms and which behaviour is recommendable in cases of conflicts of interest?

Such recommendations are a typical case of soft legislation (non-binding principles). By giving guidance and suggestions, they indicate the way to best practice without creating new and possibly inefficient regulations.

4.2.5.2 Governance and decommissioning in particular

Different strengths and weaknesses can be attributed to internal and external decommissioning methodologies. Almost all weaknesses of specific funding systems are linked to the degree of the conflicts of interests potential. Conflicts of interests do not automatically disqualify a solution. But it necessitates accompanying control measures in order to prevent negative effects stemming from conflicts of interests or, in the governance language, “checks and balances” have to be established.

As a general rule, it can be said that the higher the conflict of interests potential linked to a decommissioning methodology, the higher the need for additional checks and balances measures or measures which assure good decommissioning practice by providing appropriate fences (as risk reducers).

Given the many conflicts of interests embedded in decommissioning and the importance of the health and safety aspect over a long time horizon, it is advisable to recommend best practice of decommissioning financing, which goes beyond mere legal compliance. Important aspects, which could require recommendations, are very similar to the above-mentioned aspects of governance:

- How to improve transparency?
- How to assure independence?
- How to deal with conflicts of interests?
- How to deal with uncertainty (unexpected situations)?
- What are the appropriate control measures („fences“)?

The governance analysis depicts that internal and external methodologies need additional selected checks and balances measures. One key issue in decommissioning (cf. Chapter 4.2.2) is the question of how to prudently organise “decommissioning”, which means to assure the fulfilment of the key objective of citizen’s safety and thereby leaving sufficient decision-making ability to entrepreneurial operators of nuclear installations. Therefore, it should strive for solutions with a minimum of necessary additional measures. All additional measures cause additional costs and carry the inherent risk of inefficiency. Any control measure, which could be avoided, should be avoided. In principle, external approaches reduce the need of additional measures of checks and balances.

4.2.5.3 Governance and competition

The main focus of this report is the aspect of citizens’ health and safety and not the question of how different methodologies affect competition. However, driven by liberalisation and privatisation, the framework of competition in the nuclear energy industry is changing, and therefore, some remarks regarding the impact on competition have to be made. Three issues are relevant:

- First, competition is always a source of possible conflicts of interests (see 4.2.3.1 and 4.2.3.2).
- Second, any impact on competition by differences in decommissioning financing methodologies applied in different countries should be avoided because this could lead to pressure to compromise safety in order to raise competitiveness of a country’s energy industry. The applied decommissioning regime affects the cost structure of the nuclear facility and thus, also affects the competitiveness of an operator in the liberalised energy market. In particular, all reductions in safety in order to gain market shares and monetary benefits have to be prevented. Countries can also influence the competitiveness of their private nuclear energy industry through split of liabilities between the public and the private organisations, with dual decommissioning financing systems in place (cf. Chapter 4.2.3.6). Here, full transparency should be required.
- And finally, the third reason to discuss governance and competition is the fact, that governments as public operators tend to pay decommissioning from the current budget (for example, in Germany, or NDA in UK). An economic environment, which requires private operators to set aside decommissioning funds and, at the same time, allows public operators to pay later through the current budgets, clearly dis-

advantages private operators, at least in those areas in which both are competing with each other (cf. Chapter 4.2.3.6).

4.2.5.4 In the case of an incident or accident or other cases of early shutdown

In chapter 4.2.1.3, the inverse investment pattern has been described as a driver for conflicts of interests. A report of the Nuclear Energy Institute in the US describes this as the construction in reverse (NEI 2002).

Given the safety and health imperative, it is advisable that all financial resources for decommissioning (or at least guarantees for the availability of these resources) should be already available at the initial commissioning of a nuclear power plant (cf. Finland: the condition for giving the first operating licence is that the decommissioning and waste management financial liability is fully covered (100%) by securities at the start-up moment). This is all the more important as decommissioning has to be executed in the case of an incident or accident that induces an early shutdown of the plant.

The financial risks related to a major incident or accident or other event that leads to an early shutdown of the plant are that, at the occurrence of such an event, not all liabilities are covered (under funded situation) and the flow of contributions will cease. However, the process of decommissioning has to start immediately. In order to assure health and safety in such a critical period, a financial source must be available to bridge the financial gap induced to an early shutdown.

Another risk should be mentioned when analysing the case of a major incident or accident: the political consequences should not be ignored. They could lead to a total revaluation of the nuclear industry or to more stringent regulations and thus higher decommissioning costs.

4.2.6 Conclusions from the governance perspective

4.2.6.1 Criteria for choosing a preferred decommissioning financing solution from the governance perspective

The objective of this part of the study on “Comparison among different decommissioning methodologies” is to analyse and assess financial risks relating to the various methods to set aside and manage financial resources for decommissioning purposes and, and based upon the analysis, to propose feasible steps of optimising decommissioning funding methodologies. The ideal outcome would be to identify a preferred methodology.

However, a perfect solution doesn’t which can be recommended to all countries and facilities. The shortcomings of the current budget methodology have been clearly described in chapter 4.2.3.6 and chapter 4.2.5.3. Therefore, the current budget methodology is not regarded to be an appropriate solution. The different internal and external methodologies have their specific strengths and weaknesses. In chapter 4.2.4.1, it has

been explained that basically a bundle of internal and external solutions exists that could be applied. Therefore, it will be difficult to develop a recommendation, which embraces all critical aspects or, which differentiates between acceptable and unacceptable decommissioning funding solutions.

However, what can be done is to define important criteria characterising a preferred solution. Such a solution should preferably

- aim at reducing any possible situation where financial funds obtained by the operator can be used for different purposes (multi-purpose application), and thus aim at reducing any possible situation where financial funds for decommissioning can slip in a conflicting relation with other financing purposes. This means that decommissioning funds should preferably not be in the general accounts of operators, be they private or governmental authorities (cf. KPMG/NRG 2006, p. 63: Funds assets should be separate or legally separated from other assets and liabilities);
- avoid situations where decommissioning funds remain in the general accounts, because this can become critical in the context of securing decommissioning funds under a long term perspective;
- focus on the independence of involved parties (operator, fund management, authorities; in other words, between all members of the governance chain (A to G));
- avoid situations where the operator has the power of authority to dispose of the decommissioning funds. Such solutions can become critical in the context of securing decommissioning funds under a long term perspective;

Conflicts of interests exist for internal as well as for external decommissioning funding methodologies and for private operators as well as for public operators. However, it can be said that those sharing the responsibility in the context of internal systems are faced with more sources of possible conflicts of interest than those in external regimes. Accordingly, it can be said that the need for additional “checks and balances” measures (fences) 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.

An improvement of the decommissioning problem will not be found by proposing a one-and-only preferable solution. First, it will be difficult to reach acceptance of such a proposed preferred decommissioning financing methodology. Second, some countries are satisfied with their applied decommissioning financing methodology and wish not to change anything and fear that the development of new guidance could impair the actual national systems. Moreover, various countries do not seem to wish the decommissioning issue to be solved on a European level. A realistic perspective therefore leads to the conclusion that internal as external decommissioning methodologies will be continuously applied. However, an improvement will not be found predominantly by switch-

ing from one principle scheme to another but first and foremost on the level of generally agreed and monitored principles and additional measures (“risk reducers”, “fences”) reducing the conflict potential of decommissioning financing methodologies.

4.2.6.2 Public oversight board

In addition, 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 and have the purpose of enabling most decommissioning methodologies. Moreover, the board or committee could propose methodology-specific additional measures (fences). This will be further discussed in Chapter 6.3.2 and Chapter 6.4.3.

4.3 Accounting Perspective

4.3.1 Overriding Perspective

The accounting perspective is an overriding perspective. The comments on accounting are relevant for the discussion of all other perspectives (governance, investment and valuation perspective) because accounting provides the basic information needed to make any decision or assessment. Without valuable information no reliable assessment can be made. Accounting plays a major role in increasing transparency.

The application of different accounting approaches hampers a valuable comparison of the applied decommissioning financing systems.

The “country reports” in the appendix to this final report and previous chapters of this study describe the many uncertainties, which are embedded in estimating future decommissioning costs. Different ways how to estimate these future costs can lead to not fully comparable amounts of provisions.

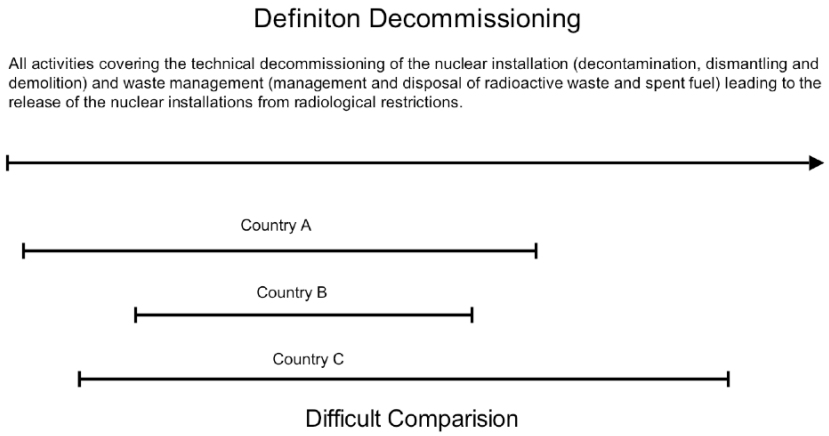
The “country reports” also reveal that, on the one hand, different accounting principles are applied and that, on the other hand, the data availability differs and is partly insufficient.

Starting from the definition of “decommissioning” it is almost impossible (or only with an enormous input of time resources which is an inefficient exercise) to compare and assess the financial risks and consequences of the applied decommissioning funding systems in all European countries.

Three main problems exist:

- The definition in each country only covers a specific, in most cases a limited range of decommissioning activities. Such an environment favours the emerging of under funded situations.
- In addition, even provisions for the same range are not comparable as they are based on country specific accounting treatments.
- And third, the basis (assumptions) of cost calculation is not always disclosed.

Figure 3: Difficult comparisons between countries



Source: Wuppertal Institute, et al., 2006

There is not always sufficient information available on the underlying accounting principles applied in the different countries, and the data are neither reliably comparable nor consistent and there is a lack of transparency. Such an accounting environment can lead to substantial misinterpretations and errors in judgement.

- Example: If one has to compare an externally managed decommissioning fund in country A with an internally managed decommissioning fund in country B, they might be inclined to prefer the external solution, because they put a significant weight on inherent governance risks linked to internal funds. However, if the external decommissioning fund were under funded because it has not been appropriately accounted for the provisions (not all cost elements are recognised) whereas the internal fund is appropriately funded the choice could possibly be in favour of the internal fund.
- Another example would be: If not all cost elements are recognised, an enterprise (nuclear operator) doesn't account for all debt, and provisions are debt. In this

case, the enterprise doesn't disclose a true and fair view of the financial position and performance. Consequently, the misled investors would overestimate the financial value. This aggravates and complicates the decision of investors in an unacceptable way. Investors would pay a too high price for a stake in the enterprise. (The shareholder value concept will be explained and discussed in more detail in the valuation chapter).

The question of valuation and credit ranking is important as many equity research publications from financial institutions reveal. The unsatisfactory and inadequate accounting environment and the missing reliability and thus comparability of information in many cases, documented in the country reports in the appendix to this final report, urge the equity research institutions to describe their accounting assumptions before they are up to explain and comment their findings. Special efforts have to be undertaken to value and compare decommissioning provisions. Such efforts are usually not necessary in other industries such as the chemical or airline industry or others where analysts and investors can rely and resort to accepted principles.

- Example: FitchRatings report by Shnaps/Monnier/Steel (2005):
  - „Generally, published accounts do not provide adequate detail on how these estimated costs are calculated. For instance, to what degree do they make allowances for future efficiency improvements due to technological innovation? … To make a useful comparison between operators' spent fuel provisions, further detailed information is needed, which is not always included in published company reports." (p.5)
  - „Long-term spent fuel storage is harder to estimate due to lack of experience, available storage capacity and definitive government policy." (p.5)

4.3.2 EU-Directives or IFRS®: Striving towards Harmonisation

It is important to work towards a harmonisation of applied accounting principles. This leads to the question: which "principles"? Different sets of accounting standards exist which all treat the key issues linked with "decommissioning activities". Therefore, it is neither advisable nor necessary to develop specific "Generally Accepted Nuclear Decommissioning Principles". The complexity linked to the underlying assumptions for measuring decommissioning provisions should not be amplified by special accounting principles.

What is paramount is to commit oneself to an existing set of "generally accepted accounting principles" and to add, where vital, clarifications.

It is not a component of this report to propose a specific set of accounting standards. However, it is imperative to underline that a reliable assessment of decommissioning funding methodologies can only be achieved by the means of a single set of accounting principles.

Basically, two accounting systems (single set of accounting standards) could be considered for European companies:

- 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 referred to in this report as 4th and 7th EU-Directives) or
- the International Financial Reporting Standards IFRSs®. These include International Accounting Standards (IASs™) and interpretations as at 1 January 2006. For the purpose of this report it is referred to as IFRSs®.

Two specific reasons speak in favour of IFRSs®.

- First reason: After a diligent and comprehensive process, the EU has adopted IFRSs® for quoted companies, applicable from the year 2005 onwards.
- Second reason: The report also treats the valuation perspective from an investor's (shareholders) point of view. Various quoted companies fully own or have shares in companies owning nuclear facilities, which implies the application of the IFRSs® logic.

This report will argue based on the IFRSs® logic. However, this should not be regarded as an anticipation of the accounting system that will be finally chosen. Both would be appropriate under the condition that they are strictly applied (including auditing).

The above mentioned report by Shnaps/Monnier/Steel (2005) supports this view: „The recent move towards IFRS accounting should allow for closer comparison as previously the operators were reporting under different accounting standards." (p.6)

4.3.3 Generally Accepted Accounting Principles (GAAP)

4.3.3.1 Accounting Framework

This section describes selected key issues and elements of "generally accepted accounting principles (GAAP)" whereas the next section will particularly treat the key issues linked to "decommissioning accounting". The meaning of accounting frameworks always is profoundly underestimated. For a detailed analysis and a deeper understanding of accounting frameworks it is recommended to consult the IFRSs® 2006 bound volume. The following description shall introduce, in few words, into the logic of accounting frameworks.

Accounting frameworks consist of different parts, which are arranged in a pyramid hierarchy. On the top, there 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 interpretation of information provided by an accounting system should only be used in the spirit of the accounting framework. All specific standards of an accounting

system are derived from the principle philosophy and logic given in the framework. If discussions arise about the meaning of a specific standard, the solution always has to be found according to the spirit of the framework.

4.3.3.2 Objective of GAAP

Within the IFRSs® Framework, the objective of accounting is recorded as follows:

"The objective of financial statements is to provide information about the financial position, performance and changes in financial position of an entity that is useful to a wide range of users. Users include present and potential investors, employees, lenders, suppliers and other creditors, customers, governments and their agencies and the public" (IFRSs® Framework, par. 12).

4.3.3.3 Underlying Assumptions of GAAP

The target of IFRSs® (and all other accounting principles) is based on two underlying assumptions, the accrual basis and the going concern:

- The accrual basis says *that transactions and other events are recognised when they occur and not when cash or cash equivalent is received or paid and that they are recorded in periods to which they relate* (IFRSs® Framework, par. 22).
- The going concern assumption means *that an entity will normally continue in operation* (IFRSs® Framework, par. 23).

4.3.3.4 Qualitative Characteristics of GAAP

Moreover, the framework defines the attributes that make information useful to users. These attributes are termed "qualitative characteristics". The IFRSs® Framework accentuates, besides others, *"understandability, relevance, reliability, comparability and constraints on relevant and reliable information*" as lead qualitative characteristics (IFRSs® Framework, par. 24-45).

It is assumed that information must meet these criteria in order to be useful for decision makers.

4.3.3.5 True and fair view (fair presentation)

The application of the principal qualitative characteristics and appropriate accounting standards normally results in financial statements, which present a "true and fair view". *True and fair view means that the financial position, the performance and changes in financial position of an entity are fairly presented* (IFRSs® Framework, par. 46).

4.3.3.6 Elements of GAAP

The next important parts of the framework are the “elements” of financial statements. Accounting groups broad classes according to their economic characteristics. These broad classes are termed “elements” (IFRSs® Framework, par. 47-80).

Elements in the Balance Sheet (related to financial position) are:

- Assets;
- Liabilities and
- Equity.

The elements in the Income Statement (related to the performance) are

- Income and
- Expenses.

4.3.3.7 Recognition, Measurement and Disclosure

As a last step, frameworks have to define when a financial item meets the definition of an element.

According to IFRSs®, *“recognition is the process of incorporating in the balance sheet or income statement an item that meets the definition of an element and satisfies the criteria for recognition”* (IFRSs® Framework, par. 82). *An item should be recognised if it is probable that any future economic benefit associated with the item will flow to or from the entity and the item has a cost or value that can be measured with reliability* (IFRSs® Framework, par. 83).

According to IFRSs®, “measurement” *is the process of determining the monetary amounts at which elements of the financial statements are to be recognised and carried in the balance sheet or income statement* (IFRSs® Framework, par. 99).

It is evident, that comparability and reliability of cost calculations can only be achieved when, in all cases, the same items are recognised and measured according to the same principles.

Finally, accounting standards also lay down which information has to be disclosed.

4.3.4 Accounting standards and decommissioning financing methodologies

The main blocks of accounting frameworks have been described in the previous chapter. This section investigates the interface between decommissioning and accounting.

One key issue in the comparison among different decommissioning financing methodologies is the question of the adequate amount of funds (assets) and provisions. Both depend on the recognised and measured costs linked to decommissioning.

Therefore, from the decommissioning perspective, the following questions have to be diligently analysed:

- Which cost items (based on cost calculations) should be recognised as costs and how, if recognised, should they be measured;
- From the accounting angle, it has to be analysed which are the relevant accounting standards for decommissioning activities.
- The accrual basis says that transactions *are recognised when they occur and that they are recorded in periods to which they relate* (IFRSs® Framework, par. 22). This leads to the question: to which point in time is the building of provisions justified?
  - Some argue that the creation of provisions, and thus funds, need not to start in the first year.
  - Others argue that the creation should start at the same moment as the nuclear power plant has been commissioned because of the nuclear plant being contaminated once the nuclear fission is initiated for the first time (DresdnerKleinwortWassersteinResearch).
  - The accrual assumption clearly speaks for the second position, at least for all demolition and dismantling costs.
  - As an example, in Finland the condition for giving the first operating licence is that the decommissioning and waste management financial liability is fully covered (100%) by securities at the start-up moment.
  - As an example, in France (Court of Accounts) it is argued that, in the case of dismantling, the start-up of the facility triggers the obligation, while in the case of spent fuel and waste management obligations they are triggered by the productive activity, shares a similar view (country report France p. 35: CDC 2005).
- Is the going concern assumption feasible given the fact of limited life of a nuclear power plant?
  - Here it can be argued that yes, because in case of an accident the valuation of assets would undergo the immediate impairment test of assets and thus, the devaluation would be reflected in the balance sheet through lower asset values.

