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NUCLEAR ENERGY AGENCY
RADIOACTIVE WASTE MANAGEMENT COMMITTEE

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Working Party on Decommissioning and Dismantling (WPDD)

WPDD WORKSHOP ON:
"SAFE, EFFICIENT, AND COST-EFFECTIVE DECOMMISSIONING"

Workshop Conclusions/Final Stocktaking

6-10 September 2004
Rome - Italy

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MAIN MESSAGES

In summary, the main messages emerging from the Rome September 2004 workshop on "Safe, Efficient, and Cost-effective Decommissioning" are:

- **Decommissioning is a mature industrial process** and many projects have been safely completed with support of local communities. Technical and scientific issues are well-understood and practical experience and associated lessons are being documented to guide future activities. Emphasis is being placed on effective planning with active programmes of community involvement.
- **Individual countries need to further develop integrated decommissioning and waste management strategies** to ensure that long-term solutions will be available for all wastes generated from decommissioning. National systems are evolving to meet national needs, against a framework provided by the international organisations, and these seem increasingly to favour early dismantling regardless of the availability of waste disposal routes.
- **Realistic and streamlined regulatory programmes are being developed** with feed back from industry experience and are placing more responsibility and accountability on licensees.
- **Accurate decommissioning waste cost calculation methods is needed.** Waste volumes may vary from project to project even for similar installations. There though appears to be a strong case for accumulating data and benchmarking costs for similar plants and processes. Further work and experience exchange on cost comparisons between different strategies (for example clearance and recycling/reuse of materials versus direct surface disposal) would be valuable.
- **International clearance criteria have been established**, with individual countries free to adopt them.
- **Financial mechanisms for decommissioning funding are evolving in the NEA member states** to meet regulatory and project needs. Continuing challenges are uncertainties in cost estimates and the implementation of measures to assure that funds will be available when required.
- **Creative research on decommissioning is being carried out.** Human factors and organisational issues are studied. Practical solutions are being implemented such as the use of management transition programmes. Some increased efficiency and effectiveness is needed by way of R&D on improving technology and developing innovative techniques, subject to justification of its cost and value. There is a need to consider how to design commercial contracts so that decommissioning contractors will be willing to test new, relatively unproven techniques.
- **Continuing emphasis on education in critical nuclear skills is needed** to ensure availability of the necessary expertise for both near-term decommissioning needs and long-term energy needs.

- **Public acceptance is still a major challenge**. Without public acceptance, decommissioning may be prolonged and difficult to implement. Hence, all actors and interested parties need to be constructively involved in the dialogue within the local communities to gather and evaluate all relevant concerns and thereby inspire confidence in the safety of decommissioning activities.

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INTRODUCTION

Some background information on the Working Party on Decommissioning and Dismantling (WPDD), and recent important meetings and workshops since 1999, can be seen in Appendix 1.

On September 6-10, 2004 a workshop on "Safe, Efficient, and Cost-Effective Decommissioning" was held in Rome Italy to enable international experts on decommissioning to compare and evaluate respective approaches and experiences in decommissioning nuclear power and fuel cycle facilities and to formulate proposals for future international cooperation in the decommissioning arena. The workshop was organized by the Organization for Economic and Cooperative Development/Nuclear Energy Agency's (OECD/NEA) Standing Committees, including the Radioactive Waste Management Committee (RWMC), Committee on Nuclear Regulatory Activities (CNRA), Committee on the Safety of Nuclear Installations (CSNI), Committee on Radiation Protection and Public Health (CRPPH), and the Nuclear Development Committee (NDC). NEA organized the meeting in cooperation with the International Atomic Energy Agency (IAEA) and the European Community (EU). The meeting was hosted by APAT (Agency for Environmental Protection and Technical Services) and SOGIN (Societ Gestione Impianti Nucleari), under the patronage of the President of the Republic of Italy.

The Chairperson for the Rome Workshop was Mrs Margaret Federline, USNRC, who also is the chairperson of the RWMC. Over 200 participants from 22 countries attended the workshop. The meeting format involved presentations from key experts followed by extensive discussion often facilitated by expert panels. Participants included technical and policy experts, regulators, experts in stakeholder involvement issues, and officials from the Italian Government, the IAEA, the EU, and the NEA. Areas discussed included a summary of the status of decommissioning in Italy and internationally, the disposal and management of materials from decommissioning, managing the transition from an operational plant to a decommissioning facility, decommissioning techniques and funding, improving decommissioning cost estimation, and the role of governments in decommissioning. In addition, workshop participants visited the Latina nuclear power plant near Rome.

The broad objectives of this international workshop were to:

- Appraise overall progress since the Rome 1999 workshop.
- Identify current technical, regulatory, policy and implementation issues and present solutions to facilitate safe, economic and timely decommissioning.
- Identify the impact of social issues and outline successful approaches, in particular for stakeholder involvement.
- Identify future challenges.

The scope comprised large decommissioning projects and included the management, waste and stakeholder issues associated with power reactors, fuel cycle facilities and facilities in transition. It was also intended to build upon the work done at the international seminar on "Strategy Selection for

the Decommissioning of Nuclear Facilities" in Tarragona, in September 2003. Against this background, specific target outcomes were identified in advance for each session and, by way of final stocktaking, conclusions were drawn around each of these target outcomes.

The keynote speaker was Dr Tom LaGuardia, President of TLG Services, Inc., USA. With his long experience in providing engineering, planning and management support for decontamination, decommissioning and waste management projects for both commercial and governmental nuclear facilities around the world, he was able to provide an excellent historical overview of performed decommissioning as well as presenting current and future challenges in the decommissioning world. He concluded that "we do know how to do decommissioning but we need in the future to do it even better, safer, faster and cheaper! Workshops like this provide a venue for sharing experience and give a new spirit of optimism!"

In addition to this report on conclusions and final stocktaking, the workshop is also documented on a set of 5 CD-Roms which includes all papers and presentations as well as video uptakes of the different speeches. A few sets of CD-Rom are available at OECD/NEA and SOGIN.

1. OUTCOME – SESSION ON "INTERNATIONAL STOCKTAKING"

1.1 Target Outcome of the session:

A vision of what should be done next on integrating international activities on decommissioning

1.2 Objectives

Luigi Novello of SOGIN chaired the first session. The objectives of this session were to "set" or describe the status of the international decommissioning and to summarize the progress of the WPDD since the 1999 Rome workshop. The Session consisted of presentations on the decommissioning activities of the NEA, EC, and the IAEA.

A summary of the papers in the session can be seen in Appendix 2

1.3 Discussion

In the European context, the EC has funded R&D on decommissioning for many years but, recognising that the technology has reached the industrial stage, this is gradually being phased out and the EC role is now more concerned with establishing policies, objectives and regulations for the safe decommissioning of nuclear facilities in EU Member States, particularly in the new accession states, and at EC Joint Research Centre facilities.

The discussion reinforced understanding of the respective roles of the IAEA and the NEA. IAEA has over 130 Member Countries, many of which have limited nuclear infrastructure and need support and guidance on nuclear safety related matters. The NEA, on the other hand, comprises Member Countries that generally have well developed nuclear programmes and are more concerned with sharing experience and disseminating best practice in regard to technical and economic developments. It seemed clear from this that, in looking to the future, these two organisations might best complement each other if IAEA continues to focus on setting down basic safety principles and publishing standards and guidance in a form that is most helpful to those with developing nuclear programmes, while the NEA continues to provide an effective forum for the sharing and gathering of information from well-developed programmes and for identifying and disseminating best practice for decision-makers at all levels. In this latter context, 'practices' include not only technical matters but also those concerned with policies and objectives, cost-estimation, funding and stakeholder involvement.

