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RADIOLOGICAL, TECHNICAL AND FINANCIAL PLANNING FOR DECOMMISSIONING OF SMALL NUCLEAR FACILITIES IN SWEDEN

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ABSTRACT

On November 1st 2008, a new ordinance came into force in Sweden. It extends the implementation of nuclear liability to all nuclear facilities and companies, regardless of size. The Government has authorized the Swedish Radiation Safety Authority (SSM) to issue further regulation as warranted and appropriate, and commissioned the same Authority to oversee the implementation.

Consequently, SSM is presently conducting research in order to establish a basis for the implementation of the ordinance to smaller facilities and enterprises. The goal is to enable finance to be assured in an efficient manner so that any burden on the companies is as small as possible.

Thus, "functional requirements" are identified, and used as a basis for various investigations. The aspects include technical and cost calculation prerequisites, as well as various domains of law: the environmental code, radiation and nuclear safety, financial reporting, and criminal law.

It is found that the basis for the differentiation among the facility operators and owners should be the cost and the associated uncertainty. Thus, a cost calculation will have to be carried out by all. It should be based on available standards and guidance documents. It is found that this is a requirement that already exists elsewhere in the legislation, and thus no additional burden is imposed on the companies.

It is found that segregated funds is the preferred option for long-term liabilities. Securities are suitable for short-term liabilities provided that the economy of the company in question is sound. Securities might also be used for long-term liabilities to cover uncertainty.

It is proposed that a *de minimis* limit of at least kSEK 25 (about k€ 2,4 and k$ 3,4) is used. An important reason for this is that lower limits might be incompatible with the rules for financial reporting.

It is also proposed that securities might be used also for long-term commitments if the total environmental liability does not exceed 1,00 MSEK (about k€ 96 and k$ 135).

It is found that the "general advice" that must be used by smaller companies lacks proper instructions on how to account for environmental liability whilst at the same time it prohibits the use of e g the international reporting standards IFRS/IAS.

It is also found that the "general advice" prohibits distribution of internal costs for research and development over time. This might be incompatible with a fund system where considerable research may be necessary at the early stages of the work and often many years before the actual decommissioning is to take place.

The rules in the penal code require that an annual report presents an "essentially correct financial situation". One of the interpretations to this statement is that a deviance of at most 30 % might be tolerated.

Although previous work has indicated that the error in cost estimates need not be higher than about 15 %, even for research facilities, concealed cost raisers may from time to time lead to much larger errors, even when best practices are being used.

It is therefore essential that decommissioning planning and cost predictions are made in accordance with state of the art, and that the estimating methods as well as the results are properly documented.

DISCLAIMER

This paper refers to work in progress and as such any conclusions represent the views of the authors and do not necessarily reflect the views held by the *Swedish Radiation Safety Authority*.

NOMENCLATURE

There are three levels of legislation in Sweden.

1 ***Law*** which is issued by the Parliament and as authorized by the people in Sweden

2 ***Ordinance*** which is issued by the Government, under the laws issued by Parliamant and after authorization by the Parliament

3 ***Regulation*** which is issued by a Competent Authority such as the Swedish Radiation Safety Authority. A regulation is issued under the laws and ordinances and after authorization by the Government.

Laws, ordinances and regulations are legally binding and the compliance of them is overseen and assured by our legal system, including our courts.

In addition, a Competent Authority can issue ***general advice*** with regard to a certain regulation. It can contain clarification as to what the actual regulation is intended to mean and may also provide examples. General advice is not legally binding and compliance must not necessarily be upheld in a court decision.

Competent Authorities – like everybody else, e g a branch organization – can also issue ***guidance documents***. They reflect good practice, but cannot necessarily be relied on for compliance with legislation.

In this paper, the ***Swedish Radiation Safety Authority*** (in Swedish: ***Strålsäkerhetsmyndigheten***) is referred to by its abbreviated name, ***SSM***.

INTRODUCTION

The new ordinance. On November 1st, 2008, a new ordinance[1] came into force in Sweden. From that date onwards, the system of finance for nuclear legacy related liabilities includes all nuclear facilities regardless of size. The establishment [2-3] and evolution [4] of our Swedish system of finance has been described earlier[2-4], see also [5-15]. The previous and still existing system includes all ten of the modern nuclear power plants as well as a number of specifically identified nuclear research and development facilities. Several facilities that have or should have required permits under the Act on Nuclear Activities[16] were not included in the past, but now all such facilities fall under the new ordinance.