4.3.5 Relevant elements in the context of decommissioning

4.3.5.1 Cost Items

The identification of cost items that should be recognised has to be derived from the definition of “decommissioning” and the underlying “polluter pays principle” assumption:

- “All activities covering the technical decommissioning of the nuclear installation (decontamination, dismantling and demolition) and waste management (manage-

ment and disposal of radioactive waste and spent fuel) leading to the release of the nuclear installations from radiological restrictions."

Based on this definition, the accounting perspective alludes to a comprehensive coverage of cost items, including future waste management costs. The underlying assumption of the polluter pays principle depicts, that the costs have to be recognised in the books of the operators of nuclear installations (polluters).

Also see chapter 3.1.4 where the eleven cost items according to the "Proposed Standardised List of Items for Costing Purposes on Decommissioning of Nuclear Installations", published by NEA/IAEA/EC are described.

4.3.5.2 Selected Standards Relating to the Balance Sheet

The following list is neither comprehensive nor does it constitute an authoritative opinion on the final application in the context of decommissioning. The list aims at highlighting which elements and standards of the IFRSs® 2006 bound volume are important and where accounting and how accounting can provide support for comparable and reliable information on decommissioning methodologies.

Liabilities:

- Provisions (IAS 37)
- Constructive Obligations (IAS 37
- Contingent Liabilities (IAS 37)

Assets:

- Property, Plant, Equipment (IAS 16) which includes depreciation
- Impairment of Assets (IAS 36)
- Contingent Assets (IAS 37)
- Rights to Interests arising from Decommissioning, Restoration and Environmental Rehabilitation Funds (IFRIC 5). (IFRIC is the International Financial Reporting Interpretations Committee of IASB, which provides timely guidance on newly, identified issues not specifically addressed in existing IFRSs®.)

Equity (consolidation method)

- Investments in Associates (IAS 28).

Not all standards will be explained in detail. However, a closer look at the treatment of provisions in IAS 37 points out the usefulness of accounting standards in the context of decommissioning.

4.3.5.3 Decommissioning costs constitute a liability

Decommissioning costs constitute a liability as they are *a present obligation of an operator arising from past events, the settlement of which is expected to result in an out-*

flow from the entity of resources embodying economic benefits (compare: IFRSs® 2006, IAS 37, par. 10). IAS 37, par. 10 defines provisions as liabilities *of uncertain timing or amount* and IAS 37 differentiates between legal and constructive obligations and contingent liabilities.

IAS 37, par. 14: **Provision** shall be recognised when:

- *an entity has a present obligation (legal or constructive) as a result of past events;*
- *it is probable that an outflow of resources embodying economic benefits will be required to settle the obligation; and*
- *a reliable estimate can be made of the amount of the obligation.*

IAS 37, par. 10: A **constructive obligation** is an obligation that derives from an entity's actions where:

- *by an established pattern of past practice, published policies or a sufficiently specific current statement, the entity has indicated to other parties that it will accept certain responsibilities; and*
- *as a result, the entity has created a valid expectation on the part of those other parties that it will discharge those responsibilities.*

IAS 37, par. 10: A **contingent liability** is:

- *A possible obligation that arises from past events and whose existence will be confirmed only by the occurrence or non-occurrence of one or more uncertain future events not wholly within the control of the entity; or*
- *a present obligation that arises from past events but is not recognised because:*
  - *It is not probable that an outflow of resources embodying economic benefits will be required to settle the obligation; or...*
  - *the amount of the obligation cannot be measured with sufficient reliability*.
- IAS 37, par. 27: *An entity shall not recognise a contingent liability.*

It seems to be evident that operators of nuclear installations have present obligations as a result of past events, which will lead to cash outflows. Moreover, it can be argued that based on licensing requirements (regulators, conditions to obtain the license) and the applied communication of operators (message towards citizens relating to the health and safety policy), operators are faced with constructive obligations, which have to be recognised as provisions.

The case of contingent liabilities is also a typical pattern that fits to the operations of a nuclear facility, as various amounts of obligations cannot be measured with sufficient reliability (interface between intermediate storage and final waste disposal).

4.3.5.4 Assessment of IAS 37

The discussion of key elements of IAS 37 exemplifies that accounting has convincing answers to the problem of treating decommissioning activities. However, gaps remain, which should be pinpointed.

IFRSs® define provisions as liabilities of uncertain timing and amount which should be recognised when, and only when an entity has a present obligation (legal or constructive) as a result of past events, it is probable that an outflow of resources embodying economic benefits will be required to settle the obligation and a reliable estimate can be made of the amount of the obligation.

This definition of provisions leaves room for different interpretations and applications in the context of decommissioning activities because of the costs of the final waste disposal remaining unclear as long as ultimate waste disposal is not definitively arranged (uncertainties as to the political, technical and industrial solution which will be chosen). For the same reason, the time period of intermediate storage also is uncertain, again leading to difficulties in estimating costs and attributing probabilities. Moreover, all cost calculations are based on a set of assumptions, which also leave room for discussions and interpretations.

Therefore, expressions such as “probable outflow, reliable estimate of the obligation, best estimate” can be interpreted in different ways leading to a situation where some operators recognise decommissioning obligations as liabilities and build up provisions in their accounts whereas others do not recognise it as liabilities and only disclose it as contingent liabilities (or a s a third way do not account for it).

Probable outflow means, in the IFRSs® logic, that the *event is more likely than not to occur* (IAS 37, par. 23). To exceed the more likely than not level, the probability has to be higher than 50%. Each probability debate can lead to diverging interpretations.

In contrast, the terms best and reliable estimate are less critical. Best estimate is the *amount that an operator would rationally pay to settle the obligation at the balance sheet day or to transfer it to a third party at that time* (IAS 37, par. 37). *A reliable estimate is only in extremely rare cases not be possible* (IAS 37, par. 26).

Therefore, a recommendation should contain the description of the mechanisms between intermediate storage and the final waste disposal in order to eliminate all possible latitude of judgement and to achieve a consistent application of recognising provisions. Such a clarification would mainly treat the interface between

- intermediate storage and final disposal of waste and
- provisions and contingent liabilities and
- legal and constructive obligations and
- the assumptions on which the cost calculations are based.

A clarification (amendment) should improve the reliability and comparability and eliminate the risk that a provision will not be recognised or only too late.

4.3.5.5 Covenants

Covenants are restrictions set on contracts and are enforceable. Examples might be that a contract between a bank and operator contains a covenant, which restricts the credit to specific criteria such as debt/equity ratio or others. If the criteria are not met any longer the credit has to be paid back immediately.

Covenants should be disclosed. They narrow the financing potential of an operator. This can lead to a possible conflict between building decommissioning funds and redeeming debt. Moreover, knowledge about covenants is imperative for investors if they want to reliably assess the risk.

4.3.5.6 Costs of future operations

Provisions are obligations based/derived from past events. However, not only costs based on past events but also costs of future operations (costs that only accrue when operations are continued) are a key element in funding systems.

However, these costs only occur when operations are continued. As soon as new fuel elements are used the additional decommissioning costs accrue and have to be recognised as provisions. In case of a stop of operations, no new fuel elements will be burnt and no additional costs accrue.

Future costs for decommissioning also are operative costs and therefore included in the estimates for future free cash flows (for more details see 4.4.1).

The theme is if an operator has the continuing ability to cover decommissioning costs of future operations or, if this is not given, he should discontinue operations. Key questions are:

- Is the operator financially sound in order to undergo incremental decommissioning costs;
- Does the (future) market environment allow to sell energy at prices which also allow to cover decommissioning costs;
- Do the disclosed financial information allow a reliable judgement of these questions?

The question if an operator can afford to continue or if he should, due to limited financial resources, rather stop operations, is in the first line a strategic question, which on her side can only be answered if a comprehensive transparency about the financial position and performance is given.

If an operator decides (or will be forced by authorities) to discontinue operations and not to incur additional future costs, the underlying “going concern” assumption will become invalid leading to an immediate revaluation of all assets.

4.3.5.7 Disclosure of liabilities

Operators should, either in the financial statements or in the annexes, disclose the following information:

- The decommissioning strategy (immediate, deferred or entombment), including the spent fuel and waste management and final disposal strategy assumed;
- provisions, constructive obligations and contingent liabilities
  - subdivided into provisions, constructive obligations and contingent liabilities for demolition, dismantling and waste disposal
  - and eventually subdivided into the respective amount of high, medium and low radioactive waste;
- the assumptions behind the cost calculations (discount rate, timing of future liabilities);
  - Dresdner Kleinwort Wasserstein Research consider the nuclear liabilities accounting assumptions to be too conservative (Buemi/Galaun 2005);
  - UK case: NDA aims at reducing the timescale for dismantling from 130 years after plant closure to 25 years. The amount of provisions considerably differs between assumed timescales of 130 or 25 years. Longer timescales considerably reduce the present value of liabilities (cf. UK Country Report).
  - In Germany, there exists a software tool (NIS, see country report Germany p. 12ff.) for the estimation and calculation of dismantling costs. However, there is no need for operators to disclose the reasons for choosing a specific decommissioning strategy or specific assumptions on decommissioning costs. Substantial differences between single operators can exist because they use different assumptions (see country report Germany p. 11 and p.44).
  - In France too, there is no public access to the underlying assumptions for the cost-calculations (cf. country report France p. 5 and 25ff).
- covenants.

This information is particularly important to all investors in order to receive a true and fair view of the financial position and performance. A fair valuation (more details in “valuation perspective”) can only be achieved when full transparency on the fair amounts of all types of liabilities is given. (The higher the liabilities the lower the value; this means that undisclosed liabilities tend to mislead investors).

4.3.5.8 Financial assets, decommissioning funds

In cases where an internal, but separated decommissioning funding methodology is applied, earmarked assets are carried on the asset side and the respective provisions are carried on the liability side of the balance sheet.

The question is if a gross presentation (total amount of provisions and total amount of funds) is reasonable or if the disclosure of the net position is advisable (only the difference between provisions and funds should be carried in the balance sheet).

Basically, it can be said that the prohibition of netting is an important accounting principle. However, in the case of decommissioning funds, the question if the funds meets the definition as financial asset, has first to be treated.

An asset is *"a resource controlled by the entity as a result of p*ast events and from which future economic benefits are expected to flow to the entity." (IFRSs® Framework, par. 49). Thereby, *the future economic benefit embodied in asset may flow to the entity in a number of ways, including settling a liability* (IFRSs® Framework, par. 55). From this point of view it can be argued that funds (respectively rights to receive reimbursements from a separated fund, BC2) meet the definition of an asset because they can be used to settle the liability.

In the context of the net presentation issue, IFRSs® uses as basis for conclusions (BC on IFRIC Interpretation 5) the analogy of decommissioning funds and pension funds. In the case of pension funds only the net position has to be disclosed whereas the gross presentation is prescribed in the case of decommissioning funds. IFRIC 5, BC8c: *It would not be appropriate to treat decommissioning funds as analogous to pension funds, which are presented net of the related liability.*

Instructive and interesting is that IFRSs® bases its arguments on the assumption of a possible use of funds for other purposes. If funds are used for other purposes, the liabilities remain and therefore the gross presentation is correct. IFRIC 5, BC8b: *Treating the decommissioning obligation as analogous to a financial liability would not result in derecognition through extinguishment. If the fund does not assume the obligation for decommissioning, the criteria in IAS 39 for derecognition of financial liabilities through extinguishment are not met. At best, the fund acts like an in-substance defeasance that does not qualify for derecognition of the liability*.

As a conclusion from this discussion can be drawn that a net presentation would possibly mislead investors and other decision takers as they might underestimate liabilities. A net presentation is only feasible if any kind of use of decommissioning funds for other than decommissioning purposes is excluded.

These arguments also support the comments made on earmarking in the chapter 4.2.4.2 (Governance Chain) where it has been argued that earmarking is not a solution to protect decommissioning funds.

4.3.5.9 Disclosure of assets (decommissioning funds)

Operators should, either in the financial statements or in the annexes, disclose the following information:

- Description of decommissioning funds,

  - applied methodology, rationale behind it;
  - accounting treatment;
  - description of the state (under funded, over funded);
  - strategy (what is the target level of decommissioning funds and how will it be financed);
  - governance structure (check and balances in the context of decommissioning funds;
- Depreciation policy;
- Investment policy (capital expenditures);

4.3.5.10 Transactions with related parties

Transactions with related parties are a normal feature of commerce and business (IAS 24, par. 5) However, they always are a delicate issue, mainly in cases where not all involved parties are independent in their decisions and where one party can exercise influence on another party. *The reason is that related parties may enter into transactions that unrelated parties would not (*IAS 24, par 6).

If the power of authority to dispose of funds is not fully separated from the contributor to the fund, rules for transactions with related parties will have to be implemented in order to ensure that the company owning the plant and being responsible for its decommissioning activities doesn't enter into transactions with its decommissioning unit, which might distort the performance (profit). A typical example would be lending of funds to a mother company at below market rates (cf. 4.5.7.5).

Two issues are relevant. One is pricing (measurement) and the other disclosure of transactions with related parties.

IAS 24 only focuses on the disclosure, measurement has been removed (IN7). According to IAS 24, par 9a, *„a party is related to an entity if: directly or indirectly through one or more intermediaries, the party:*

- *controls, is controlled by, or is under common control with, the entity*
- *(ii) has an interest in the entity that gives it significant influence over it or*
- *(iii) has joint control over the entity."*

Transactions with related parties should also be disclosed in the context of decommissioning in line with IAS 24, par. 12 to 22. They are an important component of overall transparency.

4.3.6 Accounting and public licensees (governments)

In chapter 4.2.3.5, the subject of conflicting use of financial resources for governments has been discussed, particularly for cases where governments pay decommissioning

costs from the current budget. It has been explained that paying decommissioning costs from current budgets overrules the polluter pays principle. However, this subject also has a link to accounting.

Expenditures and income have, in principle, to be recognised during the period when they occur (cf. accrual principle, 4.3.3.3 and 4.3.4). Governments paying from current budgets apply the cash principle, which has proven to be inappropriate.

Two tendencies are important:

- First, accounting tends to accrual accounting for all organisations be they private companies, non-profit organisations or governmental authorities/governments.
- Second, it can be observed that the growing competition is challenged by privatisation of public enterprises. However, enterprises can only be successfully privatised if they apply an accepted accounting standard, which are either EU-Directives or IFRS®. Finally, it should be mentioned that privatisation will be very difficult if no segregated funds for decommissioning are available.

4.3.7 Accounting and consolidation

4.3.7.1 Primary issue: Scope and method of consolidation

Consolidated figures are group figures. A group consists of a parent company and all its subsidiaries. Subsidiaries are enterprises, which are controlled by the parent (cf. IAS 27, par. 4).

The primary issues in consolidating enterprises are the scope and the method of consolidation. The scope and the methods of consolidation applied can materially influence the consolidated financial figures. According to the chosen method, certain data appear and certain data do not appear in the consolidated group accounts.

4.3.7.2 The scope of consolidation

The scope of consolidation indicates which enterprises are and which are not integrated into the consolidated group figures. It is impossible to correctly interpret group figures without knowing the scope of consolidation.

4.3.7.3 Consolidation methods

The method of consolidation configures how data from different enterprises (subsidiaries) in different countries are aggregated to produce group figures. For a useful analysis, the methods of consolidation must be known and it must be clear that all subsidiaries have applied uniform accounting policies for transactions and other events in similar circumstances (IAS 27, par. 28).

IFRSs® and other standards allow three different methods of consolidation depending on the percentage stake, which a parent company holds in a subsidiary: Full consolida-

tion, the method of equity consolidation or proportional consolidation. The standard procedures (IAS 27, par. 22ff) are:

Full consolidation

- Full consolidation is normally applied to all enterprises that are controlled by a parent enterprise. This means that, in practice, the parent enterprise owns or controls, directly or indirectly, 50% or more of voting rights. These enterprises are referred to as subsidiaries.
- Under full consolidation, the financial statements of the enterprises in the group are combined on a line-by-line basis by adding together items like assets, liabilities, equity, income and expenses. Interenterprise balances and interenterprise transactions are totally eliminated.

Equity method

- The equity method is normally applied for investments in „associates." An „associate" is an enterprise which is neither a subsidiary nor a joint venture and in which the investor has a significant influence (normally, between 20% and 49%).
- Under the equity method, the investor's investment in an investee enterprise is initially recorded at cost and is adjusted thereafter for changes in the net assets of that enterprise (IAS 28, par. 11). As is the case in full consolidation, interenterprise balances and interenterprise transactions are eliminated, together with any unrealised profits and losses relating thereto.

Proportionate consolidation

- Under proportionate consolidation, the parent's/investor's share of each of the assets, liabilities, income and expenses of the other group enterprises is combined on a line by line basis with similar items in the parent's/investor's financial statements. Again, interenterprise balances and interenterprise transactions are eliminated, together with any unrealised profits and losses relating thereto.

4.3.7.4 Assessment of consolidation methods

Of paramount importance is the equity method (applied for stakes between 20% and 49%). The equity method is less a consolidation than a valuation method. Equity is defined as the net asset value (fair value of assets minus debt). If a parent owns, example given, 49% of a nuclear power plant (subsidiary), only 49% of the equity of the subsidiary appear in the groups' balance sheet and only 49% of the benefit appear in the groups income statement. All other items such as debt (provisions for decommissioning are debt), revenues and others are not traceable in the consolidated statements, which means that an investor cannot see the amount of debt and provisions for decommissioning. However, the influence of a parent company (control) of a subsidiary increases the closer a parent comes to the 50% level (which would lead to full consolidation).

Therefore, it is of paramount importance to investors to know the total amount of debt and revenues of all equity consolidated subsidiary. It can be assumed that if a parent holds 49% of a subsidiary and all other shareholders only hold small stakes, the responsibility (liability) for appropriate decommissioning funding would fall back to the main shareholder.

The same information is important to the public. If the information were only given on a consolidated group level and not, in addition, for all consolidated enterprises on a separate basis, an important piece of information would not be accessible and the necessary transparency would be lost.

4.3.8 Conclusions from the accounting perspective: The meaning of accounting principles

Transparency is important and accounting can substantially contribute to improved transparency.

The underlying assumption of the polluter pays principle depicts, that the costs have to be recognised in the books of the operators of nuclear installations (polluters).

