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Financial Aspects of Decommissioning

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Over the course of operations, many industries (mining, quarrying, chemical industries) have to plan for end of lifetime costs for their plants, whether dismantling or reconditioning of the sites. The nuclear sector must do so for all of its activities: mining sites, fuel cycle installations, power stations, research centres, factories that produce isotopes, containers, and radioactive product casks. In the nuclear industry, dismantling has a particular character due to the nature of the technical operations, the long term perspective and the amount of money involved. These characteristics have financial consequences in regards to cost estimating and financing, for which there does not exist to date one single answer.

Technical Issues

Various Phases of the Operation

The purpose of decommissioning is to return a former operational plant back to brown or green field site status, using technologies adapted to the nuclear industry. Decommissioning uses radioactivity analysis and measurement techniques, decontamination, cutting, remote-controlled tasks and robotics, treatment, conditioning and evacuation of materials and waste.

Two phases precede dismantling itself:

- Final suspension of operations, during which the fissile materials and radioactive fluids are evacuated and process circuits are rinsed.
- Final shut-down, during which non-necessary materials are dismantled, safety is maintained, the state of containment is checked and a radioactivity assessment is made.

These two phases lead to IAEA Stage 1 classification, characterised by “closed, under monitoring”.

A more intense clean up programme, including site decontamination and partial or total dismantling, can lead to IAEA Stage 2 or 3 classification, depending on future site use and national regulations. Stage 2 status is given to a site when most of the radioactive components have been confined to a particular sealed zone. The site requires less surveillance than in Stage 1, although periodic inspections are still desirable. Stage 3 is when all radioactive materials have been removed and the site can then be released for unrestricted use. In some countries, Stage 3 is a regulatory requirement.

Timing of Decommissioning

Beyond the level of decommissioning to be achieved and the proceedings with the regulatory bodies, the operators have to set up an operational planning process which takes into account the reports and investigations required by the authorities. The question of timing is subject to a wide-ranging debate among specialists and affects future cost estimations. Is it necessary to intervene as soon as the installation has been closed down, or is it better to wait?

The decommissioning to Stage 1 is always immediate. Deferring the passage from Stage 1 to Stage 2 or from Stage 2 to Stage 3 allows the radioactivity of the short-lived radioactive elements significantly to decrease, diminishing doses and the volume of waste to be evacuated. However, waiting does increase the costs related to monitoring and maintenance. Those favouring a speedier dismantling process emphasise the ageing of the installations and the collective loss of memory, or even the exemplary nature of this approach.

Waste Management

Another concern of the operators is the management of the wastes generated by dismantling, which is a component of the complete cost of the operations. Wastes include:

- Non-radioactive wastes (primarily concrete and rubble) which are, a priori, the largest share of total waste.
- Very low level radioactive waste, more than half of which is scrap. Depending on the nature of this waste, its activity and the relevant regulations, this waste can be either recycled or stored in packages in a dedicated facility without posing a danger to the public.
- Short-lived or low-medium level activity waste, which accounts by far for the smallest share. This waste is governed by national regulations which dictate disposal procedures, either in a surface storage or interim storage facility before being sent to a medium level long-lived waste storage centre.

All waste, from dismantling or from operations, will be sent to a long-term storage centre if available or will be stored on an interim basis until such a storage centre is complete. The future costs of storage, which can be relatively large, are subject to the same type of financial treatment as future costs of dismantling (the Cogema UP-1 reprocessing plant at Marcoule, for example).

During dismantling, safety and radiation exposure questions will be raised. Under the ALARA principle, everything reasonable is done to limit doses received by workers or the public. The usual safety criteria will also, of course, have to be respected at all times.

In summary, this short presentation of technical issues clearly highlights that cost evaluations related to closing nuclear facilities, including the cost of decontamination of the equipment, dismantling, conditioning and shipment waste, are complex operations involving uncertainties related to deadlines, changes in technology and evolving requirements for safety and radiological protection.

Technical and Financial Responsibilities

Making sure that the consequences of industrial activities do not harm present and future generations is essential under the principle, widely shared today, that the “polluter pays”. Economic costs generated by future downgrading of nuclear installations have to be evaluated today, knowing that these operations will occur several decades after the start up of the plant. The financing of these operations has to be assured when required.

Evaluation of Costs

It is generally acknowledged that future financial expenses must be presented in the accounts of the operators as accurately as possible. Nevertheless, the methods of evaluation and of presentation of the costs differ from one country to another and even from one operator to another within the same country.

In all countries, total expenditures are estimated based either on costs resulting from the experience in similar situations, or on particulars related to each installation. For example, the cost of dismantling a power plant is generally estimated at 15–20% of the initial cost of construction. Dismantling represents less than 1% of the production cost of each kWh in actualised figures, or 2–3% without discounting.¹

In France, the costs of dismantling nuclear power plants, nuclear research sites and fuel cycle facilities are estimated at FFr170 billion (US\$27 billion),² compared to an order of magnitude of FFr1000 billion (US\$160 billion) invested in these facilities.