The novel feature of this ordinance is not that it introduces the polluter pays principle into Swedish legislation. Nor does it introduce legal requirements on appropriate book-keeping of environmental liabilities. As will be discussed further below, such legislation has been in force for most of the large facilities since many years. Instead, the novel feature is that such requirements are now to be implemented and enforced in a rigorous manner in the entire area of nuclear technology.

Another novel feature with the new ordinance is that it concerns also small facilities and sites as well as all sizes of enterprises including small businesses. This calls for special attention to the issue of efficiency of any new regulation, i e any burden or levy imposed on an enterprise must be clearly warranted and motivated by corresponding effects in terms of fulfilment of the polluter pays principle. This, in turn, calls for an increased concern about coherence with other legislation so that the complexity and bureaucracy are kept to a minimum.

Thus, according to the new ordinance[1], all those who have permits under the Act of Nuclear Activities[16] are obligated to plan for decommissioning and to carry out cost calculations which are to be reviwed by the SSM. Actually, this requirement may hold also for those whose permits have expired but who still have not had their decommissioning obligations lifted by the Competent Authority. Based on such a plan and such a cost calculation as well as on the outcome of the review, the SSM will then decide on what payments are to be made into a dedicated fund, what securities are to be provided and what obligations and liabilities might be managed solely by the holder of the permit.

The new ordinance[1] contains authorization from the Government to the SSM to issue regulation as warranted and appropriate for the implementation.

In addition to proper authorisation, our Constitution states a number of requirements that apply to any such regulation, including the following:

- A regulation must contain a reasonable balance between different interests, and the benefits must be reasonable in comparison with the costs for compliance.
- All must be dealt with in an equal manner.
- There must not be any contradictions with any other legislation.
- There has to be a follow-up of the outcome, and adjustments made as appropriate from any lessons learned.
- A regulation must be simple and clear.

APPROACH, PURPOSE AND SCOPE

The approach taken in the present work and paper is that the compilation of a basis for a regulation can be carried out in a manner similar to that of developing any system, including a technical system or product.

What to be achieved has already been presented above, namely that the polluter pays principle be implemented such that any nuclear facility at the proper time is left as a clean site and all the waste has been appropriately managed.

There are a number of obstacles to this that need be overcome, however. Some are technical-scientific in nature and others are non-technical. Both have to be properly understood, and the implications dealt with.

It was mentioned above that a regulation must not contradict any other legislation, and that there must be a proportionality between the obligations imposed on an enterprise and the intended effects.

These two requirements in combination imply that one must go through all other related legislation in order to find what is already required since earlier. This includes also such

legislation that for various reasons might not yet be fully implemented.

It is essential in this regard to also look for special cases where legislation might be contradictory or incompatible with what might fall under the new ordinance.

The new ordinance covers a number of mutually very different cases. It is therefore imperative that the regulation be implemented in such a manner that the complexity of the analyses required as well as the ambition in the allocations of funds are well chosen in relation to the prerequisites for different facilities in question. Consequently, the analyses include the following:

- Identification of existing records including permits and applications, records of operation, and radiological surveys.
- Compilation of parameters of interest, e g levels of radioactivity handled, alpha to gamma ratios, and whether or not the sources have been sealed.
- Type of facility, e g prototype nuclear power reactor (Ågesta), fuel fabrication (enriched uranium), waste treatment facility (incineration, scrap metal melting), medical applications, research and other industry.
- Owner category: limited stock company or government (national, regional or local)
- Type of security: segregated funds, irrevocable financial instruments, bank guarantees, internal funds or no reservation.
- Relation to existing financial systems including segregated funds and producer responsibility arrangements

TECHNICAL ISSUES AND EXAMPLES OF FACILITIES

Past international experience tells us that it has been notoriously difficult to obtain reliable and precise cost estimates for decom-missioning of nuclear facilities. This is especially true of research facilities where there are particular reasons such as[5-6]:

- Plans for decommissioning do not exist
- The facilities were not designed for decommissioning
- The facilities are small (which means that investigations can become expensive in relation to the total cost)
- The facilities are very different in character
- The types of contamination are different
- The buildings were constructed and operated at a time when the regulations were considerably less strict than today
- Incomplete documentation of the operation history, particularly accidents and incidents causing contamination
- Institutional memory has been lost and people who are able to recall what took place may not be around any more

In view of these difficulties, the IAEA[17-19] and the OECD/NEA[20] as well as the European Union[21] have issued safety standards and recommendations regarding the planning for decommissioning, see also references in [5-10]. Standards[22] and handbooks[23] have also been prepared.