To resume, it can be asked if existing accounting principles cover the requirements linked to decommissioning activities or if nuclear installations require a specific set of accounting principles. The answer given by accounting seems to be clear but clarifications are recommended.

It is not a question of which internationally accepted standards should be applied but that all operators consistently apply the same “Generally Accepted Accounting Principles (GAAP)” and that this will be confirmed in the auditors report. What is paramount is to commit oneself to an existing set of ”generally accepted accounting principles” and to add, where vital, clarifications.

Therefore, it is recommended that the licensing authorities in different countries apply a consistent definition of accounting and that a kind of oversight board should enforce the improvement of comparable and consistent accounting and auditing rules.

It is recommended to apply IFRSs® together with clarifications (EU interpretations and guidance) in order to improve the reliability and comparability. Clarifications are necessary in the context of:

Assumptions

- guidance for assumptions for cost calculations and recognising provisions;
- disclosure of assumptions behind the cost calculations;

Mechanisms

- description of the mechanisms between intermediate storage and the final waste disposal in order to eliminate all possible latitude of judgement and to achieve a

consistent application of recognising provisions. Such a clarification would mainly treat the interface between

- intermediate storage and final waste disposal and
- provisions and contingent liabilities and
- legal and constructive obligations.

Equity consolidation

- total amount of debt and provisions of all equity consolidated entities(associates)
- total revenues of all equity consolidated entities (associates)

If other standards are applied

- The relation between IFRSs® and national legislation and the discussion of where main differences are.

Applying the “current budget” methodology doesn’t meet the qualitative characteristics of modern accounting and is a possible source of failure in decommissioning financing.

4.4 Valuation Perspective

4.4.1 Free cash flow and shareholder value

4.4.1.1 Overview

The valuation perspective is particularly important to investors. The decision to invest in securities of nuclear installations (to buy or sell shares of an enterprise) depends on the valuation made by investors. Investors and analysts determine the financial value of an enterprise by deducting total debt from the sum of discounted future free cash flows thus arriving to the so-called shareholder value. The future free cash flows are based on assumptions of the probable development (business plan).

Investors always make implicit assumptions when analysing an entity and thus each financial value is a result of assumptions of future free cash flows including future costs (decommissioning costs are future/backend costs). The free cash flow consideration is strictly based on cash inflow and out flow considerations.

Revenues minus operating costs leads to the operating profit (EBIT = Earnings Before Interest and Taxes). Decommissioning costs are operating costs and therefore taken into account in a free cash flow consideration.

The free cash flow of a period is calculated as shown in the following table:

Table 12: Calculation of the free cash flow of a period

Free Cash Flow of a Period	
Operating Profit (EBIT = Earnings before Interest and Taxes)	
+	Depreciation on Fixed Assets
–	Taxes on Operating Profit
=	Cash Flow from Operations
+/–	Incremental Working Capital
+/–	Investments in Fixed Assets
=	Free Cash Flow

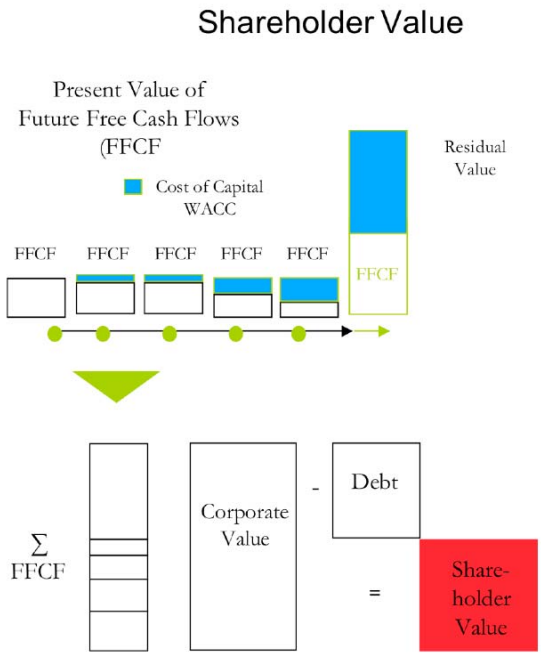
Source: Rappaport 1986.

To arrive from free cash flows to the fundamental financial value (shareholder value) of an entity all estimated future free cash flows are added. (Past free cash flows only serve as basis for the calculation of future free cash flows). In order to add cash flows from different time periods, discounting is required. Future free cash flows get discounted with the discount rate to the present value. The weighted average costs of capital (WACC) are used as discount rate.

The WACC depend on various factors such as the risk free interest rate (in the valuation context, risk free rate is a notion used by financial experts and doesn't address the risk linked to nuclear power installations), the debt/equity ratio of an entity but also from the specific risk linked to an enterprise. The higher the risk attributed or perceived the higher the WACC and thus the lower the financial value.

When investors do not trust that the free cash flows in the distant future will really materialise, they require a higher risk premium, and thus apply a higher WACC/discount rate. In other words, they add a risk premium, which leads to lower present values of future free cash flows and thus to a lower financial value (shareholder value). The reputation risk of an enterprise is also reflected in the risk premium added.

Table 13: Shareholder Value



Source: Rappaport 1986.

In the context of different decommissioning funds methodologies attention has to be drawn to three valuation components: Debt, free cash flows and WACC.

Debt

- The chart above depicts that the shareholder value decreases with increasing debt. Higher provisions therefore decrease/impair the financial value of an investment. The following remarks made by financial experts show how critical the debt issue is:
  - Nuclear waste provisions only recognise liabilities from waste generated to balance sheet date and not the expected future liability for the whole of a nuclear plant's operating life (Buemi/Galaun 2005)
  - …estimates the "decommissioning activities" to be worth $ one trillion globally and £ 44 billion in the UK (Cattley/Van t'Sant/Steel 2006):

Future Free Cash Flows

- Future free cash flows reflect all factors linked to the strategy and
- include future decommissioning costs.
- In the case of nuclear power plants, there is only a limited time period where free cash flows accrue (life time of nuclear power plant). Therefore, the residual value cannot be calculated based on eternal cash flows.

- The estimation of future free cash flows is difficult due to the many risks and uncertainties. Therefore, in order to avoid additional risks and uncertainties, the highest possible transparency is required.
- Investors are interested in value increasing investments. One financial value driver is the future free cash flows, which contain all operative costs.
  - Investors have a genuine interest (also as citizens) that safe and effective decommissioning methods be applied. Unsafe or unreliable decommissioning can impose a substantial reputational risk on operators. This would result in higher WACC and thus in a decrease in shareholder value;
  - Investors also have a strong interest in high EBITs (operating profits) and therefore in least cost decommissioning methods (cf. 3.1.3).
- Future free cash flows embrace many uncertainties as to the political, industrial and technical solutions of final waste disposal (cf. accounting perspective). These uncertainties have to be taken into account when valuing an entity.
  - It is likely that the cash outflow from managing nuclear waste is understated (Buemi/Galaun 2005)

WACC (discount factor)

- Changes in the WACC have a high sensitivity. A change in risk perception therefore substantially impacts the financial value.
- A reasonable risk assessment is only possible with a high degree of transparency.
- Low transparency bears enormous risks for both, investors and operators.

4.4.1.2 Present or current value and valuation

At the beginning of the previous subchapter, it has been said that investors determine the financial value of an enterprise by deducting total debt from the sum of discounted future free cash flows.

Now, the question has to be answered how provision estimates have to be treated. Is it appropriate to also discount decommissioning provisions (which are debt) to the net present value or should decommissioning provisions not at all be discounted. (Cf. chapter 3.1.5, where the current value method with an assumed discount rate of 0% and the present value method with a positive discount rate are addressed.)

Discounting decommissioning provisions would mean, as an example, that decommissioning costs of Euro 134 million accruing in 10 years would be only Euro 100 million today if a discount rate of 3% were to be used.

From the perspective of investors, who want to determine a rational value of the enterprise a discounted approach seems to be logical. They would argue that the discount rate mirrors the probability or uncertainty that is attributed to the future free cash flows and that future free cash flows include future decommissioning costs (such as contribu-

tions). It seems evident that the future free cash flows have to be discounted to the net present value (of the corporate value) and therefore, in order to reach consistency between the treatment of provisions and contributions, decommissioning provisions should also be discounted. This also reflects the position of IAS 37. According to IAS 37, par. 45, where the effect of time value of money is material the amount of a provision shall be the present value of the expenditures expected to be required to settle the obligation. In IAS 37, par. 46 the argument is made that provisions relating to cash outflows that arise soon after the balance sheet date are more onerous than those where cash outflows of the same amount arise later.

4.4.1.3 Present or current value and setting aside funds

If the question is addressed which is the adequate amount of funds, which have to be set aside, additional arguments become relevant. The key objective here is to assure health and safety (and not to determine a rationale value to buy or sell enterprises).

It must be assured that at any time an adequate amount is available to finance the process of decommissioning. The highest safety can be reached if at start-up, the full undiscounted amount (in our example Euro 134 million) is set aside. In this case, no additional uncertainties stemming from the investment process (expected and required annual average performance of 3% in order to reach the level of Euros 134 million in ten years) are added. The risk linked to the investment process could lead to under funded situations (mainly in the case of an unexpected early shutdown). Therefore, contrary to an undiscounted approach, the discounted approach requires very dependable guarantees.

The uncertainty aspect is very relevant because decommissioning has to deal with very long time frames. It can be argued that, given the health and safety imperative, decommissioning provisions should not be discounted. Consequently, the full amount of provisions should be set aside at the start-up moment. Thus, almost all uncertainties and risks related to the investment process can be eliminated.

If decommissioning provisions were not discounted, the required (adequate) fund assets would be higher in order to have a fully funded situation. Now, the fund assets would, under a long-term perspective, in all probability, provide a positive investment return. However, this return is not needed to cover decommissioning costs. Therefore, in such a case, the investment return should be at the free disposal of the operator in order to avoid double charging of operators. It would be a compensation for having set aside higher amounts at the beginning.

Example Finland: The system is based on undiscounted costs. The deposited money in the fund is gaining interest every year and this interest is reducing the annual amount of new money that needs to be paid to the fund. The difference to a discounted approach is that in an undiscounted system the interest gained is taken into account "a posteriori" based on realised returns rather than based on speculative expectations on high returns to the capital in the future.

The non-discounting approach in the context of determining the adequate amount of funds set aside offers higher safety to the beneficiaries but renounces on the opportunities, which possibly could be exploited with an efficient investment strategy.

With the approaches where no discounting is allowed combined with the requirement to provide securities for the unfunded liabilities, a better long-term insurance can be obtained against situations, where early shutdown means that all the decommissioning activities need to be implemented much earlier than planned and hence there is not sufficient time for the funded money to be increased by virtue of the anticipated interest gains (owing to positive discount rate).

4.4.1.4 Discounting and transparency

This discussion again draws the attention to the overwhelming meaning of transparency. All assumptions in the context of determining the financial amount of provisions must be disclosed and the rationale behind the assumptions has to be explained.

Moreover, it is crucial that both debt totals are disclosed, the provisions for decommissioning (i. e., their undiscounted or discounted amount plus the discount rate used) and the undiscounted debt burden. This allows investors and other involved parties to assess the risks and to value an enterprise according to their own risk assessment.

4.4.2 Valuation and different decommissioning methodologies

The key drivers in valuation have been described above. Now the question has to be treated if different decommissioning funding methodologies affect valuation.

From first sight, this can be denied because investors (decision makers) will not include decommissioning funds as assets (no future economic benefit embodied, which lead to a cash inflow). In the case of internal solutions, informed investors will not include cash inflows from financial assets in their future free cash flows calculations (except in the case of setting aside undiscounted amounts). Thus, full transparency and rational behaviour of investors assumed, funds have no impact on the total of corporate value.

However, in the valuation process, investors deduct the total amount of provisions as debt. This also reflects the view of IFRS that the liabilities have to be assessed independently from the assets as no automatic derecognition can be assumed (cf. Chapter 4.3.5.8).

Furthermore, in any case, the operators have to pay contributions, which affect the income statement. This cash outflow is of interest to investors. As described above, contributions to decommissioning funds and or building up of provisions is contained in the operational costs and therefore reflected in a free cash flow approach.

Moreover, it could be argued that investors attribute different risk profiles to different decommissioning funds methodologies. If this were the case, the valuation would be affected through a higher or lower WACC (discount factor).

Investors only are in position to judge and weigh the different decommissioning funds methodologies against each other if they receive all relevant information from operators. Therefore, transparency is again important.

4.4.3 Valuation and consolidation

The consolidation methods have been described in the accounting perspective chapter 4.3.6. It has been pinpointed that, in the case of equity consolidation, investors can't see the amount of debt and provisions for decommissioning of equity consolidated subsidiaries.

Even if there is only a 49% control of the subsidiary the group carries a substantial responsibility for the adequacy of provisions (example given if all other shareholders only hold 5% each).

Therefore, investors need to know the potential debt burden (respectively liability potential) in order to assess risk.

4.4.4 Valuation and limited life time

Nuclear power plants have a limited lifetime. Therefore, at the end of the operation period (final shut down) all decommissioning funds should be set aside and available. This aspect belongs to the central debate of this study.

However, another "fund" for repaying the nominal share capital should be set aside and respective liquid funds should be available at the end of operation be it in order to repay the capital to the shareholders (owners) or be it as initial share capital for constructing a new nuclear power plant.

4.4.5 Conclusions from the valuation perspective

A reliable valuation has to allow a comprehensive risk assessment (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. If transparency is given, investors will be in a position to assess the risk and, based on their investment strategy, utilise the appropriate discount factor. Different investors assess risks differently.

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. Only transparency helps to prevent wrong investment decisions and thus inefficient allocation of financial resources.

As to the valuation perspective only one important information has to be included in a recommendation: The disclosure of both, discounted and undiscounted amounts of

decommissioning provisions/debts. Other special ingredients are not required to be included in a recommendation. All what is important in the context of valuation is already included in the governance and accounting perspectives.

4.5 Investment Perspective

4.5.1 Safe system is a key objective

The key objective of the investment perspective is to analyse the aspects, which are important for a safe investment system. Safe system means that no unnecessary uncertainty or risk be added through the investment activity (fund management). The investment policy must contribute to enforcing the objective to cover all decommissioning costs.

In the context of this report, the term “safe” refers to the objective of assuring the health and safety of citizens. However, other reports define financial security in a broader sense, for example, they include in their security definition the objective that the financial interests of the government are guaranteed (KPMG/NRG 2006, p. 13 and 93).

4.5.2 The importance of efficient asset management

Operators have, under the terms of the polluter pays principle, to pay contributions into a funding system in order to cover all future decommissioning costs. Decommissioning is expensive. Huge amounts of financial means are needed to pay for all liabilities.

- In the UK, liabilities in excess of £75bn have to be paid in the future (Country Report UK).
- Liability estimates are periodically revised upward and the unpredictability of decommissioning costs – in particular, the cost of both high- and low-level radwaste disposal – is likely to push the bill much higher (Bank of New York 2006, p. 2).”
- In France: The French Court of Accounts has calculated undiscounted liabilities totalling 65 billions Euro (see country report France p. 1 and chapter 3.1.4.3).

Decommissioning costs paid in the form of contributions to an external fund (cash outflow) or in form of building up provisions against restricted/earmarked assets in the operator’s accounts are operational costs of an operator and thus a cost element of energy production (production costs per kWh). Consequently, decommissioning costs substantially impact the competitive position of an operator in the energy market. This fact, together with the unpredictability and the huge amounts of future decommissioning costs, directs the attention of involved stakeholders to the investment success (performance).

The incentive to finance part of future decommissioning costs through a high investment performance is evident. However, a high performance on its part can conflict with

the prudence principle, which plays an important role in the field of financial asset management.

4.5.3 Financial risks

Investors always have to align two key interests. They wish to receive the highest possible return and they also want to keep the risk linked to their investments in an acceptable realm.

The financial risk of an investment in securities is defined as volatility (measured as standard deviation). Therefore, the risk in the language of financial markets is measured in deviations containing both, positive as well as negative deviation, and not only, as in the insurance or legal business, the negative case. A high volatility denotes/indicates a high risk, a low volatility a low risk. A volatility of 20% means that an investor investing in a security (example given stock of company A) with an expected annual return of 10% can, with a probability of 66.6%, expect an absolute annual return between -10% (10% expected return minus 20%) and 30% (10% expected return plus 20%). If the investor were to invest in a security with an expected annual return of 5% and a volatility of 10%, the return would be, in two thirds of all cases, between -5% and 15%.

Higher investment returns are always linked to higher risks (volatilities). The art of investing consists in perfectly adjusting the risk-return ratio to the investors' objectives.

It has been said that a high absolute performance (return) can substantially contribute to mitigating the costs of an operator and assuring the availability of decommissioning funds after shutdown. However, this "possible" high performance goes hand in hand with a high risk. This trade-off is particularly important in the nuclear business as very long durations (time to maturity) are involved. The following example illustrates the impact of different returns in cases where periods of 40 years and more are concerned.

If a manager of a decommissioning fund invests Euro 100 with an expected annual yield (performance) of 2%, he/she will dispose of Euro 122 in 10 years or Euro 221 in 40 years. If the same manager invests Euro 100 with an expected annual yield (performance) of 7%, he/she will dispose of Euro 197 in 10 years or Euro 1497 in 40 years. Euro 1497 is 6.8 times as much as Euro 221, a considerable difference after 40 years. Or one would have to invest at the beginning Euro 678 in order to receive Euro 1497 after 40 years with an assumed yield of 2%.

In other words: In the case of 7% yield, an operator would have to pay contributions of Euro 100 whereas in the 2% yield he would have to pay Euro 678 in order to achieve the same target. As decommissioning costs are operating costs, such a difference will also be reflected in higher or lower energy prices (costs of kWh produced).

This example demonstrates the importance of the investment perspective. Contributions to be paid in are directly linked to the investment success and an investment performance can mitigate the contributions due.

However, investment is always linked to a risk as investors' base their investments decisions on assumptions on the future, whereas the risk from the angle of citizens, who require health and safety, is that the decommissioning funds are not available on time. They might argue that no additional risks be added through the investment process and the tools and techniques of financial markets.