It was recognised, however, that such a clear distinction is not wholly deliverable and that the closest practicable approach to complementary programmes requires continued, and perhaps enhanced, coordination between all three organisations. This might involve joint responsibility for maintaining the current WPDD map of international activities. It was also recognised, importantly, that on the subject of nuclear facility decommissioning it would be desirable also to involve those international organisations with knowledge and experience of the conventional, non-nuclear issues that arise in dismantling and decontamination and in treatment and disposal of waste.

Stakeholder involvement was also discussed during the session. Safety and protection of the environment during decommissioning, the approach to decommissioning (proactive versus deferred), the need for on-site interim waste storage, and the decommissioning end-state of the site were identified as common stakeholder issues. Stakeholders may have a variety of other social, cultural and economic issues associated with the shutdown of the plant, although it is recognized that the decommissioning implementer may not always be in a position to address these types of issues.

1.4 Progress since the Rome 1999 Workshop

Many decommissioning projects have been completed successfully and these already show that the safe decommissioning of nuclear facilities can be done and has been done.

International joint symposia and workshops have been held regarding decommissioning issues. Important documents like the NEA/WPDD map of international activities have been brought forward. IAEA has prepared and issued a set of Safety Standards to provide safety requirements and guidance to Member States. IAEA has also published a Safety Guide entitled “Application of the Concepts of Exclusion, Exemption and Clearance” (RS-G-1.7).

EC has funded R&D on decommissioning for many years but, recognising that the technology has reached the industrial stage, this is gradually being phased out and the EC role is now more concerned with establishing policies, objectives and regulations for the safe decommissioning of nuclear facilities in EU Member States, particularly in the new accession states, and at EC Joint Research Centre facilities.

1.5 Future Challenges

a) To recognise the importance and value of stakeholder involvement in decommissioning projects.

b) To structure and implement a funding system for decommissioning.

c) To achieve flexible and proportionate regulations. Realistic and consistent international standards will here be helpful.

d) To acknowledge that lack of availability of waste repositories does not necessary mean that decommissioning of nuclear facilities has to be deferred.

e) To acknowledge that security issues (i.e. threats of terrorism, risk for dispersion of radioactive materials and production of dirty bombs) today plays an important role in how decommissioning projects are perceived.

f) To make early planning of the management of transition issues and change of culture when going from operation phase to decommissioning. “It is difficult to do that first cut!”

g) To ensure that nuclear skills and site knowledge are retained through the whole decommissioning phase.

1.6 Conclusions and results of the session

Based on the discussions during the session the members agreed that the NEA, EC and IAEA each have their own spheres of interest and represent specific groups within the international community. However, it was agreed that to meet the goal as expressed in the target outcome of this session, all should work together to enhance cooperation between the organizations to better leverage and make the most efficient use of resources, knowledge and experience. Also, the support of local

communities was important to a successful decommissioning project and that the WPDD should continue to explore ways to enhance how regulators and implementers can obtain and consider local stakeholder support in decommissioning projects.

The most important conclusion of this stocktaking was that many decommissioning projects have been completed successfully and these already show that the safe decommissioning of nuclear facilities can be done and has been done, although there is still room for enhanced efficiency and effectiveness by way of R&D on development of technology and innovative techniques. It is also clear that the related experience is increasing and is being gathered, assessed and incorporated into guidance for future activities. The NEA, IAEA and the EC all play important parts in this and it was agreed that, ideally, these organisations should complement each other and continue to ensure, so far as possible, that their efforts are effectively coordinated.

2. OUTCOME – SESSION ON "ITALIAN DECOMMISSIONING SCENE"

2.1 Objectives

This session was chaired by Giancarlo Bolognini of SOGIN. The objective of this session was to give a complete picture of the work in the decommissioning area from the perspective of the different actors involved. The Session consisted of presentations from the Ministry of Environment and their EIA Commission, APAT, SOGIN, ISS, ISPESL, and CIRTEN.

A summary of the papers in the session can be seen in Appendix 2.

2.2 Conclusions and results of the session

In his summary of the session Giancarlo Bolognini stressed the fact that all participants from different organisations had a consistent view of the Italian decommissioning scene. He noted that the Ministry of Environment expressed the views from the public on the methodology of decommissioning and that there is a consensus on these views amongst the actors in decommissioning in Italy. The roles and structure of the organisations in Italy also helps to get an acceptance for the decommissioning activities.

Giancarlo Bolognini stressed that the nuclear future including decommissioning issues is dependent on the new generation of knowledgeable people that will continue the work started. One positive fact is that a rather large number of young people are involved in the Italian decommissioning area. The Universities are here playing an essential role.

In his concluding words Giancarlo Bolognini noted that the current work on nuclear issues in Italy is dealing with decommissioning**.** He summarized the situation with "We are able to manage the past" and hoped that this might also give a possibility for a nuclear future in Italy.

3. OUTCOME – SESSION ON "DISPOSAL AND MATERIALS MANAGEMENT"

3.1 Target outcomes of the session

- Workable solutions to address the issue of decommissioning waste disposal in a cost-effective way.
- Implications of working to different clearance levels, and ways forward.

3.2 Subject areas

This session was chaired by Alexander Nies, Federal Ministry for the Environment, Germany. The subjects to discuss in this session were:

- Types of waste to be decommissioned: volume, activity, physical size and shape.
- Waste disposal facilities: costs and criteria for waste acceptance.
- Clearance levels and their impact on D&D strategies and costs.

A summary of the papers in the session can be seen in Appendix 2

3.3 Conclusions and results of the session

The discussion of this subject reinforced one of the conclusions in the Summary Report of the 2003 meeting on the "Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management", which stated that Member Countries need to develop integrated, national decommissioning and waste management strategies. This is because decommissioning waste will be a significant proportion of the radioactive waste inventories in many countries, and effective planning will be required in order to secure appropriate disposal routes for all decommissioning waste streams. In this context the point was reiterated that, where disposal facilities are unavailable, it is generally for reasons other than technical feasibility.

The descriptions of the Swedish, French and Spanish programmes provided excellent examples of what needs to be done. Each of these countries already has disposal facilities that can accommodate some of their decommissioning waste streams, and they either has plans, or is evaluating options, for dealing with the remaining wastes.

As regards to the question of whether or not the unavailability of disposal facilities is a sufficient argument against early dismantling, there was general agreement that the lack of facilities should not be such an impediment. It was reported that only a small proportion (1–3%) of the total materials generated during decommissioning actually requires disposal as radioactive waste. Hence, early dismantling allows the remainder (more than 95%) to be dealt with proactively. Also, early dismantling will generally result in lower overall costs than deferred dismantling because the costs associated with interim storage of the small amount of radioactive waste requiring disposal will be less than the costs associated with care and maintenance of the intact nuclear facility over the same length

of time. Furthermore, early dismantling results in early reduction of residual risk and it can benefit from the collective knowledge of the existing workforce before it is dispersed and the knowledge is lost.

It is important to have good estimates of the types and quantities of materials and waste that will be generated as a result of decommissioning and dismantling at an early planning stage. An international project on waste estimating tools would therefore be of great value.

An interesting discussion was held on the issue of strategies on how to deal with decommissioning wastes and the large amounts of very low-level radioactive materials. Should these materials be subject to clearance (and thereby high costs for measurements and perhaps also decontamination) for recycling or reuse, or is it better and less costly to dispose of the materials as is? The availability of suitable surface disposal facilities for very low level radioactive wastes here plays an important role in the choice of strategy. Decisions on whether to clear or dispose VLLW don't seem to be technically based. Rather, the decisions seem to be based on the preferences of individual countries)

On the matter of clearance, as on previous occasions, some concerns were expressed about the different views on the use of the process of clearance, as such, and about the differences between clearance levels adopted in different countries. In regard to the use of clearance, emerging experience suggests that the costs of all the effort associated with the process may not be justified if appropriate facilities for disposal of VLLW are available, and it was noted that further discussion of this might be valuable. There was also a suggestion that, in some countries, commercial recyclers may not accept the cleared material because of public reaction. In discussion, however, it was suggested that these matters depend on local or national circumstances and that resolving these policy differences need not be a top-priority goal for the NEA.