In the Nordic countries, based on an initiative by the former Nuclear Power inspectorate (SKI), now SSM, and through co-operation within the joint Nordic Nuclear Safety Research (NKS), a guide has been developed for planning for decommissioning together with cost calculations.[5-6]

It was found that adequate planning and reasonably reliable cost estimates can be obtained if the following is used as a basis:

- Radiological surveying
- Technical planning and methodology selection
- Financial risk identification and evaluation

It was also found, that by using this guide and at least for favourable cases, an uncertainty as low as ± 15 % might be attainable, even for research facilities.

This material will not be further referenced here, but three examples are provided in the following in order to illustrate what kind of issues one might encounter.

Please note that these facilities were included in the system of finance already in 1988.

The spent fuel store at Studsvik.

The spent fuel store is shown in Figure 1.

The fuel pools are cylindrical in shape and made of concrete. They rest directly on the underlying rock. Thus, there is no double containment with leak monitoring in place in between as in modern designs.

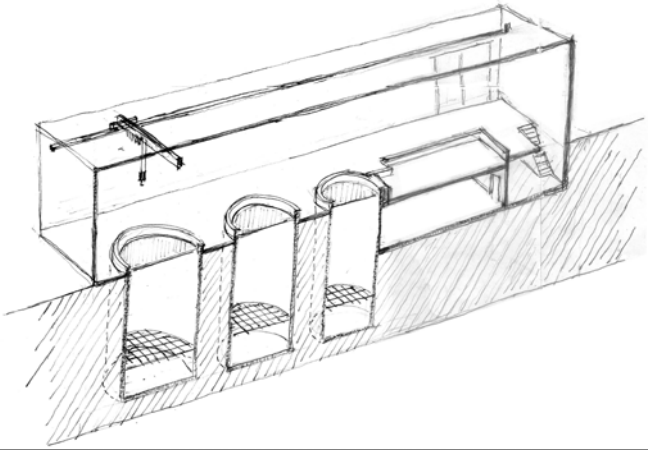
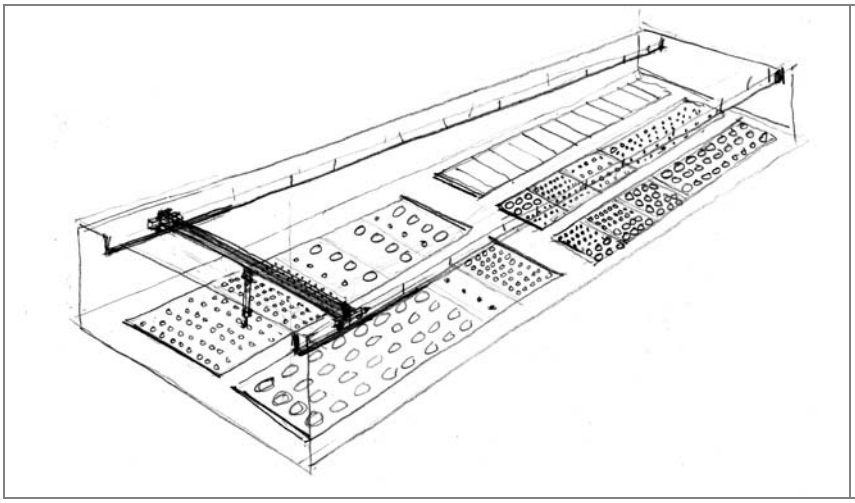


Figure 1. The *spent fuel store* at Studsvik showing the main hall as well as the interface between the building structures and the underlying soil and rock. Artist's view. (Lifting device shown is not that used for fuel transfer.)



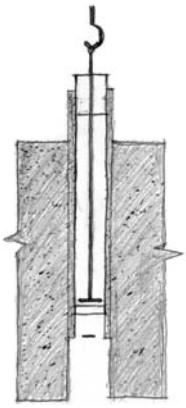


Figure 2. The *Store for old intermediate level waste* at Studsvik.

Far left: Compartments having large lids are open inside and most compartments with circular lids contain vertical pipes in concrete blocks which are about 3 meters thick.

Near left: A pipe storage location showing the removal of a pipe after an overcoring operation (artist's view).