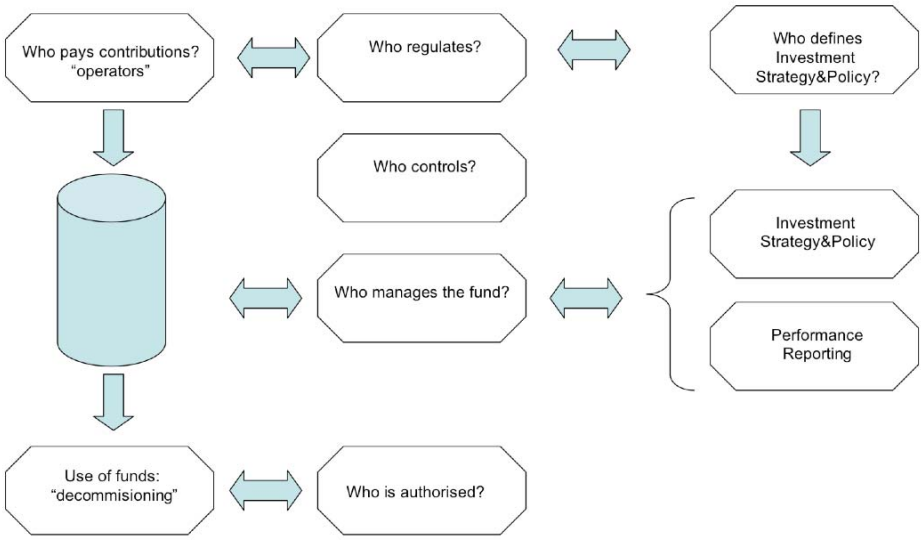
Therefore, the risk perception of financial markets is not the only aspect which has to be considered. Two risks have to be weighed against each other. The risk linked to the investment process and the risks linked to the renunciation of a positive investment performance (cf.4.4.1.1).

4.5.4 Key themes

The following chart illustrates the main elements in the context of the investment perspective. Based on the polluter pays principle required by the EU in all fields, it is evident that operators have to pay the contributions. It seems also clear that decommissioning funds should only be used for decommissioning activities. The other key themes to be treated are the questions of:

- regulation and controlling, who regulates and who controls the investment process;
- investment manager, who manages the fund;
- power of authority, who authorises the payments and
- investment strategy and policy and
- performance reporting.

Figure 4: Investment Matrix (Componenets) of Decommissioning Funds



4.5.5 Regulator and controlling/monitoring

Financial markets experience a regulating and monitoring authority in many fields of activities in general and in investment fields in particular. The main objective of regulation and control is thereby the "protection of investors". Examples are the supervision of banks or the legislation on stock exchanges, investment funds or pension funds.

The regulating effect can be achieved by a government regulation or by the means of self-regulation. Self-regulation has proven to be a successful and effective way in financial markets affairs.

Important to the success of self-regulation is the independence of the authority from the monitored entities and the ability of the authority to impose effective (corrective) measures in case of non-appliance by a member of the self-regulation system.

It is not within the scope of this report to explain and design in detail all tasks, which a regulating body should assume. However, one key element is to develop investment guidelines and monitor the investments in decommissioning funds. Such guidelines would not go in detail; they would give a frame, in which a fund manager can develop his own investment approach. Thereby, they would implicitly also describe and limit the financial risks of a portfolio (fund).

Such guidelines assure that those who carry the responsibility have clear superior targets, that they look into the subject of investment policy and asses to which extent the

guidelines (frame) allow different investment policies and that the performance can be periodically monitored. Guidelines also contribute to mitigate the various conflicts of interests, which are embedded in the course of the investment process.

Thus, “uniform” guidelines from an independent body contribute to increased transparency and comparability of funds and they procure an increased certainty to the public that the funds are well managed and an adequate amount of financial resources will be available at the time when needed.

In this context the question has to be answered whether a regulator issuing general principles and guidelines and monitoring the compliance should be positioned on an international level (EU) or on a national level. It is proposed to choose the international solution because a certain degree of consistency and clear rules of the game are necessary in order not to provoke any competition, which could threaten the safety. Such principles and guidelines could also be issued and monitored by an (European) oversight board or decommissioning financing committee (cf. Chapter 6.3.2 and Chapter 6.4.3).

4.5.6 Investment manager

In the chapter on governance (governance chain), it has been highlighted that, given the multiple conflicts of interest, it should be aimed at achieving the highest degree of independence between the operators (as polluters and thus contributors to the funds) and the investment managers.

It is not advisable to allow that the operators assume the role as investment managers (internally managed internal or external funds). The conflicts of interest are too strong (cf. Chapter 4.5.6.5) and it is not their genuine business. The business of operators of nuclear installations is to produce and sell energy and not to be an investment expert.

There should be specific requirements regarding the qualifications of investment managers such as:

- the track record and
- the independence from the operator.

It would be reasonable that the entity regulating decommissioning (financing) defines criteria for the qualifications of investment managers (cf. Chapter 4.5.4).

4.5.7 Investment policy

4.5.7.1 Objectives of an investment strategy and policy

First it must be outlined, that any investment policy has to be aligned to the interests of the beneficiaries. Beneficiaries of decommissioning funds are the public in the broadest sense because the objective of decommissioning is to assure health and safety of citizens. The public is dependent on the availability of an adequate amount at the time

needed because, in case of non-availability, the execution of safe decommissioning could be delayed or threatened (no execution at all or unsafe (only partly) execution or the public would have to pay in its role as taxpayer (which would mean that the operators have externalised internal operative costs).

4.5.7.2 Investment strategy and policy

It is not within the scope of this report to describe a general investment strategy for decommissioning fund managers. Such a strategy would contain all main elements such as the strategic and tactical asset allocation, the investment guidelines, investment committee and internal audit of the investment process in general and the specific risks linked to the investment process in particular (procedural organisation of investment process).

4.5.7.3 Correlation

The correlation is a key factor for the diversification and risk reduction of any portfolio. If a portfolio is composed of a certain number of different stocks with a low correlation, then the unsystematic risk (enterprise specific) can be eliminated and the only remaining risk is the systematic risk (market risk).

Correlation indicates to what extent the returns of security A and B correlate. Do both similarly loose at the same time (high correlation) or can it be assumed that a loss of A is usually offset by a gain in B (low correlation). The total risk of a fund (portfolio) can only be assessed if the correlation of different returns of different securities can be measured (covariance).

Now, a decommissioning fund should also consider (as a second type of correlation) the correlation between the energy industry in general and the nuclear industry in particular. It leads to the question if a decommissioning fund should be allowed to invest in nuclear energy companies or not. The idea behind is that the performance of decommissioning funds should not be correlated with the performance of nuclear operators.

Beneficiaries of decommissioning funds (citizens) especially depend on the availability of an adequate amount of financial means for decommissioning. If decommissioning funds were invested in nuclear industry, the beneficiaries would be double hit in case of economic and financial problems of the nuclear industry. It cannot be assumed that the shares of nuclear operators are high performers in times where the nuclear industry faces problems.

4.5.7.4 Asset and liability management

A summary of the significance of a high fund performance has been given in the introduction to the “investment perspective” chapter. A renunciation of a high return is only justified if the risk linked to it were not manageable. Otherwise, all should be done in order to benefit from a high performance.

Some argue, that at all time, the market value of a fund should be at least as high as the accrued costs for decommissioning (provisions). In this case, the fund manager could only accept a limited risk in investment policy because a high risk would imply a high volatility and this could lead to a temporary under-funded situation (in the case of negative deviations from the expected return).

However, the long average duration of the liabilities opens the door to an investment style, which can manage these risks. It is referred to as "asset & liability management".

On the liabilities side provisions for decommissioning are recognised. These have, to a large extent and in the absence of incidents or accidents during the planned lifetime of a nuclear installation, a long duration (average time to maturity). On the assets side are decommissioning funds (be they internal or external). Now, the investment of the funds (assets) should match the duration of the liabilities (principle of "matching maturities").

This means that, for the (usually larger) part of the assets covering long-term liabilities, a long-term investment perspective is advisable, and a medium-term/short-term investment perspective for the part of the assets matching medium-term/short-term liabilities. Long term allows allocating more means to shares (with a higher expected return). Shares have a higher volatility and thus, under a long-term perspective a higher return. This kind of investment policy is also applied by insurance companies, which have insurance contracts (liabilities) with very long durations.

The "asset & liability management" approach would reflect the business basics of nuclear power installations and would allow to benefit as much as possible from the possibilities of financial markets.

In the case of major incidents or accidents (cf. 3.1.7.1), the funds have to be immediately available. Now, it could be that just at this moment, the fund is under funded due to an actual strong decline in stock markets. This case is possible. However, it would be a lost opportunity, if therefore one could not benefit from a high return under a long-term perspective. Therefore, to cover such situations, a guarantee fund is recommended in parallel to an asset and liability management. This fund could, for example, be financed by contributions from all European operators (cf. also Chapter 6.2.2.6.3 for particular recommendations on this issue).

4.5.7.5 Investments to related parties (mother companies)

A decommissioning fund investing in shares or bonds or other kind of investments has to consider the usual investment rules. However, if the fund wishes to invest in securities of his mother company, then special attention has to be paid to the question if the transaction is made at market rates.

Two examples from the country reports can be given: *In Finland, operators have to pay contribution to an external segregated decommissioning fund (State Nuclear Waste Management Fund) with the right to borrow back 75% of the capital of the fund at market rates* (country report Finland p. 19). In Germany, where the internal unrestricted

methodology is applied for private operators, it happened in the past that *operators lent to mother companies at very low or even zero rates below market interest* (country report Germany p. 33).

The meaning of a good fund performance has been described in chapter 4.5.2. Lending money to mother companies below market rates like it was partly done in Germany not only means a cross-subsidy, because it could be considered as a redemption to the operator of already paid contributions, but also bears a considerable strategic risk for all involved parties (cf. Chapter 4.2.3.2).

4.5.8 Performance reporting

Performance reporting means that the investment manager has to periodically inform all interested parties about the performance and the risk profile of the fund.

Performance reporting contributes to an increased transparency and comparability of funds and to an increased confidence of the public that the funds are well managed and that an adequate amount of financial resources will be available at the time when needed.

4.5.9 Power of authority

This aspect has been already described in the context of the governance chain (sixth component; cf. chapter 4.2.4.1) where the highest degree of independence between the operators, the fund management and the position disposing of the power of authorising payments is proposed.

The main argument is that enormous pressure lies on the entity having access to the decommissioning funds (power of authority). If the power of authority to dispose is with a third party, the degree of independence between the third party and the operators has to be separately assessed.

4.5.10 In the case of an incident or accident or other kind of early closure

Most of the remarks made so far are based on the assumption that no major incident or accident or other unexpected event leading to an early shutdown will happen. Such events would lead to other cash outflow patterns, as financial resources set aside will be immediately used. Moreover, in the case of an incident or accident, the decommissioning costs are likely to rise as dismantling and demolition becomes more expensive.

Such potential liabilities should be fully covered at the start-up moment. Therefore, at the start-up moment, a kind of guarantee fund should exist which disposes of an adequate amount of financial means for any early closure case. (cf. Chapter 6.2.2.6.3 for particular recommendations on this issue).

Furthermore, in case of early closure the assets of nuclear installations would be impaired which leads to a substantially lower financial value: The going concern assumption would be invalid and the value would decrease to zero. If not all liabilities linked to an incident or accident were covered, the value would even be negative (minus not covered liabilities) and question of who will be able and willing to pay the remaining costs arises.

An incident or accident in a nuclear installation will not only impact the financial value of the respective operator but of all nuclear installations because investors will immediately change the risk perception and discount future free cash flows with higher WACC. Moreover, it can be assumed that the future free cash flow estimates of all nuclear installations will be revised downwards as can be assumed that the consumers will buy less nuclear energy in the future.

Whether or not such effects are permanent (revaluation of industry) or only temporary depends to a high degree on the question if, in an actual case, the liabilities linked of an incident or accident have really been appropriately covered or not. This strongly speaks for the creation of well-funded guarantee fund.

Another aspect should be addressed in the context of a guarantee fund. The composition of the portfolio of a fund has to be screened with a view on a special correlation. It can be assumed that in case of a major incident or accident the whole industry in the neighbourhood will also be affected by damages. Therefore, the value of the fund could also be impaired if the fund were invested in stocks of companies in the neighbourhood. The theme is that an incident/accident fund should, besides all other requirements, also consider the geographical distribution of the investments.

4.5.11 Conclusions from the investment perspective

The objective of the investment is to serve the needs of the beneficiaries, which are the public respectively the citizens.

A safe investment system is required which doesn't add any unnecessary additional uncertainty.

A guarantee fund is required to cover risks, which are added through the investment process in general and risk, which are linked to an incident or accident in particular.

Transparency about the investment process, strategy and performance are a key element of a safe system.

The independence and competence of all involved stakeholders is important.

The incentive to finance part of future decommissioning costs through a high investment performance is evident. A high performance on its part can conflict with the prudence principle, which plays an important role in the field of financial asset management. The professional application of asset & liability management allows managing a higher risk.

Special attention has to be paid to lending practices to related parties.

The analysis of all correlations between decommissioning funds and the nuclear industry or investments in areas surrounding the nuclear facilities is important.

It is recommended to develop “guidelines”, which describe the required qualifications of investment managers and which give a basic investment policy frame also defining the acceptable risk levels. A kind of oversight board or decommissioning financing committee could provide such guidance (cf. Chapter 6.3.26.3.2 and 6.4.3).

5 Legal framework for dealing with the different financial risks of decommissioning financing systems in Europe

5.1 Introduction

This study on EU decommissioning financing methodology underlines in previous chapters the barriers to safety of availability of sufficient funds for future decommissioning at the time needed, and the different standards, different financial risks, different systematic and different access to information in the EU member states.

This chapter analyses the legal framework, possibilities and limits for dealing with the different decommissioning financing systems and the different degrees of financial risks on the **EU level**, i. e. for dealing with the possibilities to harmonise the different approaches in the EU in order to reduce risks and increase safety. This chapter does not look into the legal possibilities for every Member States to improve their own decommissioning financing systems.

The classic legal basis for harmonising legislation in internal market relations is Article 95 Para 1 of the **European Communities Treaty (ECT)**.

The following evaluation will show that the **EURATOM** treaty does not present the adequate legal basis for harmonisation of decommissioning fund structures in this field, contrary to previous Commission moves towards harmonisation of decommissioning structures which were all exclusively based on Article 30, 31 EURATOM.

On the contrary, a move back to the ECT rules and especially Article 95 together with Article 175 on environmental grounds will enforce the position of the European Commission.

In addition, it could be considered in how far a thorough enforcement and maybe further development of the accounting directives **78/660/EEC** and **83/349 EEC** would make sense with respect to further contributing to reduce decommissioning financing risks (cf. Chapter 4.3 for more details on these accounting aspects and the rules and principles which should govern accounting of decommissioning costs; this aspect is not further discussed in this Chapter since it covers only one part of the risk problem).

This chapter tries to present to the European Commission **argumentation for opening** towards a different approach of the choice of legal bases for all efforts to harmonise decommissioning funds rules.

Up to now, the European Commission has drafted within the so-called Nuclear Package proposals from 2002 two draft directives, one on setting basic obligations and general principles on the safety of nuclear installations and the other on management of spent nuclear fuel and radioactive waste.

To choose Article 31 EURATOM for these directives and for harmonisation rules will create a dilemma for real regulatory progress in the European Union. The EURATOM Treaty does not provide any direct legal bases for legislative action in the field of financing of decommissioning. There is no legal leeway for extensive interpretation of EURATOM rules. The EC Treaty provides enough direct legal ground. Nuclear energy treatment in the broadest sense is only in those parts submitted to the specialised EURATOM treaty which are clearly defined in the EURATOM treaty itself or in secondary legislation based on the EURATOM treaty whereas all other subjects have to be treated under the ECT and its respective secondary legislation.

It would on the contrary only be adequate to integrate the discussion concerning safety and availability of decommission funding under the EC Treaty (ECT).

The following evaluation aims to provide sound legal arguments for a choice towards ECT.

5.2 Arguments in favour of the use of the European Communities Treaty (ECT) as legal basis for any draft legal proposal by the European Commission

5.2.1 Objectives and Tasks of the EURATOM Treaty

The **EURATOM treaty** has distinct objectives and tasks. EURATOM Treaty is the treaty promoting the use of nuclear technology

According to Article 1 of the Euratom Treaty of 1957 (EURATOM), the main task of the Community is “to contribute to the raising of the standards of living in the Member States and to the development of relations with other countries by creating the conditions necessary for the speedy establishment and growth of nuclear industries”.

To accomplish this task, the Community was given sovereign rights, which the Member States transferred to it by signing the Treaty, in the following areas:

- research,
- health and safety (protection of workers and the population against the dangers of ionising radiation),
- supply of raw materials,
- nuclear safeguards, and
- external relations.

The European Court of Justice (ECJ) recently repeated that:

- the establishment of a legislative and regulatory framework to govern the safety of nuclear installations;
- measures relating to the assessment and verification of safety;

- emergency preparedness;
- the siting of a nuclear installation and
- the design, construction and operation of nuclear installations,

are covered by the main focus of the EURATOM treaty.[1]

All secondary legislation, recommendations and the like can only be based on the EURATOM treaty and its options for initiate legislative proposals if they are within the limited scope of application of the EURATOM treaty.

Consequently, all legislative proposals and recommendations on the structure, availability of decommissioning funds in the respective Member States have to be based on the Treaty of the European Communities. The treaty competences of EURATOM do not relate to any financing of decommissioning relations. It goes against international rules of general interpretation to extend the competencies of the EURATOM treaty beyond the limits the treaty founder have given to it.

It is especially invalid to try to extent by the simple means of interpretation a new competence of EURATOM which is clearly regulated under the general EC Treaty but which is not covered by the EURATOM treaty.

5.2.2 Cohabitation and Prevalence- EURATOM treaty and ECT

In the European treaty context we face a situation of two treaties, EURATOM and ECT which need in some cases clear distinction of respective responsibilities, almost similar to reflections on applicability of one of these treaties with international treaties.

The European Court of Justice ruled in judgment of 26 October 1982 (*Hauptzollamt Mainz* v. *C A Kupferberg & Cie. KG*, paragraph 29) that provisions in an international agreement and in the EC Treaty having the same object, nevertheless, have to be "… considered and interpreted in their own context …"[2]. An interpretation of the applicability of EURATOM provisions as legal basis versus ECT provisions has to follow this logic.

EURATOM is not answering to necessities and requirements for safe, stable sufficient and market-compatible availability of decommissioning funds within the internal Energy market and in response to environmental protection issues.

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1 JUDGMENT OF THE COURT: 10 December 2002 (International agreements - Convention on Nuclear Safety - Accession decision - Compatibility with the Euratom Treaty - External competence of the Community - Articles 30 to 39 of the Euratom Treaty) Case C-29/99,

2 *Although article 21 of the agreement between the EEC and the Portuguese Republic on free trade and article 95 of the EEC treaty have the same object inasmuch as they aim at the elimination of tax discrimination , both provisions , which are moreover worded differently , must however be considered and interpreted in their own context .*
Since the EEC treaty and the agreement on free trade pursue different objectives , it follows that the interpretation given to article 95 of the treaty cannot be applied by way of simple analogy to the agreement on free trade .