A review of the clearance levels adopted in those countries that employ the concept of clearance showed that these are generally within an order of magnitude and it was said that having clearly defined levels for application to decommissioning projects is more important than is harmonisation of their values. It was also noted, however, that the public may be concerned by differences in clearance levels even though the radiological effect is imperceptible and, equally importantly, that such differences may introduce anomalies in regard to the transfrontier shipment of material either as cleared material or as VLLW. There seemed general agreement that the new IAEA Guide on Exclusion, Exemption, and Clearance may now be the best opportunity for increased harmonisation and that Member Countries should assess the applicability of the Guide to their individual circumstances. It was recognised, however, that an individual country's approach to clearance is not based solely on technical considerations but reflects also its national culture and values, and that total harmonisation, while desirable and worth the effort, is unlikely to be achieved.

As regards to future work in this area, it was suggested that consideration might be given to the idea of having higher clearance levels for materials such as asbestos that already have rigorous requirements for their disposal. It was noted, however, that the environmental regulations covering this generally fall under separate regimes and that it would necessarily involve satisfying both. Further, there remain concerns about the lack of consistency between the management and disposal of NORM and radioactive wastes and contaminated materials from nuclear facilities.

Given that the IAEA Guide on Exclusion, Exemption, and Clearance has only been recently published, it was suggested that member countries review the applicability of the guide to their national regulatory regimes, and that the WPDD take stock of the matter at its 2005 meeting to make recommendations on next steps and future NEA activities regarding clearance issues.

4. OUTCOME – SESSION ON "TECHNIQUES"

4.1 Target outcomes of the session

- Identification of actions needed to improve existing national and international catalogues of decommissioning techniques.
- Points of interest for R&D.

4.2 Subject areas

This session was chaired by Jean-Guy Nokhamzon, CEA, France. The subjects to discuss in this session were:

- Available, cost-effective and well-known techniques (incl. techniques for treatment of materials and waste).
- R&D techniques and how to continuously improve them.

A summary of the papers in the session can be seen in Appendix 2

4.3 Conclusions and results of the session

The current efforts of the Co-operative Program on Decommissioning (CPD) and of others in documenting techniques for decommissioning and dismantling, by way of databases and catalogues, was very much appreciated. It was noted, however, that more detailed information is required for the various techniques and on the situations and conditions under which they were applied so that users can evaluate whether a particular technique is applicable to their situation. An obviously practical observation was that the best approach is to visit facilities where a technique of interest is being used in order to get first-hand knowledge about its implementation and effectiveness and about what did and did not work.

As regards R&D on techniques for cost-effective decommissioning, including treatment of materials and waste, it was clearly stated that, even though decommissioning is now a mature commercial industry, it is nevertheless important to continue with R&D designed to improve existing techniques and develop new techniques. It was noted that this work is highly specialised, that it may be difficult to secure R&D funding from the decommissioning industry or a single government, and that collaborative, international funding may be required. It was clear from the discussion, however, that those seeking such funds will, collectively, need to identify R&D projects clearly and provide a convincing business case showing that improved or innovative techniques have the potential for improvements in safety, cost and/or efficiency.

In this context, it was reported that decommissioning contractors are reluctant to utilise new, untested techniques for fear of losing money or credibility on fixed-price contracts if a proposed technique turns out to be inappropriate for the project. It was clear that some sharing of the responsibility for employing innovating techniques, between site owner and contractor, will be

necessary before such innovative, unproven technologies are employed on major decommissioning projects, and experience and knowledge extended.

There seems to be a shift in the direction of the R&D from developing completely new methodologies to efforts on cost reduction and optimisation of already available methods. Ongoing R&D work also emphasises remote decommissioning work and techniques to reduce secondary wastes. Future R&D work will generally need to make use of mock-ups and 3-D computer simulation tools.

5. OUTCOME – SESSION ON "MANAGEMENT OF TRANSITION AND CHANGE THROUGHOUT DECOMMISSIONING"

5.1 Target outcomes of the session

Identification of management issues in transition and presentation of solutions that have worked, and future needs regarding:

- Management planning for transition and decommissioning.
- Management of decommissioning.
- Stakeholder engagement.

5.2 Subject areas

This session was chaired by Albert Frischknecht, HSK, Germany. The subjects to discuss in this session were:

- Effective ways to organize & mange a decommissioning project (including knowledge management).
- End of plant operation and transition to decommissioning with emphasis on managing workers and other stakeholders.
- Effective stakeholders interfaces (before and during decommissioning and including community aftercare).
- Transition from a nuclear decommissioned site to an industrial site.

A summary of the papers in the session can be seen in Appendix 2

5.3 Conclusions and results of the session

The need for early planning for decommissioning was re-emphasised and it was noted that this is already built into facility design and licensing arrangements in many countries, so it is clear that this message has been widely accepted. As regards the content of plans, it is also clear that a wide variety of technical and practical issues have to be addressed, and that in addition to the technical issues, stakeholder interests have to be protected. One particularly valuable point that was emphasised was the need to identify and agree on the end-point of the decommissioning process. That is to say, getting a clear understanding of what the site may be used for afterwards. (e.g. Re-use for industrial purposes or for unrestricted use, i.e. "Greenfield" status.) This may influence the extent of clearance required, the overall costs and, significantly, the eventual impact on the local community. The key point was that the plan should ensure, so far as possible, that there are no surprises during the decommissioning process, and it did not seem that there was much more to be done on this in the international context, except perhaps in regard to consideration of plans for dealing with the possible effects of terrorist activity.

Management of decommissioning was a major issue for further consideration. The first message was that decommissioning needs to be managed as a professional project in its own right. There was also some discussion of the relative merits of having decommissioning done by the existing plant operator or having it taken over by some other organisation set up for the purpose, like ENRESA in Spain or ONDRAF/NIRAS in Belgium. There were different and strongly held views on either side. One suggestion was that, for the purpose of reducing the facility to waste, it needed people different from those who had built it and cared for it during its operational life. Another was that it needed people who knew and understood the plant and its history.

There was a question of whether contractors used for decommissioning should be major contractors, with a large contract, or a larger number of smaller, local contractors working under local management and employing local people. The Spanish experience at Vandellos seemed to favour the latter option. There was also the question, related to the issue of fixed price contracts mentioned above, about how technology is developed and improved and how it is shared and disseminated if there is no mechanism for getting contractors to feed back information on what worked and what did not. These matters seemed to be of common interest and worth further study in the international context.

It was also suggested that, in parallel with such developments in the management of decommissioning, there might be scope also for developments in the management of its regulation. The regulation of decommissioning activities is not a simple extension of the regulatory regime that was in place during plant operation. New issues requiring regulatory review and consideration arise that were not present during plant operation. Also, it was agreed that regulatory burden should decrease as the risks associated with the facility decrease.

Stakeholder engagement emerged again as a major issue. It is now seen clearly as the key to progress on many issues of nuclear power, and not least on the matter of dealing with waste arising from decommissioning. Discussion covered the two broad areas of dealing with the interests of staff and dealing with the interests of the local community. As regards staff as stakeholders as well as a valuable resource, it seemed that keeping them involved in plans and decisions and caring for their interests, including long-term employment prospects, was no more than the good management seen in many fields, and it did not seem that there is much scope for international work on this. As regards the local communities, the US work on environmental conflict resolution confirmed much of what has been emerging from the NEA Forum on Stakeholder Confidence, particularly in regard to the experience in Sweden and Finland, and in Canada and Belgium, where local communities have been involved in the development or led the development of strategies and management plans.