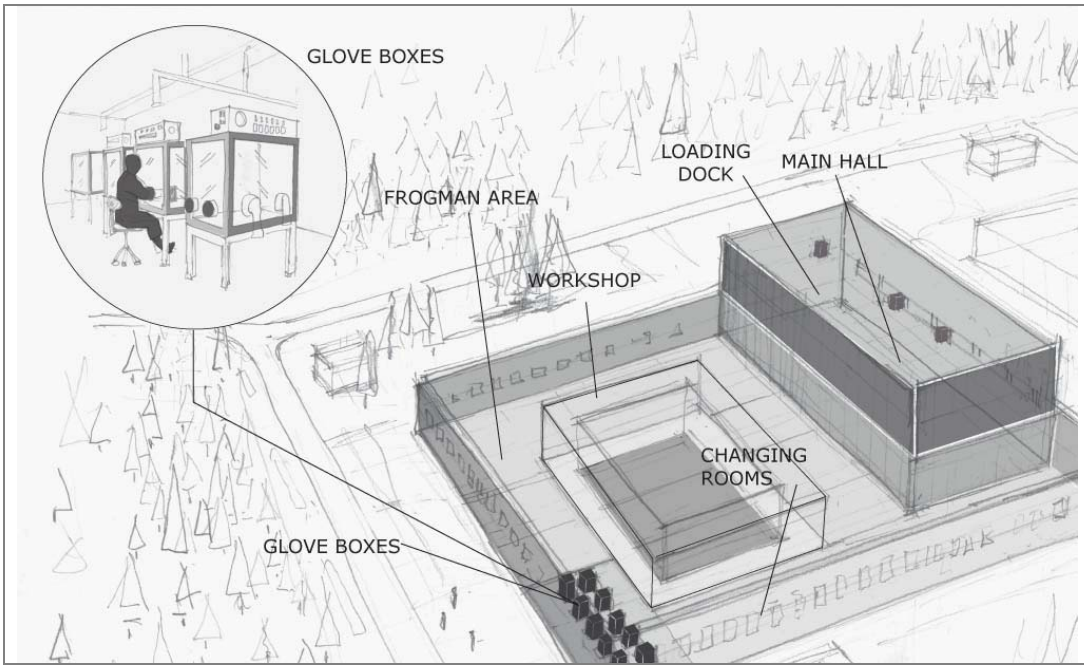


Figure 3. The *Central Active Laboratory (ACL)* at Studsvik was part of the early Swedish domestic concept with natural uranium fuel, heavy water moderation, reprocessing and mixed oxide fuel. It was used for laboratory scale reprocessing and preparation of mixed oxide fuel. The main hall was intended for a mixed oxide fuel pilot plant but no such plant was ever built.

The laboratory was constructed during 1959 to 1963 and was decommissioned during 1998 to 2006. It had a total floor area of 14 200 square meters. The Figure is an artist's view.

It can therefore not be entirely excluded that leakage might have occurred into the groundwater in which case the decommissioning might be considerably more costly. See References [7-8,11-12].

The Store for old intermediate level waste at Studsvik.

The store old intermediate level waste is shown in Figure 2. It is now emptied, but during that operation it was discovered that some of the cans containing fuel debris had corroded. Thus, some of the pipe surfaces are contaminated, and spent fuel debris has in some cases fallen into a 5 cm high ventilation slit under the pipe storage location. The anticipated overcoring is associated with the potential of voids in the concrete and loss of potentially contaminated drilling fluid. See References [7-8,13].

The Active Central Laboratory (ACL) at Studsvik.

The laboratory is shown in Figure 3. Since it was used for mixed oxide fuel and similar, the ratio of alpha to gamma radiation was high in many areas. This means that it may be cumbersome to carry out radiological characterization.

Reference [24] shares an important lesson learned:

"*Early in 1999 decommissioning of area No 1 began. As the contamination levels had been underestimated and contamination was often found where it had not been expected, work had to be interrupted between July and September 2000 for planning and cost estimations. The work in area No 1 could*

be finished in September 2000. …" (Work on areas 2 and 3 started in October 2000 and in September 2002, respectively.).

Decommissioning to green field conditions were completed in the year 2006. No final report appears to have been published yet, but previous progress reporting[24-26] appears to indicate a total cost for the work conducted from the year 1988 of around MSEK 100. This corresponds to M$ 14 and M€ 9,9 at the present rate of exchange. Significant clean-up was also conducted in the early nineteen eighties but no figures for this appear to be mentioned in any modern source.

NON-TECHNICAL ISSUES

The previous section has illustrated how significant efforts and ingenuity are required in order to obtain adequate technical planning and sufficiently precise and reliable cost estimates in conjunction with decommissioning. However, daunting requirements apply also with regard to non-technical issues.