Accounting Standards

According to current accounting standards, two methods are used by companies to evaluate expenses which will occur in the future but for which a precise date cannot be attributed:

- The method of current value consists of evaluating future expenses by their present cost. The result is corrected every year for inflation and is

revised periodically for technical and legal changes. In this way, the value of future expenses does not depend on when the expenditure is carried out. This is the method generally used in France and Germany for example.

- The method of net present value consists of calculating the current value by discounting future costs. This method is notably used in Belgium, the United Kingdom and Sweden.

When choosing the method of calculation, the various companies are largely influenced by the legal requirements and accounting practices used in their respective countries, as well as by contractual considerations. The current value method accelerates the making of the necessary provisions. The net present value method is very sensitive to the precise calendar of the forecast expenditures and to the real yield (above inflation) expected in the long run of accumulated capital.

Under the current value method provisions are made gradually during the operation of the installations, according to their estimated duration and rhythm of activity (economic and technical). The net present value method provides an annuity to cover future costs by comparing the difference with the previous year's calculations.

Account Presentation

In Germany, Belgium, France, the United Kingdom and Switzerland, for example, operator assessments must normally show the provisions necessary to cover future costs. Costs must be justified to controlling bodies such as boards of directors, independent inspectors, and official authorities. Consequently, the estimated total cost is checked at the time of the audit of the responsible entities. This system is the most widespread.

On the other hand, in countries where responsibilities for the end of cycle and dismantling have been transferred to agencies funded by taxpayers, these costs no longer appear in the producers' financial statements, but in those of the agencies. A wide variety of situations exists, covering both these cases and all situations in between.

Once future costs are recognised in the accounts of the organisations which will have to support these charges, it is then appropriate to secure the availability of the necessary funds at the appropriate time. The operator either pays into an external fund controlled by the lawful authorities, or makes provisions in his accounts whether associated or not with a mechanism of internal funds managed inside the company.

Responsibilities and Financing

A lawful organisation ensuring the availability of funds is usually created by governments, which can take responsibility for final waste storage and/or dismantling (in Belgium and France in particular, the government created public establishments responsible for the storage of waste). Based on final usage of sites, the government is often directly involved in dismantling the installations and managing the waste.

In the majority of European countries, the government is not responsible technically or financially for dismantling operations except when managing historical waste. Operators in Germany, Belgium, France, the United Kingdom, Sweden and Switzerland take responsibility for both activities.

In certain countries, like Germany, Belgium, Sweden and Switzerland, laws stipulate operator financing. In other countries, where the companies involved have become privatised, part of the future charges is always subject to special agreements (e.g. USEC in the United States, Magnox Electric/BNFL in the United Kingdom).

The various existing practices concerning technical responsibility and financing were analysed by the Nuclear Energy Agency of the OECD³ and split into four categories:

- Control of funds and responsibility in a centralised account, with operations and their financing transferred to a central governmental organisation (examples are ENRESA(Spain), ONDRAF/NIRAS (Belgium)).
- Control of centralised funds accompanied by decentralised responsibilities. The companies remain responsible for operations and financing (e.g. Sweden and Finland).
- Decentralisation of responsibility for the operations with legal or contractual guarantee mechanisms (e.g. United States and Canada for the mining industry).
- Complete decentralisation of the technical and financial responsibilities, with companies remaining responsible for operations and their financing. This last category includes the majority of situations in the Netherlands, Switzerland, the United Kingdom and France, with various degrees of control of the financial responsibilities.

It is often the case that in the same country the solutions adopted for dismantling and the management of waste differ.

Cogema's Financial Assets for Decommissioning

As an operator, Cogema has the legal obligation to dismantle its nuclear facilities upon total or partial shutdown, according to the processes presented above. The largest costs relate to back end fuel cycle facilities, i.e. reprocessing and MOX fuel fabrication plants.

As of 31 December 1998, the financial commitments of the Cogema Group were estimated at FFr25.5 billion (US\$4.1 billion) (1998 values). This figure, representing more than three years of cash flow, proceeds from the estimates

established plant by plant starting from a detailed modelling of the dismantling operations and based on previous dismantling experience.

Provisions

Each year Cogema registers in its accounts provisions for decommissioning, waste retrieval and other end-of-cycle activities linked with its own future estimated commitment. The FFfr14.5 billion (US\$2.3 billion) accounted for at year end 1998 illustrates the gradual recognition of these charges, based on the careful estimation of the utilisation period of each facility for contracts in progress or reasonably expected contracts.

Even so, such provisions are merely accounting entries anticipating future expenses, which will come up when the facilities in question are no longer generating any income or cash-flow; they do not guarantee the capability of the company to face expenditures in the remote future. This is why Cogema began five years ago to gradually put in place a mid- and long-term portfolio, making it possible to provide in due time sufficient cash to proceed with decommissioning.