It seems that the end-state of decommissioning is one of the most important considerations for local communities. Consequently, it was felt that there are still issues to be explored and experience to be exchanged on matters such as identification of legitimate stakeholders, and it seems that further international work on this topic would be justified.

Ideally the planning of decommissioning and involving of stakeholders should begin already at the start-up of the nuclear facility. The key sentence would be “Plan the work & work the plan”.

6. OUTCOME – SESSION ON "FUNDING AND COSTS"

6.1 Target outcomes of the session

- A view of advantages and disadvantages of existing mechanisms.
- A review of the prime drivers for costs in decommissioning, and attendant cost reduction measures.
- Reliability of cost estimates for funding, and ways to improve them.

6.2 Subject areas

This session was chaired by Paul Woollam, BNFL, UK. The subjects to discuss in this session were:

- Secure funding.
- Well founded cost estimation, validated by experience.

A summary of the papers in the session can be seen in Appendix 2

6.3 Conclusions and results of the session

The systems for securing funds for decommissioning might be described simply as ranging from having no specific provision at all, through having some accounting commitment that the costs will be met out of revenue or assets when necessary, to having a secure, segregated fund of money in independent, trustworthy hands. The feeling of participants seemed to be that having no provision at all was quite unacceptable and that the accounting commitment depended on trusting operators or government to have and to make available such funds when necessary. There was general agreement that a segregated fund under independent management provided for the most favourable and secure arrangements. This is the Swedish model, but the Chairman of the Swedish fund warned that, good as it is for Sweden, we should not fall into the trap of thinking that 'one size fits all', and the subsequent discussion confirmed that others take a more favourable view of alternatives such as the imposition of formal requirements to be met by the operator. It is not clear how much more needs to be done on this topic, except perhaps in regard to potential legal requirements in the European Union. In any case, the issue to be addressed in the international context might better be "What do we need to do to have secure funding and what are the safety implications of not having it?"

The prime drivers of cost in decommissioning are widely accepted as being dismantling and decontamination operations and waste management. As regards dismantling and decontamination, it had already been concluded that cost reduction was most likely to come from improvements in the effectiveness of current techniques or in the development of new techniques and, indeed, that this was one of the main drivers for R&D in what was otherwise judged to be a relatively mature business.

As regards waste management, this can constitute up to 60% of decommissioning costs. Transportation of the wastes can be as high as 25% of the decommissioning costs. It is not so clear how the industry can reduce these costs except by minimising the creation of waste by design of facilities and in their subsequent operation and dismantling. Methods of disposal and interim storage, and their costs, are probably outside the control of the operator of facilities to be decommissioned but it was noted that cost reduction might be possible if regulators and the public could be convinced about the safety of procedures such as transport of whole pressure vessels, for example. Clearly, maximum advantage can be taken from clearance of materials, but even this may be constrained if, for reasons of public acceptance for example, recyclers refuse to handle such materials, as seems likely in some countries. Nevertheless, this did seem to be a subject worth further study in the international context, at least for so long as there is any possibility of attempts to harmonise decommissioning costs for the purpose of ensuring fair competition in the international electricity supply market.

It became clear that judgement of the reliability of costs estimates is subjective and depends on whether one thinks that ±15% is reliable or not. It also depends on when the cost estimate is being made for, in the sense that ±50% is probably good enough for planning 20-30 years ahead but, for immediate management action, an estimate nearer ±15% is needed. Various methods of estimating costs were described, ranging from the detailed 'bottom-up' approach to 'expert opinion', and including a 'parametric' approach. Most of the approaches, and particularly the 'parametric' approach, seem to depend on the reliability of historic data that is not yet wholly available for decommissioning nuclear plants, and particularly not for fuel-cycle facilities. Thus, there appears to be a strong case for accumulating data and benchmarking costs for similar plants and processes. It was pointed out that the NEA/IAEA/EC NDC have proposed a joint standardised form of accounting for consistency. This needs to be tested further and improved and later applied consistently. There are however difficulties in implementation due to commercially sensitive information that may need to be given. More discussion of this item seems warranted.

As regards other issues that might improve reliability of cost-estimation, repeated reference was made to the need for good, prior characterisation of the plant, and a warning was given about some other issues can result in poor accuracy. These included;

- Changing the scope of work during or after cost-estimation.
- Not giving proper attention to accounting protocols concerning inflation, discount rate, year of cost accounting, etc.
- Having to factor in allowances for contingencies and risk without a clear and agreed methodology.

It was also noted in this context that the only way to minimise uncertainty about costs during the decommissioning process is to have continuous, independent reviews of costs as the project progresses. At the end of the project, it is important to review the actual costs and compare them to the cost estimates done before and during the project. This kind of comparisons will add to the confidence building of all stakeholders.

It was suggested that international work on developing cost-estimating methodology should be re-established even if only to provide regulators and the public with assurance about the reasonableness of decommissioning costs, but it was noted also that the issue of costs should be kept in perspective given that the costs of decommissioning and waste management constitute only 3-5 % of the cost of nuclear electricity production and that it may be difficult to get the necessary co-operation in what is now a competitive market.

7. OUTCOME – SESSION ON "REGULATION AND SAFETY"

7.1 Target outcome of the session

A review of international trends in regulation, including challenges for implementation in regard to Transition to decommissioning; License termination; and Safety case.

7.2 Subject areas

This session was chaired by Jukka Laaksonen, STUK, Finland. The subjects to discuss in this session were:

- De-licensing levels (for sites).
- A fit-for-purpose regulatory regime for decommissioning.

A summary of the papers in the session can be seen in Appendix 2

7.3 Conclusions and results of the session

7.3.1 Transition to decommissioning and license termination

In the interface between operation and decommissioning there is a need to replace the operation license with another license that authorizes the start of dismantling. As a minimum, new Technical Specifications are needed as license conditions for the decommissioning phase. The regulators should require the continuity of the transition process (i.e., no termination of site activities) and an organization that employs an adequate number of staff with experience from operation of the facility to be decommissioned.

There was a general agreement that the change in the hazards pattern has to be taken into account in the regulation, and the ambition level for quality of activities could be reduced. After the final plant shutdown and the removal of nuclear fuel, the radiological risks decrease significantly. Main hazards during dismantling are conventional, and they are related to industrial (worker) safety and the safety of transports. For achieving cost effectiveness and adapting to an optimum level of safety, a cultural change is needed both within the licensee and the regulator's organization.

On the other hand, the local stakeholders and general public at large are most concerned with potential radioactive releases from the dismantling waste and with the safety of the end state. Therefore the radiological issues have still to be handled with adequate care, to avoid releases or doses beyond limits. Transparent dialogue with the local stakeholders needs to take place as part of the Environmental Impact Assessment which normally precedes issuing of the license for dismantling. It was suggested that the end state of the decommissioned site should not be standardized in the regulations but the local stakeholders should be given an opportunity to influence the requirements for the end state.

7.3.2 Safety Case

It was emphasized that the regulatory requirements for the safety case have to be flexible. A possibility to modify the requirements should be provided, as needed to account for accumulation of experience from decommissioning. A good dialogue between the licensee and the regulator is valuable for learning on both sides and for finding pragmatic approaches to regulation of dismantling. It was suggested that the licensee has no time to wait for formal changes in the regulations, and therefore they have to find out the expectations of the regulators by means of a continuous dialogue.

Different views were expressed as concerns the contents and level of detail of the safety case. However, there was a consensus on the general principle: preparation of the safety case should support planning which needs to be done by the licensee for ensuring the safety of dismantling approach. Thus the safety case should include only issues that are considered important by the licensee. Licensee should be left with the duty to develop and suggest the dismantling strategy, and present it at the necessary level of details.

On the other hand it was remarked that the licensee's plan must be in line with the national decommissioning strategy, especially as concerns the management of different categories of decommissioning waste. It is also important that the regulator gets a global overview of the entire decommissioning project before it is started.