It is generally thought that it is the particular duty of the higher management in a company to plan for the long term, i e more than five years ahead. However, even sporadic reading of business oriented newspapers and magazines indicates that such a time span exceeds the time in office of many, perhaps even a majority, of the higher managers. Although most likely detrimental to the business as a whole, focus is frequently placed mainly on the quarterly reports. It is certain that many do make serious attempts to uncover hidden liabilities even though this impacts declared profit. But it is an uphill battle in a business climate that exaggerates the significance of short-term profits.

If - as illustrated above - it is a difficult task for the technical experts in a company to fully grasp the difficulties and costs associated with the decommissioning of a facility, then it must be "mission impossible" for an unspecialized Auditor to unveil any concealed liabilities. Furthermore, a tax Auditor might not be very active in looking for hidden losses anyway.

The general literature has been searched on this topic and the upshot is that literature on fraud in business and accounting[27-28] tells little or nothing about reluctance to declare environmental liabilities. For about the last couple of decades, court cases have started to appear where present and previous owners as well as suppliers are held responsible for land and site contamination, and are forced to pay for restoration.[29-30]

At the same time, there is a trend in business management to apply Corporate Social Responsibility (CSR) which includes proper action and accounting with regard to environmental liabilities.[31] Hopefully, this constitutes the beginning of a new trend.

NUCLEAR TECHNOLOGY REGULATION

Nuclear safety is primarily regulated in Sweden by and under two laws: The Radiation Protection Act [32] and Act on Nuclear Activities[16]. Before July 1st, 2008, they were overseen by the Swedish Radiation Protection Authority and the Swedish Nuclear Power Inspectorate, respectively, at which time these two Authorities merged to form SSM. Work is in progress to merge the two laws as well, but at present (May 2009) the two laws are still in force.

As the name indicates, the Radiation Protection Act [32] is a general law covering essentially all radiation, i e radiation that is emitted by radioactive substances as well as electromagnetically generated radiation. There exists a listing of low limits under which there is little radiological concern.

The law states, amongst other things, that an apparatus that has the capability to radiate must be incapacitated when its useful life is over.

The Act on Nuclear Activities[16] is valid for facilities in which nuclear chain reactions take place and related facilities. It is also valid for nuclear material (i e material that is fissile or can be activated to become fissile), for activated material (with several exceptions), and for nuclear waste.

Permitting is required only for possession of material above certain *de minimis* levels, e g 15 grams of uranium -235 or 5 kilograms of natural uranium.

The law states, among other things, that the holder of a permit is obligated to manage any waste that is generated and to assume financial responsibility in accordance with the Nuclear Liability Act[33].

Please note that the *de minimis* levels above have nothing to do with the levels for free release of a facility. The obligations to manage the waste and to decommission appropriately persist until a consent has been received from the Competent Authority.

The Nuclear Liability Act[33] is valid for nuclear material that is not intended to be reused and for nuclear waste that is not waste from daily operation.

There are two "compartments" for securities and fees to segregated funds:

A the anticipated costs for decommissioning and waste management e t c, and

B a risk fee intended to cover the risk that the Government takes in its management of the fund system.

Compartment A comprises a combination of securities and assets in segregated funds. Securities are lifted at the same pace as that of the payments that flow into the segregated funds.

The new ordinance[1], issued by the Government under the Nuclear Liability Act[33], states that those eligible under the law who are not nuclear power reactor owners are obligated to submit to SSM every third year a cost calculation comprising the following :

- the total best estimate for the cost for decommissioning and waste management
- the expected remaining time of operation
- the proposed proportions between securities and assets in a segregated fund

Subsequently, the SSM will review the material and decide on the fee to be paid.

The new ordinance has also granted the SSM authority to decide on exemption from requirements on securities as well as on payments to segregated funds.

No legislation exists as to the details on how the decommissioning planning and the cost calculations are to be carried out in practice. Instead, the SSM has taken initiative to research where the results of past experience can be utilized by the facility owners as well as the Authorities.[4-15] Some of this research has been carried out in Nordic co-operation[5-6] and some has been part of IAEA activities[10].

Guidance documents to support planning and cost calculation activities have also been published by the IAEA[17-19], the US DOE[23], ASTM[22,34-35], International Accounting Standards Board (IASB)[36], the European Union[21], OECD/NEA[20] and others.