If the European Commission or the Council want to integrate such competence into the EURATOM treaty, the respective amendment procedure rules provided in the EURATOM Treaty e.g. intergovernmental conferences, ratification procedure will have to be followed.

Since this is not foreseen, the application of **ECT is prevalent**.

5.2.3 Integration of principles from EURATOM into ECT based legal directive

There maybe an approach to be examined and that is to use provisions in the EURATOM treaty and general principles deriving from the Euratom Treaty used to argue and to support legislative proposals on EU level on decommissioning.

There maybe a way feasible to use a dual legal approach and to base proposals on both EURATOM and ECT rules but this is possible only under legal "leadership" of article 175 and 95 of the ECT.

The general ECT, its secondary legislation and the introduction of specific principles from international law into European legislation provide the primary applicable ground for adequate legally binding proposals and subsequent secondary legislation based on those proposals.

The European Commission had published on the 6th of November 2003 the proposal for a "Community approach to nuclear safety".

As outlined in this study this package of proposed measures has now been put on hold. As much as this proposal by the European Commission had failed to be accepted so far it had lead to an EU level attention on decommissioning financing and opened a way towards further intensive work by the European Commission.

Recently the European Commission re-opened the path towards harmonised rules for decommissioning funds with a new proposal, this time as Recommendations "of…on the management of financial resources for the decommissioning of nuclear installations, spent fuel and radioactive waste" and now uses the joint declaration as inter-institutional statement form July 2003 by the European Commission, the Council and the European Parliament[3] "at least" as setting the "ground for Community action."[4]

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3 „Statements made with regard to decommissioning and waste management activities
Interinstitutional statement
The European Parliament, the Council and the Commission underline the need for Member States to ensure that adequate financial resources for decommissioning and waste management activities, which are audited in Member States, are actually available for the purpose for which they have been established and are managed in a transparent way, thus avoiding obstacles to fair competition in the energy market'.
Commissions statement
'The Commission notes the importance of ensuring that funds established for the purpose of decommissioning and waste management activities, which relate to the objectives of the Euratom Treaty, are managed in a transparent way, and used only for the said purpose. In this context, it intends, within

This ground for action can by itself only be seen as a certain programme or action plan, but has by itself no legal power to serve as bases for legally binding actions. And at close sight the inter-institutional statement itself only underlines the "need of Member States to ensure" but does not open in a direction of legislative proposal by the European and especially the Commission's level.

The European Commission published Recommendations for decommissioning funds, but they were classified by the Commission as being "legally non-binding"[5].

5.2.4 The legal nature of the inter-institutional agreement on decommissioning

Neither the EURATOM Treaty nor the ECT provide direct ground and legal character for such inter-institutional agreement as bases for actions on decommissioning regulations.

The fact that the declaration is published in the Official Journal does not give it a legal binding character as legal bases for action on the side of the European Commission. It may help for arguments for the Commission on why it thinks necessary and adequate to come up with a legislative proposal. But such legal proposal has to stand on firm rules established in the European Treaties.

The concept of an institutionalised inter-institutional agreement by Council, Commission and Parliament came up during the discussion for a Constitution for Europe (TEU). The work on this treaty was underway at the same time of discussion for a nuclear package.

In the draft constitution Article I-25 European Commission outlines as following under paragraph 1 and 2:

> *"The European Commission shall promote the general European interest of the Union and take appropriate initiatives to that end. It shall ensure the application of the Constitution, and steps taken measures adopted by the Institutions under the Constitution. It shall oversee the application of Union law under the control of the Court of Justice of the European Union. It shall execute the budget and manage programmes. It shall exercise coordinating, executive and management functions, as laid down in the Constitution.*

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the scope of its responsibilities of the Euratom Treaty to publish an annual report on the use of decommissioning and waste management funds. It shall pay particular attention to ensuring the full application of the relevant provisions of Community law'. Official Journal L 176/56 15.7.2003

4 See Draft COMMISSION RECOMMENDATION of … on the management of financial resources for the decommissioning of nuclear installations, spent fuel and radioactive waste, Explanatory memorandum (as of October 2006)

5 See also explicitly on this the "European Parliament resolution on the use of financial resources earmarked for the decommissioning of nuclear power plants" (2005/2027(INI), adopted 16th of November 2005 which underlines the promised recommendation of the European Commission as legally non-binding

> *With the exception of the common foreign and security policy, and other cases provided for in the Constitution, it shall ensure the Union's external representation. It shall initiate the Union's annual and multi annual programming with a view to achieving interinstitutional agreements. 2. Except where the Constitution provides otherwise, Union legislative acts can be adopted only on the basis of a Commission proposal. Other acts are adopted on the basis of a Commission proposal where the Constitution so provides."*

This restricts the agreement to programming and planning and by itself does not open to a new ground for legally binding acts.

The EC treaty would be the right basis, in order to ensure the environmental and safety provision of Article 6 of the ECT and the regulations concerning the free market principle according to Article 14 ECT. It would be first of all Article 175 Par. 1 ECT, which provides the appropriate legal ground for such initiatives by the European Commission. Concerning the implication for the internal market for energy, especially in view to the decommissioning funds proposed Article 95 ECT is also to be taken as legal basis.

Since the liberalisation of the energy markets, especially since the entering into force of Directive 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity, now regulated by Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC, all regulations for the different sources of energy and all production of electricity from energy sources such as nuclear have to be coherent and in line with the internal market regulations, if they have an impact on the internal market. Commission proposals concerning funding for decommissioning will have an impact on the activities of the electricity market. All regulations concerning this market have to be balanced in view of the above directive 96/92/EC.

5.2.5 The European Commission's current legal arguments for EURATOM as bases for decommissioning regulation on European level

The **Commission** at present supports the following line of argument in their legal reasoning:

Article 2(c) of the Treaty calls on the Community to facilitate investment and ensure the establishment of the basic installations necessary for the development of nuclear energy in the Community. The development of such energy cannot be dissociated from the process of the decommissioning of such investments or installations. Article 41 of the Treaty requires investment projects relating to nuclear energy to be communicated to the Commission for examination. Council Regulation (Euratom) No 2587/1999 of 2 December 1999 defining the investment projects to be communicated to the Commis-

sion in accordance with Article 41 of the Treaty establishing the European Atomic Energy Community[6] includes decommissioning activities as investment projects to be communicated to and discussed with the Commission. Consequently, persons and undertakings[7] should inform the Commission of decommissioning funding arrangements in respect of newly built nuclear installations.

There is no dissent by this decommissioning study on the importance of acting on European level and the Commission should be supported in its tenacity. But the above Commission arguments lead to a factual new EURATOM treaty. The interpretation procedure of the Commission goes too far and neglects the ECT in basically denying applicability of the ECT.

5.2.6 Evaluation in view of prevalence of the ECT – Article 305 Paragraph 2 ECT

Concerning the question of which treaty should be applicable, EURATOM or the general EC treaty (ECT), Article 305 Par. 2 ECT places the ECT in a subsidiary position in relation to the EURATOM treaty, but only if the predominant applicability of Article 31 EURATOM treaty is proven.

Article 305 par 2: "The provisions of this Treaty shall not derogate from those of the Treaty establishing the European Atomic Energy Community."

But this article is of declaratory nature only. Therefore it has to be evaluated if Article 31 EURATOM would be the right and exclusive legal basis for the concrete draft proposals.

Articles 30 seq. of the EURATOM Treaty form part of Title Two, Chapter III of this treaty, entitled "Health and Safety" and are connected with the preamble to the EURATOM Treaty, in which the signatory States declare to be "anxious to create the conditions of safety necessary to eliminate hazards to the life and health of the public".

Linked to this, Article 2(b) of the EURATOM Treaty develops further, that the Community shall establish uniform safety standards to protect the health of workers and of the general public and ensure that they are applied.

Article 31 refers directly to Article 30 EURATOM Treaty.

The text of Article 30 to 32 reads as follows:

"Article 30

Basic standards shall be laid down within the Community for the protection of the health of workers and the general public against dangers arising form ionizing radiations.

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6 OJ L 315, 9.12.1999, p. 1.

7 Persons and undertakings engaged in industrial activities listed in Annex II to the EURATOM Treaty

The expression basic standards means:

a. *maximum permissible doses compatible with adequate safety;*
b. *maximum permissible levels of exposure and contamination;*
c. *the fundamental principles governing the health surveillance of workers.*

Article 31

The basic standards shall be worked out by the Commission after it has obtained the opinion of a group of persons appointed by the Scientific and Technical Committee from among scientific experts, and in particular public health experts, in the Member States. The Commission shall obtain the opinion of the Economic and Social Committee on these basic standards.

After consulting the European Parliament the Council shall, on a proposal from the Commission, which shall forward to it the opinions obtained from these Committees, establish the basic standards; the Council shall act by a qualified majority.

Article 32

At the request of the Commission or of a Member State, the basic standards may be revised or supplemented in accordance with the procedure laid down in Article 31.

The Commission shall examine any request made by a Member State.

In the EURATOM treaty, especially competition and respectively internal market law considerations are not established. The procedural requirements and conditions of Article 31 EURATOM Treaty profoundly different from those of the ECT, especially Article 175 and the internal market harmonization provisions as laid down in Article 95 ECT.

> *Article 95 Para 1 ECT reads as following: »"*
>
> *1. By way of derogation from Article 94 and save where otherwise provided in this Treaty, the following provisions shall apply for the achievement of the objectives set out in Article 14. The Council shall, acting in accordance with the procedure referred to in Article 251 and after consulting the Economic and Social Committee, adopt the measures for the approximation of the provisions laid down by law, regulation or administrative action in Member States which have as their object the establishment and functioning of the internal market.*
>
> *.."*

Art. 175 ECT gives the ground for regulations to follow the scope and obligations of the basic Article 6 ECT, such as the precautionary principle and the principle of preventive action. Article 6 has the following wording:

Article 6 ECT

Environmental protection requirements must be integrated into the definition and implementation of the Community policies and activities referred to in Article 3, in particular with a view to promoting sustainable development.

Article 174 ECT describes the aims and principles of the EC environmental policy. Article 174 Par 2 calls for a high level of protection. Article 175 contains the legal basis for legislative measures and governs the decision-making process for their coming into being. Article 176 allows Member States the option to maintain or take more stringent measures.

Article 175 Par 1 ECT reads as following:

> *1. The Council, acting in accordance with the procedure referred to in Article 251 and after consulting the Economic and Social Committee and the Committee of the Regions, shall decide what action is to be taken by the Community in order to achieve the objectives referred to in Article 174.*

Article 175 ECT reflects the Treaty of Amsterdam, which reformed the existing treaties in 1999, enlarging the power of the European Parliament.

The Treaty of Amsterdam ('Amsterdam Treaty') revising the Treaties of the European Union ('EU') - the EU's "constitutional basis" - entered into force on May 1, 1999. The revisions include a strengthening of the powers of the European Parliament in decision-making procedure. The revised Treaty of the European Community (ECT) put an end to the legislative procedure of co-operation in which the Council could overrule the Parliament. The procedure of cooperation has been replaced by the procedure of co-decision which gives the Parliament substantial and equal legislative powers with the Council.

As from May 1, 1999, the co-decision procedure, regulated by Article 251 of the EC Treaty, amongst others, applies to those legislative proposals regarding the environment which were formerly governed by the cooperation procedure (Article 175(1) of the ECT.

All examination concerning applicability has to acknowledge the important priority of involvement of the European Parliament subsequent to the Amsterdam Treaty in legal decision procedures. On the basis of Article 10 ECT and the principle of loyalty, the Commission is obliged to carefully evaluate and weigh the main objectives of specific regulations before deciding whether the EURATOM Treaty is applicable or the ECT provisions.

According to judgment of the Court of 4th of October 1991 (Case C-70/88) the choice of a legal basis does not simply depend on an institution's conviction as to the objective

pursued but must be based on objective factors which are amenable to juridical review. Those factors are in particularly related to the aim and content of the measure in question.

The Member States as founders of the EURATOM treaty "clearly wished to retain technological control over the installations on their territories." Therefore up to now the European Commission had never proposed legislation on the technological aspects of nuclear safety, (see opinion of Advocate General Francis Jacobs delivered on 13th of December 1999, RN 138, case C 29/99). The Member States have "exclusive competence over the technological aspects of nuclear safety" (Case C 29/99, par 138).

Even if radiation protection must be understood broadly in the sense rendering tribute to the development of an integrated and scientifically more advanced radiation protection scheme, it is "nevertheless clear that the authors of the EURATOM Treaty did not intend the Community to interfere with safety of nuclear installations in strictu sensu" (Advocate General Francis Jacobs, Case C 29/99, par.195). An overlap between radiation protection (Community task) and safety of nuclear installations (Member States' task) could only lead to a limited competence of the Community concerning radiation issues having an impact in the field of safety of nuclear installations.

5.2.7 Specific focus on key provisions in the nuclear package proposal

The following chapter will focus on some of the provisions in the nuclear package proposed by the European Commission in order to evaluate them in the light of limits to interpretation of the EURATOM treaty and the applicability of ECT.

Article 4 (independence of the safety authority) of the draft proposal setting out basic obligations and general principles on the safety of nuclear installation (herewith named "Package Proposal 1") nuclear package proposal obliges the Member States to establish a safety authority, on the legal basis of Article 30 EURATOM treaty.

The draft proposal for a council directive on the management of spent nuclear fuel and radioactive waste (herewith named "Package Proposal 2") of the nuclear package the Commission proposes the following Article 4 (General requirements for the management of spent nuclear fuel and radioactive waste) outlining important and basic principles for financial resources for decommissioning:

> *"…*
>
> *3.Member States shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.*
>
> *4. Member States shall ensure that adequate financial resources are available to support the safe management of spent nuclear fuel and radioactive*

> *waste, including that from decommissioning activities, and that financing schemes respect the "polluter pays" principle.*
>
> *5. Member States shall ensure that there will be effective public information and, where necessary, participation in order to achieve a high level of transparency on issues related to the management of spent nuclear fuel and radioactive waste under their jurisdiction…"*

In its recent above mentioned draft recommendations the Commission proposes again measures in line with Nr. 3 and 4 of Article 4 of the package proposal. It is out of question and clearly shown in this report that the Commission is right to propose such measures. From the general ECT law and further principles the Commission is even obliged to act. EURATOM fails to provide any correct legal bases in this respect.

According to the explanatory remarks of the Commission in the Package Proposal 2, the list of general requirements in Article 4 specifies measures are to be observed by Member States in order to achieve the stated objectives in Article 1 of the proposed Directive. "These measures can be considered as constituting established international best practice in the field of spent nuclear fuel and radioactive waste management, and cover such aspects as public health, environmental protection, nuclear safety, financing and governance. Many of these measures may be a part of current policy in many Member States." (ibid, p. 9).

But rules on safety of nuclear installations and on decommissioning funding are not directly mentioned as responsibility of the EURATOM Community under the EURATOM Treaty and Article 30, 31 cannot serve as legal basis. Decommissioning clearly is a question of safety of nuclear installations and thus not within the discretion of the EURATOM Community.

Since there is no room for an application of EURATOM on the technical and organisational problems and tasks related to decommissioning, it is not necessary to examine whether Article 203 EURATOM treaty could apply. Article 203 allows appropriate measures for the Council on proposal by the Commission, but only if one of the objectives of the EURATOM Community and the EURATOM Treaty is addressed. As shown above, the EURATOM treaty has no objectives for the Community to regulate the technical or financial aspects of decommissioning, EURATOM cannot be chosen as basis for a regulation of decommissioning in the proposed way. Therefore neither Article 30 nor Article 203 could serve as basis.

The same incompatibility of the EURATOM treaty provisions as basis for the regulation is valid for Article 13 (operating incidents) of the Package Proposal 1. Operating is linked to the technical running of the respective nuclear installations and thus excluded from the scope of the EURATOM treaty.

Article 5 (Programme for the management of radioactive waste) of package proposal 2 obliges all Member States to establish a "clearly defined programme for radioactive waste management" and gives a strict plan for "long-term management" and disposal

with a defined timetable without any concentration on basic standards for health or related issues. Article 7 (Investments) of the same proposal calls on specific investment securities for the assurance of the management according to Article 5.

But financing and governance of the installations etc. for handling waste, information on issues related to the management are not covered by the Community competencies according to the EURATOM Treaty but have ample legal background in the ECT.

The founders of the EURATOM treaty have clearly limited the scope of responsibility of the Community also in the context of EURATOM, this limits have to be respected.

Article 31 EURATOM manifests these limits that EURATOM is not applicable as the basis for legal proposals for decommissioning funding following Article 30 EURATOM. The specific scientific committee following Article 31 EURATOM is established to give opinions on strictly direct radiation and safety issues. It has no competence to give such opinion on financial aspects of decommissioning, fund structures, availability and framework rules on decommissioning. It is a committee of highly qualified nuclear radiation specialist not of experts on competition, energy markets and market compatibility and the financial consequences of different decommissioning rules in the European Union. The Committee can certainly evaluate basic safety standards and their scientific viability and has in the past fulfilled just this function. The group of experts has no legitimate power to comment on proposals that regulate other questions than those strictly related to the correct scientific compliance of the respective rules with basic standards for health and safety, meaning maximum permissible doses compatible with adequate safety, maximum permissible levels of exposure and contamination, fundamental principles governing the health surveillance of workers, see Article 30 Par. 2 EURATOM treaty.

5.2.8 Internal market rules underline ECT as legal bases

Any regulation concerning decommissioning funds for nuclear power stations will have to be based on the Article 175 ECT and on Article 95 ECT since they have direct impact on the internal market for electricity.

Even though the Commission does not explicitly make this link to the ECT it already laid the ground for this in its proposal. This is evident in the explanatory remark to the proposal and in the communication concerning nuclear safety:

"On the basis of regular information from Member States, to be provided every three years, the Commission will produce a periodical report on the state of the funds and will undertake, if necessary, measures to address irregularities which could either compromise the completion of decommissioning or create distortions in the electricity market." (s. draft Directive proposal, p. 6).

"While Member States which have nuclear power stations have made financial provisions to ensure the availability of sufficient funds to cover the expense of decommissioning such plants, their approach to the management of these funds varies

significantly from one Member State to another. In addition, the current situation involves disparities which are a hindrance to the smooth functioning of the internal market and undermine healthy competition in the electricity sector." (s. "Communication from the Commission to the Council and the European Parliament - Nuclear safety in the European Union").

The most recent link to the internal market rules comes from the draft recommendation "Commission Recommendation of … on the management of financial resources for the decommissioning of nuclear installations, spent fuel and radioactive waste":

"In the context of the EC Directive concerning common rules for the internal market in electricity, nuclear decommissioning funding schemes within the EU became subject to high level political discussions between the European Parliament, the Council and the Commission."