The following topics were suggested as potential elements of a safety case:

- a decommissioning plan covering all stages, and including a plan for waste management, site clearance, and target end point;
- demonstration of planned dismantling technologies for operations involving elevated radiation hazards, especially a risk of spreading radioactive materials;
- safety analysis of operations involving potential hazards: deterministic, PRA;
- implementation of radiation protection in various stages of decommissioning;
- worker safety;
- inventory and characterization of waste in different categories;
- cost estimates and funding (adequacy of funding is an important safety issue).

7.3.3 International harmonization

There was a consensus that the international harmonization of safety requirements, such as clearance levels, should be based on the IAEA Safety Standards. Also the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management must be taken into account. National regulators should make an effort to take into account these standards to the extent possible. On the other hand, it was noted that there are differences between the countries, and it is not meaningful to aim for full consistency of different national regulations.

As an example, a harmonization process within WENRA was described that besides harmonization of regulations and practices helps the regulators with no decommissioning experience to learn from experiences in the countries having decommissioned some nuclear facilities.

It was also suggested that a potential area for further international work might be considerations of what can be done to reduce nuclear regulations as risks and hazards are reduced or as they change from being nuclear-related to conventional risks and hazards.

7.3.4 Regulator's role in pushing specific decommissioning strategies

Strong views were expressed that the regulators should not enforce specific decommissioning strategies beyond the conditions given in the national legislation and in the national approaches for radioactive waste management. However, there was a general consensus that immediate dismantling should be aimed for rather than delayed one, no matter whether the final repositories for radioactive waste are available or not. It was also pointed out that national strategies for nuclear waste management should be promoted with the aim to make such repositories available before start of dismantling, whenever feasible.

8. OUTCOME – SESSION ON "CONCLUSIONS/FINAL STOCKTAKING"

This session was chaired by Mrs Margaret Federline, USNRC.

8.1 Plenary discussion

Mrs Margaret Federline noted in her introduction to the plenary discussion that it had been obvious throughout the workshop that progress have been made since the last workshop in 1999. National systems and strategies are evolving. However, lack of consistency between national programmes does not mean that there is a lack of progress! The NEA databases on fact Sheets from the member countries and the brochure "Decommissioning of Nuclear Facilities - It can and has been done" are good examples of progress on sharing available information between the NEA member states.

Challenges do remain! Some of these are:

- Public acceptance - the primary challenge for the future.
- Regulators should be more visible and support the outreach activities needed.
- More realistic standards are needed.
- Many techniques already available but R&D on new technologies are valuable. These efforts must though be justified in cost and value.
- Assurance to have accurate funds available at the right time is a challenge.
- Educational skills must be provided.
- The international organisations work on decommissioning needs to be more co-ordinated.

In the discussion the question on the technical possibility of disposing waste from decommissioning was raised. A conclusion of the discussions was the following statement: "Disposal of all kinds of waste arising from decommissioning is feasible today!"

When discussing the public acceptance issue the experience was that the interested public often is bringing up questions on safety for workers, end-state of the decommissioning project in question and in some cases (specially in the USA) terrorism and security measures to meet these threats. It was noted that WPDD is planning a Topical session on Stakeholder involvement in November 2005.

When discussing cost estimation methodologies it was clear that benchmark data are needed. An international database on actual cost data would be very beneficial. This would give the implementers, the public and the governments a view on how reasonable provided estimates for a certain decommissioning project are. Baselines on how to make accurate cost estimates could then be established in a better way then today. The obstacle is that some of these data have a commercial touch and are hard to gather. Ongoing examples of information exchange in this area are the work in the NEA Co-operative Programme on Decommissioning (CPD) where about 40 projects share detailed

information on decommissioning issues. Also in the TEGDE group at IAEA information is shared and gathered in reports soon to be distributed.

The co-ordination between the international organisations was discussed. It was noted that co-ordination already exist in the form of membership and observers in each others workgroups. The participants in the workshop though emphasised that they would welcome an even further co-ordination between the international organisations regarding their work plans on decommissioning.

The consistency of clearance levels between different countries was briefly discussed. It was noted that IAEA has established and distributed a document on International clearance criteria. The individual countries are now free to adopt these criteria. Future discussions in this area might concentrate on characterisation and measurement methodologies. A future workshop on characterisation issues would be welcomed.

8.2 Main Messages

In summary, the main messages emerging from the Rome 2004 workshop on "Safe, Efficient, and Cost-effective Decommissioning" are:

- **Decommissioning is a mature industrial process** and many projects have been safely completed with support of local communities. Technical and scientific issues are well-understood and practical experience and associated lessons are being documented to guide future activities. Emphasis is being placed on effective planning with active programmes of community involvement.
- **Individual countries need to further develop integrated decommissioning and waste management strategies** to ensure that long-term solutions will be available for all wastes generated from decommissioning. National systems are evolving to meet national needs, against a framework provided by the international organisations, and these seem increasingly to favour early dismantling regardless of the availability of waste disposal routes.
- **Realistic and streamlined regulatory programmes are being developed** with feed back from industry experience and are placing more responsibility and accountability on licensees.
- **Accurate** decommissioning **waste cost calculation methods is needed.** Waste volumes may vary from project to project even for similar installations. There though appears to be a strong case for accumulating data and benchmarking costs for similar plants and processes. Further work and experience exchange on cost comparisons between different strategies (for example clearance and recycling/reuse of materials versus direct surface disposal) would be valuable.
- **International clearance criteria have been established**, with individual countries free to adopt them.
- **Financial mechanisms for decommissioning funding are evolving in the NEA member states** to meet regulatory and project needs. Continuing challenges are uncertainties in cost estimates and the implementation of measures to assure that funds will be available when required.
- **Creative research on decommissioning is being carried out.** Human factors and organisational issues are studied. Practical solutions are being implemented such as the use of management transition programmes. Some increased efficiency and effectiveness is

needed by way of R&D on improving technology and developing innovative techniques, subject to justification of its cost and value. There is a need to consider how to design commercial contracts so that decommissioning contractors will be willing to test new, relatively unproven techniques.

- **Continuing emphasis on education in critical nuclear skills is needed** to ensure availability of the necessary expertise for both near-term decommissioning needs and long-term energy needs.
- **Public acceptance is still a major challenge**. Without public acceptance, decommissioning may be prolonged and difficult to implement. Hence, all actors and interested parties need to be constructively involved in the dialogue within the local communities to gather and evaluate all relevant concerns and thereby inspire confidence in the safety of decommissioning activities.

APPENDIX 1

Background on WPDD

The standing committee "Radiaoactive Waste Management Committee"(RWMC) of the NEA formed in 2001 a "Working Party of Decommissioning and Dismantling"(WPDD) which consists of senior representatives of national organizations who have a broad overview of decommissioning issues through their work as regulators, implementers, R&D experts or policy makers. The WPDD is mandated to:

- Analyze and comment on policies and strategies of decommissioning including decommissioning financial assurance, recycling/reuse and/or disposal of materials and the release/reuse of sites and buildings.
- Complement, at policy and regulatory levels, the technical work of the International Co-operative Program for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Programs (CPD).
- Make experience available to other bodies.
- Facilitate communication and information exchange among WPDD members and promote open dialogue among peers in industry, regulatory authorities and R&D.
- Coordinate decommissioning activities among NEA standing committees; Keep the RWMC aware of ongoing international decommissioning activities and contribute to the integration of these activities with other RWMC activities including the Forum on Stakeholder Confidence.
- Develop the link between decommissioning/decision making/public acceptance and confidence.
- Set up, manage and make broadly available a database of information on D&D in member countries.