THE SWEDISH ENVIRONMENTAL CODE

It has always been a legal offence to damage something that belongs to someone else, whilst natural resources in general used to be freely available for those who could make use of them. However, the increase by mining and beneficiation of metals gave rise to competition with farming for the wood, and on March 18th 1639, Queen Kristina banned burn-beating by the penalty of banishment. This might well be the inception of Environmental Law in Sweden.

Today, and for about ten years, the Swedish Environmental Code states[37] as follows: "*Persons who pursue or have pursued an activity or taken a measure that causes damage or detriment to the environment shall be responsible, until such time as the damage or detriment ceases, for remedying it to the extent deemed reasonable pursuant to chapter 10. Where this Code so provides, the person may be liable for compensation for the damage or detriment instead*". A similar statement was made in the preceding code from 1961.[38-39]

Otherwise, it is generally considered[38] that it was OECD that minted the principle in 1972[40]. A similar statement was made one year later by the European Union[38].

The general statement cited above from the Swedish Environmental Code may not be sufficient for full compliance and is therefore supplemented in the code and elsewhere with regard to specific areas.

Thus, chapter 16 § 3 in our Environmental Code[37] states that permits issued under the code may be associated with requirements on securities corresponding to all future costs. Local and Central Government does not have to comply with this, however.

FINANCIAL REPORTING LEGISLATION

The laws covering financial reporting for ordinary companies in Sweden are primarily the Accounting Act[41], Annual Reports Act[42] and the Swedish Companies Act[43].

The Accounting Act states in § 2 that the obligation of book-keeping must be carried out in accordance with good practice.

"Good practice" has a somewhat different meaning depending on the size of the enterprise.

Companies are divided into large companies with more than 50 employees and a certain minimum turnover, and small companies (which are those that are not large).

Large companies are obligated to follow the *International Financial Reporting Standards and International Accounting Standards* (IFRS/IAS)[36] issued by the *International Accounting Standards Board* while small companies have to follow the general advice issued by *Swedish Accounting Standards Board* (in Swedish: Bokföringsnämnden, BFN)[44].

The idea is to simplify the rules for small enterprises and indeed the general advice is actually much shorter than the corresponding text the international standard.

Both have strict requirements on how liabilities are to be specified. The international standard also provides relatively detailed instructions as to how the liability is to be evaluated. The general advice, however, provides little guidance. Moreover, the general advice states (point 1.6) that when in doubt, it is not permitted to make comparison with the international standard, but to seek guidance in the "fundamental principles of accounting" as expressed in the Annual Reports Act[42]. Thus, small enterprises can find little guidance in our financial reporting legislation as to how to evaluate environmental liabilities. Moreover, as elaborated on below, the rules for research and development are widely different, and this may constitute an obstacle in conjunction with a segregated fund system (see further below).

CRIMINAL LAW AND LEGAL CONSEQUENCES

Contrary to the financial reporting legislation, the Swedish Penal Code[45] is the same regardless of the size of the company.

Actually, court decisions on punishment can be made based either on the specialized legislation or on the actual Swedish Penal Code. As a rule, the court selects the law that leads to the harshest punishment. On the other hand, the requirements on proof and intentions may be higher in the Swedish Penal Code.

For instance, the Nuclear Liability Act[33] states that anyone who deliberately or through considerable neglect submits incorrect cost calculations may have to pay fines.

The Swedish Penal Code[45], however, states that anyone who is obligated to follow the Accounting Act[41] but declares figures that are not correct so that the books no longer present an "essentially correct financial situation" may be sentenced to jail for at most six years (in severe cases).

There is a clear possibility that errors and uncertainties in estimations of decommissioning costs may be large in comparison with the errors and uncertainties for other posts in financial books. It is therefore warranted to look somewhat into

what kinds and levels of deviance that may be acceptable to an Auditor and to a court.

There is not a large volume of domestic literature on this topic, but the present situation has been summarised in Reference [28].

Firstly it should be realised that courts decide on this matter on a case by case basis. Each case is different, and general patterns may not at all apply in individual cases.

There is a method of evaluation, called the Eloffson method, according to which an independent Auditor makes his or her evaluation. Acceptable deviance according to this method may be at most 30 %. There are other methods to discuss as well, but the interested reader is referred to the specialised literature.

Auditors are generally anxious to determine the reasons for any deviance in book-keeping, and can spend a considerable time identifying even moderate deviances.

Use of readily available radiation protection data from ordinary operations together with some back-of-an-envelope estimation might not impress an Auditor who compares the potential uncertainty of the decommissioning cost with the total gross profit of the enterprise.