Since liberalisation of the energy markets, especially since the Directive 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity became valid, subsequently replaced by Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC, all regulations for the different sources of energy and all production of electricity from energy sources such as nuclear have to be coherent and in line with the internal market regulations, if they have an impact on the internal market. The Commission proposals, especially the envisaged fund for dismantling and related provisions in the Directive proposal on the management of spent nuclear fuel and radioactive waste will have an impact on the activities of the electricity market. Nuclear power stations have entered the general liberalised market for electricity and all regulations concerning this market have to be balanced in view of the above directive. There is not exemption or special treatment foreseen for nuclear energy in this directive.

Keeping the above Nuclear directive proposals and recent draft recommendations for decommissioning funding out of ECT by overstretching all established rules for interpretation of international or supranational treaties the Commission discriminates the ECT and subsequent directives on the internal market.

This is creating a situation where the European Commission itself is violating the effet utile principle in regards to the Directive 2003/54/CE by using a wrong legal ground for action the Commission risks further delay in achieving a reduction of possible market distortion based on different structures of decommissioning funds and their impact on the general energy market.

Interpretation of treaties has to follow established rules as for example in the field of international law laid down in the Convention Vienna Convention on the Law of Treaties from May 1969. A detailed analysis how the European Commission has used these established guidelines is obsolete. Since evidently financing issues in relation to decommissioning is not regulated in EURATOM first and foremost recourse to the ECT is necessary. And in the ECT Article 175 and article 95 ECT give the adequate framework

for legal bases. Only if those options were not regulated in the ECT either the European Commission may have needed to come back to interpretation rules.

An active shift by the European Commission back to ECT as general treaty applicable also for ensuring market balance and availability of funds for decommissioning will earn the Commission and the European Union enormous argumentative power and enforcement clarity especially if based on competition law rules.

ECT, its secondary legislation and introduced international law principles such as polluter pays principle and precautionary principle concerning nuclear energy give the sufficient bases for legal action.

Examples for clear applicability of ECT rules as legal basis in the field of nuclear energy provisions are manifold. The most recent acknowledgement comes from the European Court of First Instance's judgment in the case T-92/02. 26 January 2006 Judgment of the Court of First Instance in Case T-92/02 (*Stadtwerke Schwäbisch Hall GmbH, Stadtwerke Tübingen GmbH, Stadtwerke Uelzen GmbH v Commission of the European Communities).* In this case the main issue concerned the question whether the German scheme of tax exemption for the reserves set up by nuclear power stations does amount to State aid.

Although the Court of First instance denied state aid in its judgment, the Court nonetheless states very clearly that the "examined tax exemption amounts to an economic advantage granted through State resources in so far as the State waives its right to levy a certain amount of tax revenue"[8] and made no objection against the principal applicability of competition rules also in the field of decommissioning funds for nuclear installations.

And the European Commission has repeatedly applied competition rules to the nuclear sector.

An interesting decision in view of decommissioning funds is certainly Commission Decision 2005/407/EC of 22 September 2004 (OJ L 142, 6.6.2005) on the State aid which the United Kingdom is planning to implement for British Energy plc.

In the same context lies the Commission Decision (2006/643/EC) of 4 April 2006 (OJ 27.9.2006, L 268/37) on the State Aid which the United Kingdom planned to implement for the establishment of the Nuclear Decommissioning Authority.

These decisions support the herewith proposed legal analysis of cohabitation of the two treatises and fact that even though relations and principles of the EURATOM treaty are to be considered the evaluation of violation of competition rules is evaluated under ECT competition rules. The following reasons of the Commission in its decision 206/643/EC are especially noteworthy:

8 See press release No 06/06 of the Court of First Instance as of 26th of January 2006 (CJE/06/6)

"The notified measure further reinforces the fulfilment of the Euratom Treaty objectives by ensuring that the public intervention will not be used for other purposes than the decommissioning of obsolete nuclear facilities and the safe management of radioactive waste in the context of the discharge of nuclear liabilities." The Commission than evaluates the scheme without any questioning of applicability of ECT under competition rules:

"In order to analyse whether the Measure includes State aid to BNFL and/or to the NDA, the Commission first assessed whether it provided an advantage to these entities."

The most recent decision with competition rules as background is the Commission's decision for formal investigation in state export guarantees by French Export Agency Coface to French Nuclear construction company AREVA for the construction of a nuclear reactor for TVO in Finland.

And the need to re-apply the ECT as bases for legislative proposals also for decommissioning fund matters can be underlined by previous important directives which include regulations on Nuclear without being subject to the EURATOM treaty but to general ECT law:

- Council Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment Nuclear power plants, including their decommissioning, and radioactive waste disposal and long-term storage sites are included in the scope of the Directive and must therefore be subjected to an assessment. There is no mentioning of EURATOM at all, but Annex I of the Directive which relates to project subject to Article 4 (1) shall be subject to an assessment: and Annex I (2) explicitly includes nuclear power stations and other nuclear reactors including the dismantling or decommissions of such power stations or reactors
- These nuclear installations are also included in the scope of the Espoo Convention on environmental impact assessment in the international context and, in the more general context of public information on environmental issues, the Aarhus Convention –(OJ L 073 14/03/97 p.5 cons amending OJ 175 05/07/85 p. 430 cons.
- Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment Again Nuclear power plants, including their decommissioning, and radioactive waste disposal and long-term storage sites are included in the scope of the Directive and have to be assessed accordingly therefore.
- Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption.
- The Directive established the maximum permissible indicative dose from drinking water of 0.10 mSv/year excluding tritium for which there is a separate limit of 100 Bq/l, potassium-40, radon and radon decay products), which could be important in

areas affected, for instance, by uranium mining activities or other sources of radioactive contamination – see OJ L 330 5/12/98 page 32 cons.

In using only ECT rules, the Council respectively Council and European Parliament on proposal by the European Commission clearly distinguished between legal acts which fall into the sole discretion of EURATOM rules and legal acts which have their basis under ECT.

As summary it is proposed to apply only Article 95 and Article 174 for regulative directive proposal on decommissioning funding. Also the recent draft recommendation would be based on ECT and not EURATOM.

5.3 Secondary legislation and introduced international law principles

5.3.1 European Commission is obliged to act

During discussion of the Nuclear package and its above directive proposals, arguments were heard which expressed that since EURATOM treaty does not give any legal basis for the European Union to act; only Member States could act within their own discretion to reform for example the decommissioning sector and the financial background to it.

Conclusion was formed by some Member States that the European level has no legal possibility to act in way of legislation. This is - in the light of ECT and settled principles - certainly not correct. The European level is - viewing its specific role of dismantling of some Eastern European Power plants and the role of the Commission as owner of fissile material according to EURATOM - even obliged to act.

As soon as the European Commission would follow the here presented ECT approach and would chose Article 95 and 175 as ground for drafting of legislation any such doubt would be removed, and the European Commission could set a framework which contributes to harmonisation of the decommissioning financing approaches, thereby contributing to harmonisation of the liberalised electricity market.

5.3.2 Precautionary Principle

The European Union represented by the European Commission has direct legal responsibility to secure an overall system for decommissioning funds and management of those funds following the principles laid down in Article 6 of ECT and subsequent development of the high standard of environmental protection in Europe.

The most important principle in this context is the Precautionary principle. The precautionary principle or the precautionary approach in international environmental law has become integrated part of customary international and European law. The precautionary principle is part of many international declaration and conventions such as the OSPAR Convention. It is now well established in the European legislation and part of mainstream politics.

Several principles of international environmental policy, some first enunciated in the Stockholm Declaration, were crystallized through the Rio process. Among them, were the principles of precaution, polluter-pays, sustainable development, common but differentiated responsibility, and environment impact assessment. Since Principle 15 of the Rio Declaration, which demands, that in cases when serious harm is threatened, positive action to protect the environment should not be delayed until irrefutable scientific, proof of harm is available. The Precautionary principle requires in its strongest consequence a reversal of the normal burden of proof, so that a potential actor would need to prove that a proposed activity will not cause harm before it can be sanctioned. It has been endorsed by virtually all recent environmental treaties, including regional treaties such as the 1992 Maastricht Treaty on European Union, the 1992 Paris Convention on the North East Atlantic, the Helsinki Convention on the Baltic, and global environmental treaties such as the UNFCCC, the Convention on Biological Diversity, and the 1995 United Nations Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks. A Member State or the European Union as such interested in undertaking or continuing a particular activity has to prove that such activities will not result in any harm, rather than the opposite that others have to prove that it will result in harm.

This principle opens towards the necessity of making efficient environment-related decisions concerning the potential future harm of a particular activity.

This principle and its application in European Union law since Maastricht obliges also the European Commission as guardian of the treaty to enforce its application in the field of decommissioning funding. The European Union cannot wait and see having obvious evidence of the inequality of funding schemes, risks for availability of sufficient funding and decommissioning tools, as outlined in this report.

5.3.3 Polluter pays principle

The Polluter Pays Principle is deeply integrated in the European environmental legislation, such as under the different waste regulations or the IPCC directive. The most recent application of the principle in the field of nuclear energy can be found in the Commission Decision (2006/643/EC) of 4 April 2006 on the State Aid which the United Kingdom is planning to implement for the establishment of the Nuclear Decommissioning Authority. The analysis whether the polluter pays principle was sufficiently followed by the United Kingdom formed a major part of the decision process as to see whether the BNFL (British Nuclear Fuel Agency) would by modification of the organisational structure have as consequence that BNFL “could be relieved of charges that it might otherwise have had to bear under the polluter pays principle”. And the Commission came to the conclusion that “estimates show that about 12% of the pollution costs will not be covered by the polluters, which demonstrates that the Measure does not fully implement the polluter-pays principle”.

In the case of decommissioning funds the importance of the Commission to act as guardian of the treaties is supported by its specific role in view of the EURATOM Treaty

and in view of established international and European legal principles introduced since 1959. The Commission is co-responsible as polluter within the framework of the EURATOM treaty.

In order to perform its tasks in line with the EURATOM treaty, the EURATOM Community exercises "the right of ownership conferred upon it with respect to special fissile materials", Article 2 f. EURATOM Treaty. Article 6 EURATOM underlines:

> *"To encourage the carrying out of research programmes communicated to it the Commission may: ….*
>
> *supply, either free of charge or against payment, for carrying out such programmes, any source materials or special fissile materials which it has available;" and*
>
> *"place installations, equipment or expert assistance at the disposal of Member States, persons or undertakings, either free of charge or against payment."*
>
> *Article 197 EURATOM defines special fissile materials as plutonium 239; uranium 233; uranium enriched in uranium 235 or uranium 233; and any substance containing one or more of the foregoing isotopes and such other fissile materials as may be specified by the Council, acting by a qualified majority on a proposal from the Commission.*

With the establishment of the specific Supply Agency the European Community has the ownership right beyond fissile material also for source material and ores, laid down in the Regulation of the Supply Agency of the European Atomic Energy Community amending the rules of the Supply Agency of 5 May 1960 determining the manner in which demand is to be balanced against the supply of ores, source materials and special fissile materials (O.J. L 193 of 25.7.1975). With this regulation, the Euratom Supply Agency has the right of option on ores, source materials and special fissile materials produced in the territories of the Member States as well as an exclusive right to conclude contracts relating to the supply of nuclear materials both from inside and from outside the Community.

Further regulations enforce the ownership authority of the European Community represented by the European Commission:

- Regulation (Euratom) No 3137/74 of the Commission of 12 December 1974 amending Commission Regulation No 17/66/EURATOM of 29 November 1966 exempting the transfer of small quantities of ores, source materials and special fissile materials from the rules of the chapter on supplies (O.J. L 333 of 13.12.1974).
- EAEC Supply Agency: Rules of the Supply Agency of the European Atomic Energy Community of 5 May 1960 determining the manner in which demand is to be balanced against the supply of ores, source materials and special fissile materials (O.J. P 32 of 11.05.1960). This Regulation lays down provisions regarding users' notification of demand and producers' notification of supply. It also establishes pro-

cedures relating to the Agency's role, such as the rules for informing interested parties of supply options, market trends, etc.

- EAEC Commission: Decision fixing the date on which the Euratom Supply Agency shall take up its duties and approving the Agency Rules of 5 May 1960 determining the manner in which demand is to be balanced against the supply of ores, source materials and special fissile materials (O.J. L 32 of 11.5.1960). The Agency began operating on 1 June 1960. Procedures for notification, demand, etc. were regulated.

Following the cradle to grave approach of the Polluter Pays Principle, the Community via the European Commission is thus as much responsible for the adequate and sufficient set up, monitoring and management of decommissioning funds as each single Member State who has nuclear installations on his territory. Failure to act on the side of the European Commission to set enforceable rules for overall guidelines and principles for decommissioning could in principle lead to the same legal recourse as against Member States who fail to act to establish sufficient systems. In the case of the nuclear energy production chain, the Commission is part of the legally responsible core.

5.3.4 Financing of Decommissioning in Lithuania and in Slovak Republic increases responsibility under the Polluter Pays Principle

This direct responsibility of the European Commission is even more underlined for all nuclear installations which are covered under extensive financial support schemes from European budget for decommissioning.

According to the draft recommendations of the European Commission on the management of financial resources for the decommissioning of nuclear installations, spent fuel and radioactive waste " the European Community has, on its own initiative, taken part in the raising of financial resources and provides financial assistance, subject to certain conditions, to various decommissioning projects in the Member States (i.e. Ignalina nuclear power plant in Lithuania and Bohunice V1 nuclear power plant in Slovak Republic) and in Bulgaria (Kozloduy nuclear power plant)."

During the accession negotiations, **Lithuania** committed to closure of Unit 1 of the Ignalina nuclear power plant before 2005 and of Unit 2 by 31 December 2009 at the latest[9]. **Slovak Republic** committed to the closure of Unit 1 of the Bohunice nuclear power plant by 31 December 2006 and of Unit 2 by 31 December 2008 at the latest. While **Bulgaria** committed to the closure of Units 1 and 2 by the end of 2002 and Units 3 and 4 by the end of 2006.

Community support was installed as consequence in a form as to be "seamlessly continued and extended, including throughout the period of the next Financial Perspec-

9 These commitments formed part of Protocol No 4 to the Act concerning the conditions of accession to the European Union of the Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovak Republic.

tives.[10]" The financial assistance covers the decommissioning process "and its non-nuclear consequences"[11].

Given the considerable funding needed for the decommissioning of the above-named installations, the European Union has also accepted that, for the period covered by the next Financial Perspectives, the overall appropriations should be appropriate and the programming of these resources should be based on actual payment needs and absorption capacity. As further explained in Chapter 3.1.7.4 and in the respective country reports in the Appendix to this final report, the European Union became the biggest spender under international aid programmes to finance decommissioning of these plants. The Commission estimates that a total Community contribution of 1.052 billion Euros will enable the European Union to meet its commitments for the period 2007-2013.[12] The Commission had proposed in 2004 the necessary legal framework to ensure Community support to be provided from 1 January 2007 to 31 December 2013.

In view of the above arguments deriving from the polluter pays principle and considering the enormous financial engagement of the European Union from its public budget in this venture in both new Member States the Commission is obliged to ensure a European harmonised legal system for decommissioning.

In conclusion, it can be said that the need to propose a European legal framework on decommissioning funds, the ECT providing with a safe and reliable legal basis, and the special situation of the EURATOM community and the role of the European Community represented by the European Commission as owners of nuclear material and main sponsor of the most problematic decommissioning projects so far legally oblige for specific EC action (directives) in this respect.

10 See: European Commisison, 29.9.2004, COM(2004) 624 final - Proposal for a COUNCIL REGULATION on the implementation of Protocol No 4 on the Ignalina nuclear power plantin Lithuania, as annexed to the Act concerning the conditions of accession to the European Union of the Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovak Republic "Ignalina Programme" - Proposal for a COUNCIL REGULATION on the implementation of Protocol No 9 on the Bohunice V1 nuclear power plant in Slovak Republic, as annexed to the Act concerning the conditions of accession to the European Union of the Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovak Republic (submitted by the Commission)

11 COM(2004) 624 final

12 COM(2004) 624 final

6 Conclusions and recommendations

6.1 From the analysis of existing approaches to recommendations for future decommissioning financing on Member State and EU level

In the following, overall conclusions and recommendations will be developed for both,

- the national level (recommendations to the Member States and their decommissioning financing systems), and,
- the EU level (recommendations for measures to be initiated by the European Commission / European Institutions).

These conclusions are based on

- the results of the analysis of financial consequences and risks (Chapter 4), which in turn is based on the country analyses (Chapter 3 and Appendix),
- the stakeholder analyses on the national and the EU level (Chapter 1.1, 3.1.9, and as part of the country analyses and as EU stakeholder analyses in the Appendix),
- the legal framework and the possibilities for changes in the legal basis of policies and measures on EU level (Chapter 5), and,
- what can be learnt from decommissioning financing regulation in non-European countries and non-nuclear areas (Appendix).

6.2 How Member States can improve their decommissioning financing systems

6.2.1 Existing recommendations in literature

In 2005, the decommissioning **working group of the nuclear regulators in Europe (WGWD)** declared that national regulatory requirements with regard to decommissioning financing would be important. However, WGWD did not develop such requirements or gave any detailed recommendations on this issue.

More detailed recommendations on decommissioning financing can be found in other international documents. For example, some recommendations were given by participants in **WPDD workshops** (cf., e. g., Pfeifer/Gordelier/Drake 2004). Most important, an international expert committee assisting the **IAEA** (2005), the Technical Group on Decommissioning (TEGDE), published six pages of recommendations on decommissioning financing, addressing private as well as public licensees. These recommendations cover

- Recommendations with regard to long term planning, starting at the time of facility start-up or even earlier: preparation of cost estimates, funding plan, etc.;

- Recommendations with regard to short term planning: update of cost estimate, evaluating the existing trust fund balance, preparation of preliminary transition plan, etc.; and,
- Specific recommendations for
  - Cost estimating following the proposed standardised list by (NEA/IAEA/EC 1999) and including, among others, contingency in the estimate for unexpected costs that are likely to occur (without questioning how far unexpected costs are likely to occur);
  - Collection and Management of funds including, among others, earmarking of assets for decommissioning, and regular review of fund adequacy;
  - Reducing costs including, among others, the enforcement of a rigorous project cost and schedule control system to control costs;
  - Options of decommissioning fund expenditure, including, among others, monitoring of decommissioning fund performance and cost escalation, and adjustment of collections accordingly;
  - Considering social impacts, including, among others, costs of job training for decommissioning, severance funds for redundant employees, and job retraining for employees for future job opportunities.

There are also general recommendations by **NEA** (2006a) based on underlying ethical considerations emphasizing the ‚Polluter Pays Principle' and ‚intergenerational continuity'.