Decommissioning issues – Meetings 1999-2003

Background on 1999 Rome meeting

In the end of the 90-ies it was recognised that more nuclear installations were beginning to reach the end of their useful lives, that decommissioning projects were becoming more common, and that the technical aspects of decommissioning processes were increasingly becoming better understood. With this shift to more routine decommissioning operations interest was risen in more generically applicable regulations, guides and standards both nationally and internationally.

To further the dialogue between regulators and implementers in this area, The OECD Nuclear Energy Agency (NEA), the International Atomic Energy Agency (IAEA), and the European

Commission (EC) agreed to co-sponsor a workshop in 1999 to bring together regulators, implementers and waste receiving organisations to identify those regulatory issues of most concern.

The scope of the discussions at the workshop included the decommissioning of all nuclear installations, but excluded mines, mills and mill tailings piles, as well as waste disposal facilities.

Background on Tarragona meeting 2003

On September 1 - September 5, 2003, the WPDD held an International Seminar on "Strategy Selection for the Decommissioning of Nuclear Facilities." This seminar was by invitation only and was held in conjunction with the regular yearly meeting of the WPDD. The objective of the seminar was to have focused discussions of decommissioning strategy selection between implementers (i.e., licensees), regulators and local communities and the seminar focused on the key factors that influence the selection of a particular decommissioning strategy.

APPENDIX 2

Below are summaries of available papers from the different sessions. For obtaining pdf-versions of the full papers (and often pdf-versions of correspondent PowerPoint presentations as well as video uptakes of the actual presentations) please consult the CD-Rom version of the Proceedings.

SUMMARY OF PAPERS

SESSION 1:

INTERNATIONAL STOCKTAKING

DECOMMISSIONING: A SUCCESS STORY IN QUEST OF NEW ACHIEVEMENTS

K. Shimomura, C. Pescatore and T. Eng
OECD/Nuclear Energy Agency

Since 1999 we see that the emphasis has shifted to provide increased attention to the general governance of decommissioning. The inventorying of liabilities, the establishment and running of funds, the formulation of proportionate regulation have taken a more central stage. There has been much talk about strategy as well, with some nations like Italy and France changing their stance and opting for prompt decommissioning.

The NEA, IAEA, and EC have overlapping membership but distinct mandates. Our programmes do receive a certain amount of co-ordination – through agreements and discussion amongst secretariats and through participation in each other activities. Co-ordination, however, starts at home, in the member countries, and in the end it is also in the hands of many in this audience. NEA is open for suggestions.

Overall we can conclude that much has been done in the field of decommissioning, especially in terms of techniques and in setting up institutional frameworks, and especially so in the more mature nuclear programmes. Depending on national circumstances both fine and less-fine tuning may be needed, however, in preparing for the bigger challenges that lie ahead due to the number of projects to be taken on and the magnitude of those projects in terms of both size and time. We do start on the solid footing provided by the work carried out so far, but the quest for new decommissioning achievements is still on.

DECOMMISSIONING IN THE EUROPEAN UNION - THE VIEW OF THE COMMISSION'S DIRECTORATE-GENERAL ENERGY AND TRANSPORT

U. Blohm-Hieber, R. Clarke and Z. Széles
European Commission

Although there is not yet an agreement between the Commission and the Council on the corresponding Directives, both the Community and its MS are committed to a high level of nuclear safety and to the safe management of spent fuel and radioactive waste. Nuclear safety means safety for the whole lifetime of nuclear installations - covering not only their operation but also the whole cycle from design to decommissioning.

The safety concerns of decommissioning are twofold: safe operations during the decommissioning activities and safe storage of the resulting waste.

With the relevance of the above in mind, the paper concentrates on the following topics:

- The current decommissioning approach within the EU in general
- The situation of nuclear power plants in the new MS and in particular the decommissioning of those reactors subject to early closure
- The decommissioning of the Joint Research Centre installations for which the Commission is responsible**;** and finally
- The important area of Research and Development

Since efficiency and cost-effectiveness are the responsibility of the MS, these matters are not dealt with.

INTERNATIONAL ATOMIC ENERGY AGENCY ACTIVITIES IN DECOMMISSIONING

D W. Reisenweaver
IAEA

The International Atomic Energy Agency (IAEA) has been addressing the safety and technical issues of decommissioning for over 20 years, but their focus has been primarily on planning. Up to know, the activities have been on an ad hoc basis and sometimes, important issues have been missed. A new Action Plan on the Decommissioning of Nuclear Facilities has recently been approved by the Agency's board of Governors which will focus the Agency's efforts and ensure that our Member States' concerns are addressed. The new initiatives associated with this Action Plan will help ensure that decommissioning activities in the future are performed in a safe and coherent manner.

The International Atomic Energy Agency (IAEA) has been preparing safety and technical documents concerning decommissioning since the mid-1980's. There have been over 30 documents prepared that provide safety requirements, guidance and supporting technical information. Many of these documents are over 10 years old and need updating. The main focus in the past has been on planning for decommissioning.

During the past five years, a set of Safety Standards have been prepared and issued to provide safety requirements and guidance to Member States. However, decommissioning was never a real priority with the Agency, but was something that had to be addressed. To illustrate this point, the first requirements documents on decommissioning were issued as part of a Safety Requirements [1] on predisposal management of radioactive waste. It was felt that decommissioning did not deserve its own document because it was just part of the normal waste management process. The focus was mostly on waste management.

The Agency has assisted Member States with the planning process for decommissioning. Most of these activities have been focused on nuclear power plants and research reactors. Now, support for the decommissioning of other types of facilities is being requested. The Agency is currently providing technical assistance to Bulgaria, China, Georgia, Kazakhstan, Latvia, Lithuania, Philippines, Romania, Serbia and Montenegro, Slovakia, Tajikistan and Ukraine. This list of countries requesting assistance from the Agency continues to grow every year.

A recently published Safety Guide entitled "Application of the Concepts of Exclusion, Exemption and Clearance" (RS-G-1.7) [2] provides guidance to national authorities and operating organizations on the application of the concepts of exclusion, exemption and clearance as established in the Basic Safety Standards [3]. It provides specific values of activity concentrations for both radionuclides of natural origin and those of artificial origin that may be used for bulk amounts of material for the purposes of applying exemption. The document also provides guidance on the application of these values for clearance.

SUMMARY OF PAPERS

SESSION 2:

ITALIAN DECOMMISSIONING SCENE

THE INSTITUTIONAL FRAMEWORK OF DECOMMISSIONING IN ITALY

Massimo Goti
Ministero delle Attività Produttive Direzione generale per lo sviluppo produttivo e la competitività, Italy

Decommissioning of the NPP is generally viewed in a negative framework. On the contrary, it is an activity which aims is said to obtain the final removal of the risk factors from the environment. It is the last step of the production cycle, whose importance is underlined by the Regulation recently issued for the correct management of resources in the territory.

Decommissioning NPP involves the final arrangements of the radioactive wastes, produced either during the past operation period or resulting from the dismantling operation. All the radioactive wastes must be conditioned and maintained in safe conditions.

Radioactive waste management is no longer a problem for those countries that decided to face it, that is the majority of the industrialised countries. Correct technological solutions exist, due exist, respectful of the environment, of the people, of the ethical principles.

The centrality of the problem is also decreed by the fact that sometimes now, the European Commission has been working on the issue of the directive on waste management, an effort which Italy has strongly supported, also during the Presidency period.

Decommissioning on NPP is moreover an activity that implies advanced technological solutions, multilateral overlapping programs, working of style situations.

Not many countries have completed yet (the) decommissioning of their plants: such activity should therefore be seen as an opportunity for the growth and the assertion of the Italian industry, also in view of the potential new market and the alliance with European industries. Of the 530 nuclear reactors present in world today, approximately 100 are undergoing decommissioning. In the next 2 years another 100 will reach the end of their operative life. Probably after the necessary system improvement many of them will continue to work, but it is clear that the international market of the decommissioning will continue to grow in the next years. Italy can play an important role in this scenario: the decommissioning program produced by Sogin can therefore be a springboard for specific activities.