DISCUSSION AND CONCLUSIONS

The first question with regard to how the new ordinance might best be implemented is perhaps exactly who ought to be considered and included. Firstly, it should be reiterated that financing associated with the Radiation Protection Act [32] but not the Act on Nuclear Activities[16] is not included in the New Ordinance[1]. Instead, responsibility is here required under the rules for producer's responsibility as well as directly under the Radiation Protection Act (alternatively under the Environmental Code).

Thus, only those having or having had permits under the Act on Nuclear Activities[16] are included. It is plausible that it is the intent of the legislators also to include those who for "historic" reasons have not had the opportunity to obtain permits under the Act on Nuclear Activities[16], but who should have had to do so under the legislation that exists today.

The next question is if some of those potentially eligible should or could be exempted after only very simple considerations. Cases of this nature might include those where it can be shown that all sources have been sealed, they have never leaked and they have all been removed. Other cases include those where all activity has been short-lived.

The main basis for assessing whether there exists an obligation to apply for and to hold a permit under the Act on Nuclear Activities rests on limits of total activity for various types of radionuclides.

It would therefore be tempting to explore a similar path for determining when dedicated funds, securities and exemption should be selected. However, the co-variation between activity type and content in a facility and the costs and uncertainties for its decommissioning is very weak, as illustrated e g by the examples above. Consequently, this path has been abandoned.

Instead, and as summarised above, it has been found that the cost and associated uncertainty cannot be assessed in any useful manner unless proper decommissioning planning has been carried out, including radiological surveying, method selection and uncertainty analysis. Such costs and uncertainties are therefore identified as the basis for when and how dedicated funds, securities and exemption are to be used.

This implies that appropriate decommissioning planning and cost calculations will have to be required from all present and previous holders of permits under the law of Act on Nuclear Activities[16] (and its predecessors).

This, in turn, raises the question whether such a requirement might be considered warranted in view of the requirement on proportionality between effects and efforts.

The review above of the requirements on financial reporting shows, however, that stringent requirements on cost estimations already exist in that domain. No additional burden would thus be put on the facility owners and operators by the new ordinance[1]. Instead, synergy is achieved in that the basis for reporting can be the same.

The search for potential contradictions has, however, resulted in the identification of two potential problems. Large companies in Sweden must follow the IFRS/IAS[36]. Small companies are required to comply with good reporting practice by following the general advice[44] of the *Swedish Accounting Standards Board* (in Swedish: Bokföringsnämnden). In addition, small companies can find little or no guidance in the financial legislation as to how to actually evaluate environmental liabilities. One might be tempted to believe that they could then read and apply relevant parts of the IFRS/IAS standard. This is, however, forbidden by the *Swedish Accounting Standards Board.*

Moreover, the advice of the Swedish Accounting Standards Board states, contrary to the IFRS/IAS, and in contradiction with the Annual Reports Act[42], that internal costs for research and development cannot be distributed over a period of time but must be accounted for as a cost for the specific year in question.

It is obvious that significant efforts have to be spent on planning as well as various investigations as a natural part of the total decommissioning undertaking for a facility. This is very different from the ordinary operation. For instance, the radiological characterization required in order for reasonable cost estimates to be obtained is usually far more extensive than that needed for the ordinary operations.

It is therefore essential that companies managing their decommissioning under the new ordinance and under a system of segregated funds can allocate all outlays as expenses under the system of finance and have them balanced against the balance in the fund. It is also essential that this can be carried out swiftly even in the introductory stages when the balance in the fund may be low.

New plants or pieces of equipment are usually written off over cautiously chosen life times. Similarly, the burden of

decommissioning should be carried throughout those years during which the facility in question generates revenue.

In cases where such a system of finance has been inaugurated at the onset of operation it can be expected that when the period of earning of revenue is over, the sum of fund balance and security equals the remaining costs, with additional security to match the uncertainty. In such a “reference case”, no additional payments or securities should be required after closing except for adjustments that may occur as a result of recurrent cost estimations.

In cases where such a system of finance has not been inaugurated at the onset of operation it might be viewed as warranted - based on the rules for accounting as well as on the polluter pays principle in the environmental code - that corrections are made such that a reference case situation is achieved instantly.

However, such an approach may well be substantially more difficult for a company to handle in comparison with a situation when the transition can be carried out over the course of a number of years.

From a company point of view it may also be difficult and impractical to suddenly allocate a lot of liquid assets into a Government fund. Transfer of securities might be much easier, in comparison. If such securities consist of plants and facilities, then it is a matter of mortgage. Albeit reducing the total value of a company, a mortgage still leaves liquid assets and other essentials for continued operation largely intact. The same can be said about securities in a bank.