Wuppertal Institute has analysed some principal modes of financing future decommissioning and waste disposal expenditures (cf. Irrek 1996). Based on recommendations developed in this and other studies on this topic in the 1990ies, in 2003, Wuppertal Institute further developed the following list of criteria, which decommissioning and waste management funds should meet (cf. Irrek 2003):

- All nuclear liabilities should be recognized.
- The availability of the funds for all the future decommissioning and waste management expenditures has to be ensured. The organisations which are responsible for the liabilities must have the capacity to pay when the actual expenditures arise.
- Future generations should not have to pay for the present beneficiaries of nuclear power. General equity generations and the “Polluter Pays Principle” call for the establishment of measures ensuring that funds are set aside when the future liabilities are generated.
- The annual provisions should reflect changes in estimated prices and costs.
- The nuclear power plant operators should not have any access to these funds. At least, the access should be strictly limited.

- An independent body should effectively control how the accruals are set up, how and for what purpose they are reversed and how the funds are used in the meantime.
- The constitutionality of the approach has to be verified.
- Transaction costs should be minimized.
- Transparency to the public should be ensured.

Recently, **KPMG and NRG** (2006) analysed the financial risks of the existing internal, unrestricted decommissioning financing system of the nuclear licensees in the Netherlands. KPMG and NRG suggest three alternatives to increase financial security:

- Bank guarantees
- Dedicated fund (different types analysed: individual internal / central external / central individual): “Een fonds dat juridisch is afgescheiden van de overige activa en passiva van de vergunninghouder is de vorm die de meeste zekerheid bidet.”
- Other measures which ensure that decommissioning costs will be covered.

With regard to investment of funding means, KPMG and NRG suggest different investment policies/rules for the first years of operation of a nuclear facility, for the years immediately before the final shutdown and for the years after the final shutdown, so that duration of investment in assets meets duration of liabilities.

The following recommendations are based on the financial risk analysis presented in Chapter 4, which in turn is based on the country analyses in Chapter 3. However, when developing these recommendations, existing recommendations in literature like the ones described above, examples from non-EU countries and non-nuclear areas (Appendix), statements by stakeholders interviewed in the course of this project (cf. the results of the stakeholder analysis in Chapter 3) and the general legal framework for possible changes in decommissioning financing schemes on EU level and in the Member States (Chapter 5) were taken into account.

6.2.2 General recommendations based on the financial risk analysis

6.2.2.1 Risks identified

The objective of “Decommissioning Financing Systems” is to ensure the availability of an adequate amount of financial resources for decommissioning by the time decommissioning activities have to be carried out in order to assure the health and safety of workers and citizens. As analysed in Chapter 4, the complex field of decommissioning financing includes the following risks, which could adversely affect this objective:

- risk of insufficient transparency and clarity of liabilities and how they are and should be covered;
- risk of inappropriate recognition, measurement and disclosure of liabilities;

- risk of change in ownership;
- strategic risks linked to inverse investment pattern, tempting private or public operators or fund managers to conflicting use of financial resources, or for provisions lagging behind liabilities;
- risks linked to further conflicting use of financial resources, particularly in the course of intensified competition and preparation of privatisation due to the process of liberalisation/re-regulation of the energy markets;
- risk of debt burden of governments (i. e. debt burden of future generations);
- risks of early closure because of incidents or accidents or other unforeseen event;
- risks of changes in decommissioning regulations, e. g. caused by new scientific knowledge gathered or new political decisions made, leading to increased decommissioning costs;
- risks of changes in the general economic or political framework, in the behaviour of important stakeholders, or other unexpected changes leading to increased decommissioning costs.
- risks of insecure investment; in particular, risk of correlation between nuclear and investment risks;
- risk of investment not matching the duration of liabilities;
- risk of insufficient investment performance;
- risk of authorising payments in advance (before expenditures for decommissioning activities can be proven) or although not justified to their full extent;
- risks of insufficient degree of independence of the different functions within the governance chain;
- risks linked to inadequate competence and know how particularly of fund managers, but also of regulators, auditors, and other stakeholders;
- risks of inefficient systems of checks and balances / inherent inefficiency of selected regulations;
- risks linked to the existence of two or more different decommissioning financing methodologies in one market;
- risks linked to already existing under-funded situations;
- risks of insufficient sanctions in case of non-compliance with decommissioning (financing) rules.

6.2.2.2 Key themes of any risk reducing recommendation

A decommissioning financing scheme should be designed in such a way that it eliminates or mitigates risks and uncertainties as far as possible. To achieve this, the follow-

ing key themes have to be addressed (cf. Chapter 4 for the importance of these aspects):

- How can it be assured that adequate provisions are set up according to the ‚Polluter Pays Principle', even in the case of early shutdown or unexpected events that lead to unplanned cost increase;
- How can transparency be increased;
- How can independence be assured (cf. Chapter 4.2 with regard to this particular aspect);
- How can a uniform accounting treatment be introduced;
- How can a possible misuse of funds be avoided, and,
- How can a professional, risk adjusted investment policy be promoted?

In the following sections, several "risk reducers" (possible measures, restrictions, "fences") are described, which address these key themes and can be used to manage the risks identified. Risk reducing measures can be regarded as restrictions or „fences" to a decommissioning financing system. Different methodologies need different „fences".

An effective and efficient system of authorisation, audits and sanctions, checks and balances, can ensure that the key themes mentioned above will be effectively addressed, and that risk reducers will be implemented contributing to reducing risks and uncertainties. In following, several important risk reducers are shortly described.

6.2.2.3 Measures to increase transparency and clarity

Transparency is a key issue for any internal and external solution. Chapter 6.3 and Chapter 7 contain detailed recommendations how to increase transparency, which should be pursued not only on the level of the Member States but on the European level.

Experience shows that it is not always evident that adequate financial means are timely available to process decommissioning activities (cf., e.g., the case of THTR in Hamm-Uentrop, Germany, the case of Bohunice A1 in Slovak Republic, or the case of the Italian NPP at the time of the decision to finally shut them down). Experience also shows that this failure is not only caused by the decommissioning financing methodology chosen.

This remark leads to the quality level of procedural organisation. Given a basic decommissioning funding methodology, an operator has to define and establish a procedural organisation, which is effective, clear and transparent. The procedural organisation must contain any additional measure (restriction, „fence") which is deemed to be necessary and it must be explained how the implementation is periodically monitored.

6.2.2.4 Measures to assure a high degree of independence in order to avoid possible conflicts of interests

6.2.2.4.1 Independence criteria

In general it can be observed that, given the many possible conflicts of interests, the highest degree of independence between all involved members of the governance chain (cf. Figure 2) is paramount.

Independence means that independent criteria should be defined. Such criteria should cover

- The organisational and structural independence between the operators (entity) and the authority, and,
- The personal independence of the executive employees.

6.2.2.4.2 Independent licensing authority

In particular, the independence of the licensing authority is a key factor, as it has to align different objectives from different stakeholders. Independence criteria should be defined in general and for executive employees of an authority in particular.

In this context, it could be recommended that executive employees of an authority should not have been employees of an operator (be it private or public) or, at least, that a cooling period should be met. Furthermore, it might be sensible to split technical and financial oversight on decommissioning within the nuclear authority.

6.2.2.4.3 Independence of decommissioning fund manager from operator

The governance analysis depicted that internal and external methodologies need selected additional checks and balances measures. However, solutions should be strived for with a minimum of necessary additional measures. All additional measures cause additional costs and carry the inherent risk of inefficiency. Any control measure, which could be avoided, should be avoided. In principle, external approaches ensuring independence of decommissioning fund management from operational tasks reduce the need of additional measures of checks and balances (cf. also KPMG/NRG 2006).

Internal unrestricted decommissioning financing schemes even do not secure a minimum degree of independence, and thus inhibit a high potential for possible conflicts of interest. This is both true for private as well as for public licensees. In addition, internal funds contain some risk with regard to the question if assets accumulated in this fund can be sufficiently claimed after decades of operation, given the assumption that there exists a risk of bankruptcy for all companies over a period of at least 60 years, which is a minimum operating life and time to complete decommissioning.

Therefore, internal unrestricted decommissioning financing schemes should develop towards the direction of restricted funds, with at least some kind of separation of funds.

This conclusion is valid both for private and for public licensees. Public licensees should not pay decommissioning costs from the current budget, but should build up provisions, too. Private as well as public licensees should ensure a minimum degree of independence of the functions (1) facility operation / technical decommissioning activities and (2) decommissioning fund management.

6.2.2.4.4 Separating the power of authority to dispose of collected means of finance

A main conflict potential always remains with the entity that disposes of the power of authority to use the funds set aside. Therefore, one concrete measure would be to separate the power of authority of disposal of decommissioning fund and the contributor of the payments to the fund (operator), while at the same time not reducing any incentives to reduce costs of decommissioning activities.

If the power of authority to dispose is with a third party, the degree of independence between the third party and the operators can vary significantly. Therefore, in each case, the degree of independence has to be separately assessed.

Example*: „In France, private operators have to set aside internal restricted funds covered by dedicated assets. These assets seem to be well protected by the new waste law. The law stipulates earmarking of decommissioning funds (assets) and separate disclosure. In addition the law protects the assets and nobody, besides the state in execution of its right to enforce the operators' obligations to decommission can claim any right over the assets"* (Source: Country report France in the annex to this final report). Such a protection of the assets substantially improves the quality of a decommissioning methodology applied.

In order to ensure that the company owning the plant and being responsible for its decommissioning activities makes no unreasonable profit with its decommissioning unit, rules for transactions with related parties will have to be implemented, if the power of authority to dispose funds is not fully separated from the contributor to the fund.

6.2.2.4.5 Independent national body providing expert judgement on fund management and decommissioning cost matters

As recommended by the Commission in its recently published recommendations, a national body should be set up or appointed on a national level, where not already provided for, capable of providing an expert judgement on fund management and decommissioning cost matters. The members of this body should be independent from the licensees and the government. This body shall further contribute to increasing transparency and enabling oversight.

6.2.2.5 Introducing a uniform accounting treatment

On the level of the Member States as well as on the European level, generally accepted accounting principles (GAAP) should be applied to all public and private licensees in the same way in order to increase transparency and comparability of

decommissioning cost estimates and financing schemes. This report recommends applying the International Financial Reporting Standards IFRSs® together with clarifications (EU interpretations and guidance) as outlined in Chapter 4.3.8 in order to improve the reliability and comparability. The scope of liabilities thereby taken into account could follow, e. g., the proposed standardised list by (NEA/IAEA/EC 1999).

Applying the "current budget" methodology does not meet the qualitative characteristics of modern accounting and is a possible source of failure in decommissioning financing.

6.2.2.6 Measures to avoid deviations from the ‚Polluter Pays Principle' even in case of early shutdown or other unexpected events

6.2.2.6.1 Operating license

In some countries, the fulfilment of liabilities (operational and financial) related to nuclear decommissioning is an absolute condition for the continued validity of the **operating licences** of nuclear facilities. For instance, in Finland, according to the Nuclear Energy Act (section 26), the Government must cancel the operating licence wholly or partly, if the licensee is omitting to fulfil the financial provision obligation for nuclear waste management and decommissioning at the start of operation of the plant.

In addition, it is important that operating licenses also contain requirements for the cases of bankruptcy and change in ownership of a nuclear power plant. It must be prevented that the responsibility for decommissioning is separated from the nuclear power plant owner through a change in ownership. Therefore, it must also be assured that, in the case of a change of ownership, all decommissioning liabilities are transferred to a new owner or that the liabilities are secured by other measures. In no case should a situation evolve where no financially solvent legal entity remains responsible for the liabilities.

6.2.2.6.2 Transparent and enforceable contractual agreements between mother and daughter companies and integration of such agreements as requirement into the licensing process

In this context, the **relationship between mother and daughter companies** has to be carefully examined. For example, in case the licensee is a limited company belonging to a large corporate group, it should be ensured that contractual agreements between both are designed in such a way that the corporate group will cover all liabilities of the limited company in any case of bankruptcy of the daughter company („deep pocket liability"). Such contractual agreements should be integrated into the licensing process at start of operation and should not be affected by any transfer of ownership.

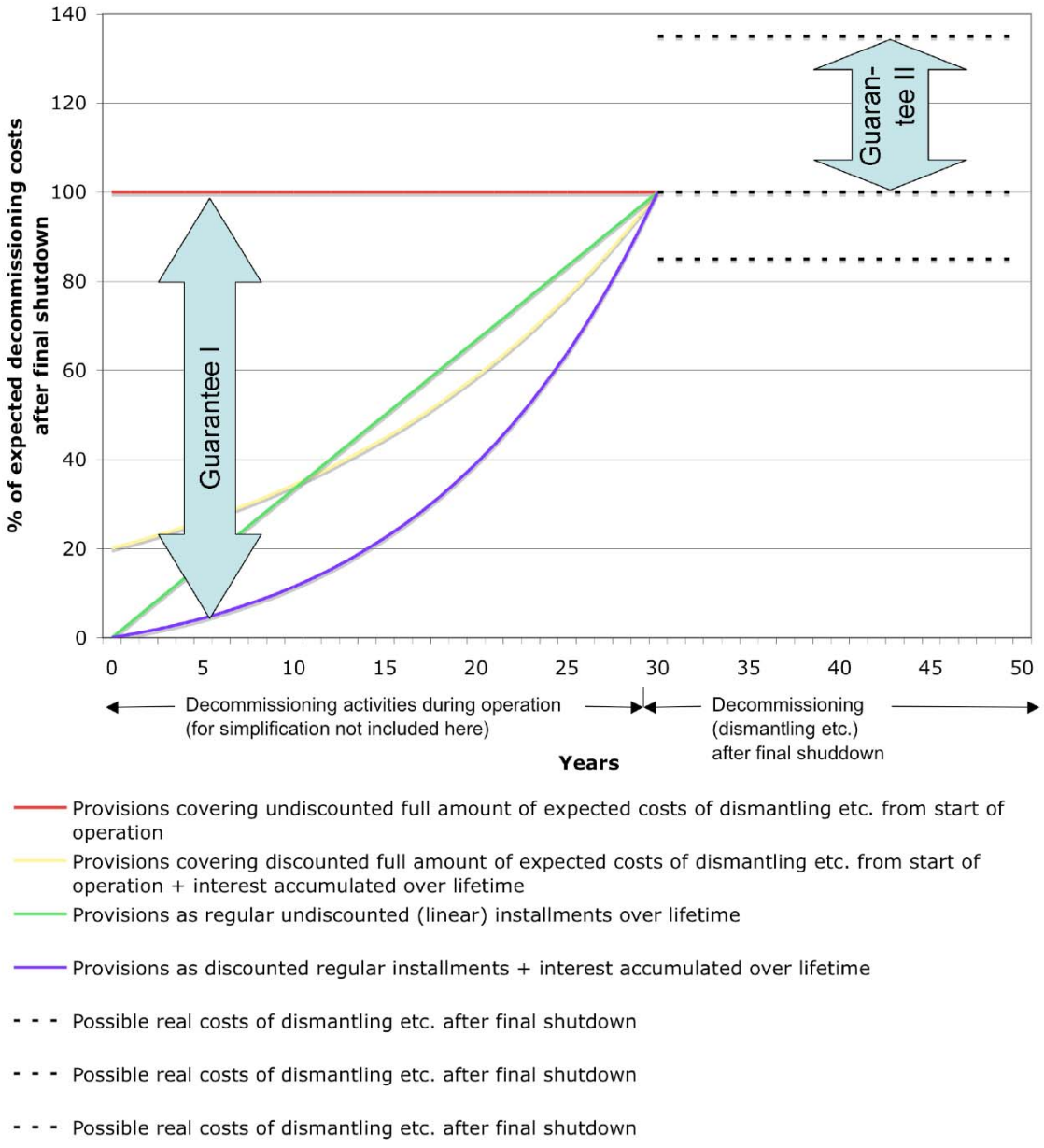
6.2.2.6.3 Two kind of guarantees

Following particularly the Swedish example, in addition to the principle financing scheme providing for the „normal" case of having to pay for decommissioning activities as

as expected and estimated, guarantees should be established to cover the following two kind of risks (unexpected events):

- Risk of an early shutdown, to be covered by Guarantee I;
- Risks of inadequate fund balance in the end after the final shutdown, e. g., due to unexpected cost increase or fund mismanagement, to be covered by Guarantee II.

Figure 5: Guarantee I and Guarantee II covering financial risks related to decommissioning costs occurring after final shutdown of the plant (dismantling, etc.)



Source: Wuppertal Institute, et al., 2006

However, **Guarantee I** is not or only partly needed in case the full amount of decommissioning liabilities related to activities after a final shutdown of a facility is already covered by provisions from the start of faculty operation, as it is required in Finland (undiscounted amount to be provided at start of operation) or partly in France (discounted amount to be provided at start of operation). Therefore, as it can be seen from Figure 5, the size of Guarantee I depends on the way provisions are set up. It should be noted that, for reason of simplification, Figure 5 only refers to costs of dismantling, decontamination and demolition and other costs occurring after final shutdown, and neglects decommissioning (e.g., waste management) activities already taking place during operation.

Guarantee II is not needed as far as additional means of finance are individually secured in other ways, as it is partly done in Finland by supplementary securities which the Ministry has to require from the licensees covering up to 10% of the assessed liability.

There are several possibilities how to set up such guarantees in order to ensure adequate and available financial resources at the time needed. However, in any case, extreme cost increase due to major incidents or accidents, which should be covered by a Guarantee II scheme, cannot be fully accounted for on an individual plant base. It would be unreasonable to base the cost estimates for decommissioning on the assumption that each nuclear facility will encounter a major accident during their operational lifetime. Therefore, for such a case, solidarity agreements between the operators of nuclear power plants, group insurances or similar approaches might be suitable solutions. However, this is, of course, a problem for countries where only few nuclear facilities are under operation, or where those few nuclear facilities all belong to a single company. In these cases, with inclusion of an appropriate insurance or provision for such rare cases like accidents or major incidents or other unforeseen events, the facility might not be operated economically anymore. Another possibility would be some international pooling solution. Nevertheless, regulation should assure that the ‚Polluter Pays Principle' will be followed also in such cases as far as possible.

In particular, guarantee or similar solutions covering the two kind of risks mentioned above could be the following:

- Pooling/Solidarity solution: All operators of nuclear facilities (in a country, or in case of countries with only few facilities, in a region) collectively finance a guarantee fund (solidarity fund) by paying a fraction of the total contribution, which they periodically pay into their own decommissioning fund, into the guarantee fund. The amount paid in a common fund could be based on probabilities (benefit from the risk diversification effect). Whereas a single fund of an operator should not calculate with probabilities because no risk diversification effect can be achieved with single solutions. Social insurance and pension fund systems undertake such common schemes.