Decommissioning of the Italian NPP will cost a total of approximately 3.5 billions euro. This amount of money will be founded by the electricity market (electricity bill): in order to optimise this huge amount, the efficiency and efficacy of the decommissioning program must be guaranteed. For this reason in 2003 the Italian government gave a significant drive for the centralisation of all the activities and responsibilities to a unique operator, also assigning Sogin with the management of the ENEA fuel cycle plants and related companies.

Decommissioning program for Italian nuclear plants have been issued since 1999 and have under-gone the complex licensing procedure foreseen by a specific regulation of the sector, the law 241/2000 and by the regulation regarding the Environmental Impact Assessment. This regulatory frame is a recent one and, for some aspects, is still not completed and has, for the same reasons, sometimes caused some delay in activities.

Other factors providing delays involved the excessive sensitivity of some local situation which, even though guaranteed by regulation that envisage the direct participation in decision making, see the decommissioning as a risk factor that they can't control directly.

In order to proceed in completing this unpostponable operations in the most correct and effective manner, it is important that the different institutional bodies involved in the licensing procedure co-operate in the success of the program.

The issue of the decree envisaged by law 230/95 constitutes a test table to this end. Working along these lines, the government has already began by signed the institutional agreement for the co-ordination of the licensing procedure related to the mention law 230/95 and the Environmental Impact Assessment.

THE ROLE OF THE COMMISSION FOR THE ENVIRONMENTAL IMPACT ASSESSMENT (V.I.A.) IN THE DECOMMISSIONING OF NUCLEAR INSTALLATIONS IN ITALY

G. Damiani
Member of Environmental Impact Assessment Commission
of the Ministry for Environment and Land Defence, Italy

In Italy decommissioning of nuclear installation is regulated through two basic main laws:

- The first one is the decree-law n. 230 /1999, regarding licensing and controls procedures in nuclear field. The Italian Environmental Protection Agency (now reorganized as APAT: Environmental Protection and Technical Services Agency) is the Authority in nuclear safety, radioprotection, licensing and controls; Agency's concern – in the matter of radioprotection- care the safety in nuclear plants, the exposed worker's health, the population health and the radiological protection of environment. Decommissioning procedures, for the radiological aspects, must be authorized by APAT agency.
- The second law consists of the Directive of European Community (97/11, 1997.3.3, published 1997.3.14). According to this directive, decommissioning's planes are included into the list of the planes obliged to Environmental Impact Assessment procedures, and a complex of obligations come from: procedures regarding Italian Decree 1988/12/27 and, for general aspects, the according to the whole of current general provisions, usual procedures and routine .The duty of National Environmental Assessment Commission is to supply to the Ministry for Environment, the view, based on technical examination of the concerned planes and Study of Environmental Impact. The environmental compatibility is an "into-procedure" for the final authorization decree of the government.

The first question, for that, discussed in Commission was harmonizing own actions with the action of other Institutional Organisms: integration, avoiding overlapping.

Objectives of assessment procedures

Environmental Impact Assessment Commission individualise and value every, direct or indirect, effect, possible to have during the planed accomplishment of a project, particularly regarding (in order of importance, according to European Union directives):

1. man, fauna and flora;
2. soil, water, air, climate and landscape;
3. interactions between two former factors;
4. material property, and cultural , natural and artistic patrimony.

During the assessment implementation, so, in particular, are focused:

- Individuation of best procedures and technologies for the whole of planned operations. (decommissioning must be addressed to minimize the impact both – on natural and human – environment, including socio-cultural aspects for citizens concerned).
- Identification of all possible impacts may be originated, for each actions, beyond the matter of radioprotection - although very important but not exhausted- , like noise emissions, liquid and gaseous pollutants emissions, traffic, disturbance against natural protected areas ecc.
- Individuation of strategies and methods to reduce inevitable impacts (mitigation);
- Guarantee the opportunity for the public to participate (In the Assessment Impact Procedure is guaranteed the public information about the Environmental Study and information about the plan. Public in single or associated form, and Local Administrations, may intervene through observations).

The used method

Decommissioning of an nuclear installation in considered in the same way of a complex industrial installation decommissioning and so the evaluation is operated into three "classic" frameworks (DPCM 88.27.12): **programmatic, plan- relative, environmental-relative.**

Particular aspects

In the field of nuclear plants decommissioning, the development of the valuation of three mentioned frameworks is absolutely diverse in confront with the cases that the Commission has had in Italy as routine during several years. The programmatic framework, in fact, is very uniform because is disciplined in Italy with decree of the Ministry of Productive Activities (99/14/12, containing Strategic Trends on Administration of Nuclear Outcomes). Local differences occur only in local specific regional or municipal land-discipline.

In the routine the environmental-related framework Commission value the situation *ante operam* and make a comparison with the previewed situations in *phase of realization* and with the future situation *post operam* when the opera will come in exercise. In the decommissioning operations the impact post operam practically doesn't exists. On the contrary the assessment is concentrated on the demolition project and on the timing.

Obviously evaluation regards technological facilities and systems concerned decommissioning. The guide- trend of the Commission is to avoid, as much as possible, the realization of new structures, pursue the objective of re-use existing facilities and realize the Waste Management Facility and others utilities into existing spaces and using existing structures, obviously after some intervention if necessary.

We retain a very useful reference in this procedure the Study promoted by European Union "Environmental Impact Assessment for the Decommissioning of Nuclear Installations", compiled in ambit of Cassiopee Project.

In addition, a particularity consists in having a unique technical interlocutor, Sogin, for all the planes of decommissioning of Italian nuclear sites.

Problems

Complete previsions of all the aspects in decommissioning and the perfect timing are impossible. Some variation necessary may occur i.e. contamination levels not predictable in some parts of the plant, decontamination treatment times prolonged in some structures ecc. Late on prefixed times (15 years circa) may be possible if , at the opportune moment , the solution for radwaste disposal will not available (particularly for high activity waste).

For the first question it is necessary to have procedures, well individuated, rigorous but within a controlled degree of flexibility. For the second question (waste storage and waste disposal) we intend take in count the possibility of a late in definitive solution and have the situation under control organizing the work by steps with intermediate check points and final check points for each of them, in witch is possible to have a pause standing in a situation of clear and important improvement, in every environmental aspects, in confront with actual situation, and particularly both in terms of safety and security.

When decommissioning is concluded?

In order to radioprotection view point the objective is very clear: the site of the nuclear installation must be released radiologically- constraint free;

The view point for V.I.A. Commission is not so definite. General diffused idea (in administrators people) is to realize a green field in the site when decommissiong will finish. In our evaluations is emerging green field is in some cases in vain too much expensive and the realization has high environmental impact. It is in discussion, therefore, if it's better, for the society and the environment interest, the re-use of conventional structures, not affected by radiologic problems, like meeting-rooms, refectory, offices, storehouses. Such structures might be reused within social finality (i.e. depository of equipments for Civil Protection Agency, museum in the field of energy since hydraulic mill-wheel to nuclear plants and hydrogen fluel-cells, research centres, cultural centres, congress palace ecc.).

To favourite the political decisioners to take a choice in order to save those structures, Commission intends value different options in confront, both on costs/benefits and Environmental Impact view point.

In some situation it is necessary to define the meaning of "green field": for example in a river bank it is scientifically correct restore the riparian native vegetation realizing a vegetate buffer strip to protect and improve water quality and favourite wildlife riparian environment recolonization. Realization of a green field by excavating and moving very large quantitatives of soil, vice versa, is expensive, has a great impact due to mechanical means operations, noise emission, fossil fuel consumption, requirement of very large landfills realization for disposal of removed materials. In addition in a river bank is "ecologically" a mistake.