Consequently, from a company point of view, it would be desirable

A to absorb the liability in portions over a number of years, and

B to provide securities initially and that such securities are gradually converted into assets in dedicated funds (see further below)

Alternative A above is in conflict with the rules for accounting of liabilities in annual reports (e g IFRS/IAS[36]). They state that it is the full liability that is to be reported.

The same rules might, however, also be interpreted to imply that it is the full liability for decommissioning that must be reported as soon as a facility has been taken into operation.

This would, however, be in conflict with the continuity principle that says that that an appraisal of a company should usually be based on the assumption that the business is continuous. (This value is usually much higher than the scrap value.) It might not be unreasonable to apply the continuity principle also to certain closed facilities, namely if the benefits of the facilities are still reaped in the present production at the nuclear power plants. This argument was used by the Swedish Government when the Studsvik fund was established.

A comparison with the situation for Swedish nuclear power plants shows that they have had to provide fund payments and securities to cover all future costs should the nuclear power plants be closed today.

Comparison can also be made with the rules for assuming the costs of an investment. It is well known that investments are usually written off during a number of years.

The approach in the present paper is that all existing legislation is to be taken as prerequisites. The conclusion here is therefore that environmental liability is to be absorbed as soon as it can be identified, and that the Nuclear Liability Act[33] as well as the Swedish Penal Code[45] state that cost calculations have to be made and that they have to reflect the situation in a just manner.

The conclusion is also that it is feasible that this assumption of liability initially can take place in the form of submitting securities. For the long term, assets in dedicated funds is the pertinent option, but it is desirable that they be filled over the course of a number of years.

The reason for the preference of assets in segregated funds is that securities in a company or in a bank are usually good only as long as the company is not insolvent. The longer the intended duration of the securities, the larger is the probability that a company becomes insolvent. Consequently, securities should preferably be used for short term situations and for management of uncertainty.

For small facilities and for low estimated costs for decommissioning, securities might be preferred for simplicity reasons. For very low estimated costs, exemption might be appropriate.

The information search included looking for comparison criteria that could be used to select between the type and value of segregated funds, securities and exemption.

It was found in the general advice issued by the Swedish Accounting Standards Board[44], point 16.6, that provisions for liabilities need not be declared if they are below kSEK 25 (about k€ 2,4 and k$ 3,4). Similar lower limits exist in the tax domain. Thus, if SSM were not to accept to exempt liabilities below this level, then some complications could arise in relation to the rules for accounting.

No feature was found to support any selection of level of boundary between securities and segregated funds (cf conclusions above on securities versus segregated funds). It should be considered, however, that there is a certain amount of administration associated with a fund, and this calls for a level that is not too low. At the same time, a segregated fund is a more robust alternative than securities. Perhaps MSEK 1,00 (about k€ 96 and k$ 135) is a reasonable lower boundary for long-term liabilities. For short term liabilities, securities should suffice, provided that the business in question is financially sound.

The IFRS/IAS[36] as well as the ASTM standards on decommissioning[22,35-36] presuppose and put forward that relatively exact figures can and must be provided even for decommissioning of complex facilities decades ahead in the future. In cases of uncertainty, the declaration should contain a

risk analysis type of approach for cost estimation, including descriptions of scenarios together with assessments of their respective costs and relative probability.

It was said above that for well behaved cases and with proper evaluation, an uncertainty as low as ± 15 % might be attained. In other cases, this might be difficult, e g because it might not be possible to evaluate potential cost raisers unless the actual decommissioning work is carried out to a certain extent.

In such cases, the uncertainty might approach or even exceed levels at which courts decide on sentences based on criminal law.

It is, of course, a criminal offence to mislead concerned parties outside a company by making incorrect statements about the liabilities associated with future decommissioning.

On the other hand, cases may appear where all the appropriate action has been taken in order to properly evaluate the cost, but a high uncertainty still persists, and for good reasons. It should then be possible to document such findings in the annual report and still obtain discharge from liability for the management. Correspondingly, a high level of uncertainty should be accounted for in the system of finance implying higher than ordinary levels for the securities.

Surprises in retrospect are frequently difficult to handle in this regard. If – or when – they occur, it is very helpful if the planning for decommissioning as well as the cost estimations have been carried out in accordance with all legislation and best practices in the industry, and that all the work and findings have been properly documented.

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