- The guarantees can be insurance products, which are financially secured by general insurance regulation.
- The guarantees can be bank guarantees or special bank products as long as they are financially secured by general banking regulation (cf. KPMG/NRG 2006).

6.2.2.7 Avoiding any misuse of funds and implementing a professional, risk adjusted investment policy

Investment guidelines should be set dealing with the trade-off between high performance and high security and describing the required **qualifications of investment managers**.

A professional **asset & liability management** should be implemented for all private and public facilities, with matching durations of liabilities and assets. Furthermore, incentives should be set for a high performance within the boundaries set by the investment guidelines, thereby trying to overcome any principal-agent problem. Special attention has to be paid to lending practices to related parties.

A periodical evaluation of the financial risk rating (solvency) of the operators (mother and daughter/consolidated view) should be undertaken. **Audits** by certified auditors on the state of provisions, the state of the decommissioning funds and the investment policy should be carried out.

6.3 Increasing transparency and oversight - First steps proposed at EU level

6.3.1 Additional reporting requirements – Information rights

One central problem is the many financial risks and uncertainties involved in decommissioning financing for a variety of reasons. A way towards better recognition of financial risks, more accurate cost estimates and improved learning how to deal with financial risks and uncertainties, is to initiate a steady process of discussion, regularly cost updates and data exchange on cost estimates, fund accumulation and fund management, and on further experiences with the different decommissioning financing systems on EU level. Such a process has already started:

- The European Commission produces annual reports to the European Parliament and the Council on the use of financial resources earmarked for the decommissioning of nuclear power plants.
- The European Commission has initiated studies leading to a better overview and understanding of decommissioning financing issues in the EU.
- The Council has established a working group, and the Commission has initiated a Decommissioning Funding Group, in which country experts exchange information on decommissioning financing. The importance of this group has been further

strengthened by the recently issued recommendations of the Commission. The Commission sees the Decommissioning Funding Group as a lynchpin of future work on this issue.

However, in order to have a further improved, regular and stable data and information basis for such a process of increasing transparency, **additional reporting requirements** should be set for the Member States and the European Commission's own nuclear facilities. A benchmarking system looking at specific indicators could be based upon this. How such a reporting and benchmarking system could look is explained in detail in Chapter 7.

A perceived barrier towards implementation of such a step might be the possible trade-off between

- the degree of detail of data and information needed to ensure sufficient transparency and oversight of the decommissioning financing system, and
- the degree to which transparency affects competition of companies highly specialised in decommissioning activities.

However, according to the experience of this project and discussions with stakeholders from decommissioning industry, the level of detail proposed in Chapter 7 will not affect competition at all. In contrast, the data and information gained will improve transparency in the market, and thus lead to a more competitive environment in the end.

Furthermore, at the same time, such reporting requirements, if properly forwarded by the Member States to the nuclear operators and decommissioning fund managers in the course of the national implementation processes, could be understood as a right of the public for access to information. Such an information right should be implemented in order to ensure a minimum level of a participatory process and to lay a basis for effective protection of EU citizens. This is needed because of the substantial risks for health and environment of the back-end activities of nuclear installations having impacts not only for todays but also for future generations of EU citizens.

6.3.2 Council of European Nuclear Decommissioning Funds (CENDF)

The whole process of increasing transparency could be further supported by the installation of a **Council (of Trustees) of European Nuclear Decommissioning Funds (CENDF)** on the EU or European level or a similar kind of committee. Like, for example, the Council of European Energy Regulators (CEER), such a board does not necessarily have to be part of the European Commission. It can be an independent „not for profit association", which

- acts as a focal point for contacts between the national decommissioning fund managers or trustees or other representatives of the national decommissioning financing systems in the different Member States,

- is their interface at the European level with the European institutions on nuclear decommissioning financing,
- has strong linkages to the European Commission's Decommissioning Funding Group advising and assisting the Commission in ensuring financial security of decommissioning funding in the EU, and
- facilitates the process of increasing transparency on nuclear decommissioning financing in Europe,
- agrees on good practice and consequently contributes to improving the existing systems, and finally,
- contributes to a higher degree of harmonisation of decommissioning financing methodologies in the European Union.

Members of CENDF could be the managers of external funds, representatives of managers of internal funds, representatives of governments, and independent financial experts, i. e. that in this case independency of members of the council or committee from the licensees and governments is not ensured, because the exchange of best practice experience between the actors in practice is of high importance here.

The CENDF should not question the existence of the Decommissioning Funding Group initiated by the European Commission which could further exist to accompany the whole process, and to advice the Commission in EU funding of decommissioning projects, with the European Commission having strong role in it compared to the CENDF or to the European Nuclear Decommissioning Oversight Board (ENDOB) proposed in Chapter 6.4.3.

How far the CENDF could or should be further replaced or complemented by a European Public Oversight Board, with members independent of the licensees and the governments, and with more competences, as suggested as a result of the financial risk assessment from the governance perspective (cf. Chapter 4.2.6.2), will be discussed in Chapter 6.4.3.

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

6.4.1 Justification of possible further regulation

According to the experiences with the European Commission's draft directive of 2003 under Article 31 of the Euratom Treaty on nuclear safety ("nuclear package") and discussions with stakeholders in the course of this project, further legal steps on the European level appear not feasible at the moment. The political window for additional regulations concerning decommissioning financing on the European level seems to be currently rather narrow. This is why the European Commission (2006) has recently issued only recommendations and not a new directive on this issue.

However, if the European institutions not only considered the Euratom Treaty as the most important legal basis for dealing with decommissioning financing issues, but moved back to the ECT rules and especially Article 95 together with Article 175 on environmental grounds like it has been argued in Chapter 5, further regulation of decommissioning financing at EU level would be justified. In this context, the Commission should not base its action on safety issues only, but should focus more con competition aspects, which have not been subject of analysis in this project.

Nevertheless, the study has confirmed that there are significant differences in the accumulation, management and accessibility of decommissioning and waste management funds in Europe. Therefore, the European Commission (2006) claimed, that „without prejudice to the general principle of subsidiarity, a certain degree of harmonisation should be suggested with regard to the concepts used in decommissioning matters“. Economists like Hensing et al. (1997) already analysed in the 1990s that these differences explained a significant part of the differences in power generation costs between countries in Europe. Following this argumentation - without having the possibility to analyse these aspects in more detail here - would mean that a distortion in competition between different NPP operators but also in competition between NPP operators and electricity generation from other energy sources, as well as the heat market, as far as heat produced from electricity is concerned, could be assumed. Following the argumentation in Chapter 5, and concentrating more on these competition aspects, further regulation on EU level could be justified.

6.4.2 Elements of a possible EU Directive

A possible future regulation could be a European Directive addressing general requirements with regard to decommissioning financing like the ones described in Chapter 6.2.2. This regulation should particularly concentrate on issues of transparency and independency („unbundling“) of the different functions with regard to decommissioning activities, their financing, their authorisation, and their monitoring and control, because conflict of interest leads to pressure to compromise safety in a competitive environment. Thereby, the possible Directive should take the different historical developments and future planning for the nuclear sector in the different countries into account, not prescribing any specific „ideal“ type of decommissioning financing scheme, but leading to an improvement of the existing schemes. The Annex of such a possible Directive could include specific recommendations with regard to good practice of decommissioning financing schemes.

However, such a possible Directive would only be needed if the following steps failed or did not lead to substantial improvements:

- The ongoing process of increasing transparency and learning from each other within the Council’s working group and the Decommissioning Funding Group,
- The recommendations on decommissioning financing issued by the European Commission in October 2006, and

- The steps of increasing transparency and oversight described in Chapter 6.3.

6.4.3 From CENDF to a European Nuclear Decommissioning Oversight Board (ENDOB)?

6.4.3.1 Possible fields of activity of the ENDOB

After experiences with the proposed Council of European Nuclear Decommissioning Funds (CENDF) have been made, it should be evaluated how far such a CENDF should be replaced or completed a European Nuclear Decommissioning Oversight Board (ENDOB), consisting of persons being independent from the licensees and the governments, and with more competences, being able to set general principles and framework guidelines and monitoring their implementation (e. g., proposing the elements of the possible Directive described before, and monitoring its implementation).

Fields of activity/responsibility of such a board or committee could be:

- Definition of accounting and auditing rules in order to adequately recognise, measure and disclose relevant liabilities and the assumptions and methodologies of estimating decommissioning costs;
- Setting decommissioning financing principles and framework guidelines and monitor their enforcement
- Developing and proposing „good practice“ of decommissioning funding methodologies according to recent developments (preferred solution).
- The general principles and framework guidelines should
  - improve the good functioning of systems and have the purpose of enabling any decommissioning methodology, which meets the agreed standards (subsidiarity principle).,
  - enforce transparency in all matters,
  - enforce independence of all involved parties,
  - improve accounting and auditing rules (by proposing accounting clarifications)
  - set framework guidelines for investment practices which guarantee a safe investment system and which define the acceptable risk levels.
- Moreover, the board or committee should propose methodology-specific additional measures („good practice“ of additional restrictions or „fences“ for different types of decommissioning financing schemes).

In this context, this board could become a key element embracing all possible decommissioning financing solutions (to oversee and regulate different solutions) meeting the agreed standards, and enforcing the highest possible safety of different methodologies.

Such an organisation could also be compared with the state supervision in other industries where safety, reputation and confidence are key. A typical example is the banking sector, which will be explained in the following subchapter.

6.4.3.2 Experience of financial markets with oversight boards

The overwhelming meaning of independence between all involved parties has been clearly outlined. In this context, financial markets can provide a deeper insight into the concrete implementation of strategies aiming at strengthening the well functioning of systems.

The US regulators have enacted the Sarbanes Oxley Act in 2002 (SOX) as a reaction of severe accounting and auditing problems/failures (Enron and WorldCom cases). The aim of SOX is to enforce and strengthen the independence of the control system and thus to better protect shareholders and all other important stakeholders from possible accounting errors or even fraud. The SOX establishes detailed standards for corporate boards and audit committees, new standards for the independence of external auditors. In addition, the SOX follows a fourth avenue by establishing a “Public Company Accounting Oversight Board” (PCAOB) under the SEC (Security and Exchange Commission). The SOX is very stringent as it also entails various sanctions including fines and imprisonment in case of non-compliance.

Similar legislation exists in Germany where the APAG law (Gesetz zur Fortentwicklung der Berufsaufsicht der gesetzlichen Abschlussprüfer) has been enacted in 2004. The aim is also to strengthen/sustain the confidence of the public in the auditing profession. The APAG aims, analogous to the PCAOB, to improve the quality of external auditing and entails a Commission (Kommission für die Aufsicht über die Abschlussprüfer in Deutschland). This Commission is exclusively composed of non-auditors in order to guarantee independence (Source: Corporate Governance in Deutschland; Rasche Entwicklung und hohe Regelungsdichte by Funk, Rossmanith and Alber in: Der Schweizer Treuhänder 2006/9).

7 Reporting requirements – Data and information needed for comparison of different approaches in the EU

7.1 Overview

Transparency is seen as an essential part of ensuring market, environmental and security of supply protection in all areas of the energy sector. In relation to decommissioning and radioactive waste management funds, transparency is of even more importance, due to the size of funds involved, the impact on the market and environment, the lack of certainty over all the technical and therefore financials details and the fact that funds are collected decades prior to their use.

The sharing of experiences and expertise can help to remove some of the uncertainties around the financing of decommission. In order to increase the confidence in and value of the information provided, information needs to be provided on a regular basis. In 2003, the European Commission stated that it "intends, within the scope of its responsibilities of the Euratom Treaty to publish an annual report on the use of decommissioning and waste management funds". To ensure that accurate and upto date information is used Member States should be asked to provide annually data and information to the Commission for report.

The following proposal contains elements of such a report by the Member States. However, looking at benefit-cost relation of reporting, it might be sufficient to collect parts of this information [especially those relating to the tertiary level] biannually or triannually instead of annually. The reporting requirements proposed are divided into three levels:

- **Primary level**
  The six primary indicators enable a rough comparison or benchmarking. The indicators should reflect the overall financing of decommissioning and waste management activities in each Member State. This information will allow comparison between Member States as to the degree in which funds are being collected and guarantees provided and measured against the expected final costs. Furthermore, it will indicate the measures taken by Member States to ensure that funds are separated from the regular activities of the utility and the measures taken to ensure that the funds will be adequate.
- **Secondary level**
  Secondary data will demonstrate the state of financing for each individual nuclear facility (including the JRC facilities of the European Commission). This may reflect both the differences between different types of facility (for example between reprocessing plants and power stations) and between different designs (for example between gas cooled reactors and light water reactors). This could also function as a basis for facility type-specific benchmarking.

- **Tertiary level**
  Finally, on the tertiary level, more detailed information on the framework, procedures and rules for the financing of decommissioning is given, with respect to the five main categories of the first and the secondary level, i. e. (estimation of) **costs**, (setting up of) **provisions**, additional **guarantees** or similar financial securities, **asset** (fund) management and use of funds for **payment** of decommissioning expenditures. In addition, information on **fund oversight** will be provided.

By providing information on all three levels, the Member States will increase the transparency in the sector and increase confidence that the necessary funds will be available when needed. Furthermore, it will highlight the areas of commonality between Member States and those areas where different approaches are taken.

7.2 Primary level

Information needs to be provided on the extent of the expected costs of decommissioning and the scope of the current funds and guarantees in each country:

1.1 Sum of those estimated undiscounted (overnight) decommissioning **costs** of all nuclear installations in each Member State that are expected to occur *after* the final shutdown of the installations; this includes all civil and dual use facilities.

1.2 Sum of the **provisions** in each Member State accumulated to cover the costs collected for decommissioning, as outlined in point 1.1.

1.3 Sum of the possible costs in each Member State covered by **guarantees** or similar financial securities exceeding the sum of provisions, as outlined in point 1.2. This should detail the mechanisms to cover the estimated decommissioning costs in the event of early closure or expected or unexpected increase in costs.

1.4 Sum of **assets** in separated (segregated, internal or external) dedicated funds in each Member State.

1.5 Average sum of **payments** per year for decommissioning activities for all nuclear installations in each Member State over the previous three years.

7.3 Secondary level

Information needs to be provided on the extent of the expected costs of decommissioning and the scope of the current funds and guarantees for each nuclear facility. This information on the secondary level will already be needed when compiling the aggregated figures on the primary level.

2.1 Sum of those estimated undiscounted (overnight) decommissioning **costs** of each civil and dual use nuclear installation in each Member State that are expected to occur *after* the final shutdown of the installations.

2.2 Sum of the **provisions** accumulated to cover the costs collected for decommissioning for each facility, as outlined in point 2.1.

2.3 Sum of the possible costs covered by **guarantees** or similar financial securities exceeding the sum of provisions for each facility, as outlined in point 2.2. This should detail the mechanisms to cover the estimated decommissioning costs in the event of early closure or expected or unexpected increase in costs.

2.3 Sum of **assets** in separated (segregated, internal or external) dedicated funds for each facility.

2.4 Average sum of **payments** per year for decommissioning activities for each nuclear installation over the previous three years.

7.4 Tertiary level

These questions ask for more detail with regard to the data collected on the primary and secondary level. They can be answered by country if the answers are the same for all facilities, by licensee or type of facility if the answers are the same for all facilities of a specific licensee or type, by facility if the answers differ between facilities.

3.1 **Cost** estimates

3.1.1 What was the date of the cost estimate?

3.1.2 Who has done the estimate?

3.1.3 What was the methodology applied to estimate costs?

3.1.3 Has the estimate been reviewed? If yes, by whom?

3.1.4 How is the scope of costs to be estimated defined and by whom?

3.1.5 What is the decommissioning strategy, and what are the time horizons assumed for this cost estimate?

3.1.6 How have risks and uncertainties been taken into account? Is the degree of reliability of the cost estimate indicated?

3.1.7 How much of expected costs are private licensees/public licensees liable for?

3.1.8 What was the reason for changes in cost estimates compared to last report, if any?

3.2 Setting up **provisions**

3.2.1 Will decommissioning funds be required to be collected prior to start up of new facilities, if so how much of the final decommissioning costs are they expected to cover (either overnight or discounted costs estimates)?

3.2.2 What are the accounting rules applied for setting up provisions?

3.2.3 Are costs discounted for calculating provisions to be made? If yes, what nominal and what real rate of discounting are deployed?

3.2.4 Are funds collected via:

- o Implicit inclusion in electricity prices
- o Separately visible part of electricity bill
- o Taxation
- o Government fee
- o Other?

3.2.4 How is the rate of collection altered in light of changes in the cost estimate, reduced operating output/lifetime or other changes in circumstances?

3.3 **Guarantees** or similar financial securities

3.3.1 Will the licensee have to provide any kind of guarantee, insurance or similar financial security, if decommissioning funds are not required to be collected prior to start up of new facilities up to the full amount of those undiscounted decommissioning costs that are expected to occur after the final shutdown of the installation (Guarantee I)? Please describe the guarantee system.

3.3.2 In how far does the licensee have to provide any kind of guarantee, insurance or similar financial security for any kind of unexpected event that leads to unexpected increase in cost after the final shutdown of the facility (Guarantee II)? Please describe the guarantee system.

3.4 **Asset** Management / Fund Management

3.4.1 Which body is responsible for managing the funds, utility, government, independent body?

3.4.2 How is the fund separated from the regular accounts of the operator/Government?

3.4.3 Are there separate funds for each nuclear facility or for each company/facility, a common fund with sub accounts for each company/facility, or a common solidarity fund with no separation between companies/facilities?

3.4.4 Is it possible for the fund to be transferred to an alternative body/management system?

3.4.5 Are there investment rules for the funds, and who sets these rules? In particular, are there any liquidity requirements?

3.4.6 How are risks of investment managed?

3.4.7 What was the return on investment received on average during the last three years?

3.4.8 Who benefits from investment performance?

3.5 **Payments**

3.5.1 Who has the power to authorise payment?

3.5.2 Are payments possible in advance of occurrence of expenditures or only based on proven expenditures?

3.6 **Fund Oversight**

3.6.1 What body is responsible for ensuring provisions are made and the fund is managed correctly according to national or European regulation?

3.6.2 Is the oversight body independent of the operators/Government, how is it appointed?

3.6.3 Does this body assess the funds and/or the suitability of the fund managers? How and how often is this done?

3.6.4 How often does the oversight body report and who too? Parliament, Licensee and/or Government?

3.6.5 Are there any requirements with regard to decommissioning financing imposed in the operating licenses?

8 References

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Appendix

- EU stakeholder report
- 16 country reports with annexes
- Report with examples of regulation of decommissioning financing in non-EU countries and non-nuclear areas
- Technical overview on dismantling of nuclear facilities in the European Community