Specific Portfolio

Cogema started in 1993 to invest in a specific portfolio for decommissioning funding. At the end of 1996 the company had ensured a coverage of 60% of the provisions and 30% of the quota of the estimated commitment remaining to its charge (see Table 1). The need to optimise the use of the funds was quickly addressed. From the viewpoint of financial management techniques it seems at first analogous with pension funds and the technical reserves for insurance companies. However, the differences are substantial:

- The two quoted cases are managed with constantly flowing deposits and withdrawals according to well-known statistics. Cogema's portfolio is intended to be completely emptied over a period of years, while its total charge to cover remains exposed to risks.
- Cogema is an industrial company subjected to common laws regarding accounting and tax standards.

After broad consultation with financial partners well known for their competence on long term issues, a special policy was set up.

The Cogema Policy

The general policy can be summarised by the three following points:

- To engage in a policy of financial coverage specific to the costs (which is not obligatory). Cogema earmarks a portfolio thus dedicated to decommissioning in the balance sheet in a transparent way, and separates it from the management of the current treasury.
- To grow this portfolio by optimising the timing of financial investments in such a way that the capacity of the company to finance its industrial development is not restricted.
- To have the opinion of an external adviser on the methodology of the constitution of the portfolio and the strategic asset allocation process; this adviser being at the same time the guarantor of the long-term viability of a system of reporting and performance measures.

Concerning the operational aspects related to the technique of fund management, the principal orientations are as follows:

- In long term investing, it is proven that as an asset class equities will do better than bonds or short term money market instruments, but with the highest volatility among these three type of asset classes. They are likely to provide in the long term a higher return than inflation, which impacts the future costs. Paradoxically “day to day” investments in bonds and cash instruments, periodically rolled over, would present important risks. There are indeed combinations of inflation and interest rates in which performance after taxation is not sufficient. However, when payment of expenditures is sufficiently specified, equity exposure of the portfolio will be gradually decreased by selling shares and purchasing bonds of maturity matching the outlays.
- The portfolio is 75% composed of a rather small number of equity holdings in French companies listed on the Paris stock exchange (the initial component of the portfolio), managed in-house, and 25% of other European equities, the management of which is carried out through mutual funds.
- Equity management requires a certain diversification and an acceptable level of risks. The cost coverage in the euro currency directed, until now, the portfolio of European stockholding (it is supposed that the United Kingdom and Sweden will adopt the euro at some point). Taking into account globalisation, however, the quoted values of the European companies are dependent on the level of the euro versus other currencies. Management of European equities excluding France is today the major contribution to the diversification of the initial portfolio, which concentrated on a single country and a few lines of shares.
- The external management of these mutual funds was entrusted to a small number of asset-management companies selected by invitation to tender. The objective is to exceed in the medium term a benchmark (MSCI Europe without France, net dividends reinvested) with a controlled active risk. The active risk or “tracking error” measures the volatility of the difference between the portfolio and a benchmark performance. For example, a tracking error of 4 means that there is a 66% chance that over one year the portfolio does not deviate more than $\pm 4\%$ from its benchmark. An indexed fund has a zero tracking error. The fund managers were selected to represent a range of management styles: selection of “value” as well as “growth” equities, and bottom-up as well as top-down approaches. The non-correlation of styles within the combination of mutual funds tends to reduce the resulting tracking error.
- Risk control is carried out with our external adviser to ensure that combined in-house and externally managed portfolios fit with long term objectives.

Results

As shown in Table 1, on 31 December 1998 the portfolio reached a historical value worth FFr15.4 billion (US\$2.5 billion) for accountable provisions of FFr14.5 billion (US\$2.3 billion). Thanks to the remarkable performance of the European markets in 1997 and 1998, the market value before taxes on accrued unrealised gains reached FFr22.5 billion (US\$3.6 billion).

Conclusions

- The nuclear power industry is committed to managing its future costs suitably, better than the majority of other industries.
- These costs, though important in absolute value, are reasonable in comparison with the cash-flows generated by the industry over a long period.
- The Cogema example shows that in a few years a mechanism can be put in place to manage prudently the funding of future costs.

Table 1. Provisions for decommissioning, waste retrieval and other end-of-cycle expenses for the Cogema Group: book and market value of earmarked portfolio dedicated to cover the future costs (from Cogema Group annual reports) (billions of French francs).

REFERENCES

1. *Projected Costs of Generating Electricity: Update 1992*. OECD NEA, Paris, 1992.
2. Public Report of the French Audit Office, 1998.
3. *Future Financial Liabilities of Nuclear Activities*. OCED NEA, Paris, 1996.

Year (end of year)	1994	1995	1996	1997	1998
Provisions	11.7	12.0	13.0	13.8	14.5
Portfolio book value	3.1	4.5	7.9	13.5	15.4
Portfolio market value before taxes	3.5	5.0	10.0	20.3	22.5
Estimated commitment					25.5