This problem has not a unique solution and we are assessing every possible and/or necessary alternatives, case by case, auditing regional and local administration opinions and reporting those in the state central ambit valuations and initiatives.

NUCLEAR DECOMMISSIONING IN ITALY

I. Tripputi
SOGIN, Italy

Introduction

Italy is in a unique position. Italy has been in the past among the leading countries in the pacific use of nuclear energy, but, as a consequence of the 1987 referendum decided to shutdown all operating power plants, to leave uncompleted the plants under construction and to stop all related research and industrial activities declaring a 5 years moratorium on any future initiative.

The moratorium ended unnoticed in 1992, since there was no political move to restart nuclear power in Italy and, in practice, it is still acting. Therefore, now the major efforts in the nuclear field are focused on the closure of past liabilities assuring safety and security highest levels. This is a duty to be carried out by the generation that used this form of energy, but, at least for somebody, also a pre-condition for the acceptance of any future renaissance of nuclear energy in Italy.

A vision for the future

SOGIN is a Company carrying out a service for the country and fully committed to solve the liabilities left by the interrupted nuclear industry in Italy. To this aim SOGIN is managed as a private company to assure the highest possible efficiency, but, at the same time, is driven by moral and ethical objectives and the vision of protecting the environment and health and safety of the public.

SOGIN blends in a synergic way the various ENEL experiences (design and operation of NPP's) and ENEA experiences (engineering and operation of R&D and industrial facilities supporting NPP's). Such a comprehensive combination of technical competences should not be dispersed in the medium and long term and the management is committed to facilitate the technical growth of the impressing number of motivated young people joining the Company, whose enthusiasm is contaminating every day also the "veterans", to assure for the country an asset and a presidium of very specialized multi-disciplinary nuclear competences.

Speaking of possible scenarios for the future, we should mention that the current international situation in the oil market, both in terms of barrel cost and in terms of security of supplies, and the severe black-outs that have plagued also Italy (the major one in September 2003 lasting in some areas for about 24 hours), have started a widespread discussion about energy alternatives and strategic energy plans. In this frame an increasing number of politicians and scientists are calling for a reconsideration of nuclear energy as a viable option also for Italy in a new energy mix. It is clear that public acceptance of nuclear energy is strictly connected not only to the demonstration of high safety standards of future plants, but also to the solution of radioactive waste disposal and of plant decommissioning. This is the link that could make the SOGIN mission even more strategic for the country.

LIST OF MAJOR ACTIVITIES RECENTLY COMPLETED OR TO BE STARTED SOON

Trino

- Decontamination of the steam generators (completed)
- Removal of turbine asbestos insulation (completed)
- Dismantlement of some conventional buildings, i.e. emergency diesels, emergency cooling towers, administrative building (completed)
- Construction of the new industrial water system (advanced)
- Asbestos removal from the Controlled Area (underway)
- Turbine system removal (underway)
- Removal of the river barrier for water supply (underway)
- Removal of the remaining spent fuel from the pool and loading them in CASTOR casks (2005)
- Supercompaction of operational wastes (DAW and asbestos containing materials) (2006)
- Modification of the ventilation system of the primary containment (2006)
- Realization of the waste route from the primary containment and of the new
- personnel access (2006)
- Realization of the Waste Management Facility (2006)
- Realization of the Monitor release facility (2006)
- Realization of the new radwaste system (2006)

Caorso

- Primary circuit decontamination (completed)
- Removal of asbestos from the turbine system (completed)
- Main generator removal (completed)
- Main turbine components and thermal cycle components removal (underway)
- Centralized facility for material management (underway)
- Insulation materials removal from the Reactor Building (underway)
- Dismantlement of the Residual Heat Removal system cooling towers (underway)
- Treatment and conditioning of operational wastes (waiting authorization)
- Dismantlement of the Off-gas building (2006)
- Removal of the spent fuel from the pool and loading it in CASTOR casks (2007)

Latina

- Removal of asbestos from the turbine system and from some rooms of the Reactor Building (completed).- 12 -
- Primary loops piping removal (underway)
- Extraction, treatment and conditioning of the operational sludge's (underway)
- Extraction, treatment and conditioning of splitters (to be authorized)
- Dismantlement and melting of the boilers (to be authorized)
- Construction of the interim storage building (waiting for authorization)
- Removal of the auxiliary systems from the Reactor Building (2006)
- Scarification of the spent fuel pool (2006)
- Preparation of the Reactor building to dismantling (2006)

Garigliano

- such as a light decontamination and drainage of the vessel, primary circuit and spent fuel pit; dry low level operational wastes compaction, cementation of liquid and semi-liquid (sludge) radioactive wastes, refurbishing of the reactor spherical containment. All the activities have been authorized in anticipation to the approval of the Global Decommissioning Plan
- Removal and dismantlement of the T11 tank (completed)
- Removal of asbestos from selected rooms (completed)
- Removal of asbestos from turbine building (waiting for authorization)
- Refurbishing and adaptation of turbine building ventilation system (waiting for authorization)
- Clean-up of waste trenches (2006)
- Demolition of plant stack (2006)

Saluggia/EUREX

- Decontamination of two process hot cells (completed)
- Flooding protection barrier (completed)
- Construction of a new tank park bunkerized building for highest activity liquids, about 120 m3, produced by the reprocessing of MTR and CANDU fuel (2005)
- Construction of 2 modules of interim storage facilities for medium level conditioned wastes 1000 m3 each (2006)
- Start of construction of the cementation facility for all liquid waste present on-site (2005)
- Modification of the pool structures and systems in preparation for the removal of the remaining spent fuel (2006)

Bosco Marengo/FN

- Complete removal from the site of all fresh fuel scraps (2005)
- Start of the decontamination facility (pallinatrice) (2005)

Casaccia/Plutonio

- Alfa contaminated liquids treatment (completed)
- Modification of the Fire system, ventilation radioactive monitoring systems and plant access system (2005).- 13 -
- Start of dismantling of the plutonium contaminated glove boxes (2005)

Casaccia/Hot Cells

- Removal of contaminated tools from hot cells (completed)
- Initial decontamination of 3 hot cells (completed)
- Removal of underground tanks for liquid wastes (2007)
- Modification of Fire system (2005)
- Refurbishing of one Hot Cell for all expected needs (2005)
- Complete refurbishing of an existing building to be used for interim storage of alfa contaminated conditioned wastes (2005)

Trisaia/ITREC

- Cementation of medium and high level liquid wastes (completed)
- Clean-up of trenches containing low level contaminated materials and their super compaction (completed)
- Realization of a new on-site interim storage for medium level wastes (2005)
- Conditioning of the operational dry wastes (2008)
- Removal of wastes from grouted trenches (2005)
- Construction of a new cementation facility for low and medium level wastes (2006)
- Start of construction of a cementation facility for nitric solution of uranium and thorium (2005)
- Modification of pool structure and auxiliary systems in preparation for the dry storage of the uranium-thorium spent fuel in TN casks (2006)

HEALTH PROTECTION IN THE DECOMMISSIONING PHASE IN ITALY AND ITS ACCEPTABILITY TO THE PUBLIC

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Introduction: setting the problems.

From previous talks you have heard that all the nuclear plants in Italy have ended their commercial activity more than 15 years ago (Garigliano since 1978) and practically since then they are in the decommissioning phase together with other facilities of the nuclear fuel cycle. From the radioprotection point of view, the decommissioning phase has a minor impact than that related to the production phase. For the aspects regarding the general public, liquid discharges and gaseouseffluents are at lower levels and accident analyses foresee events at lower scale; for what regards workers, operations with high level-wastes are, in principle, not more demanding in term of radiation doses than several inspection or replacement operations needed in maintenance periods during the commercial life of the nuclear plant. Then, as such, the decommissioning phase does not raise particular radioprotection problems and certainly it is of less radiological risk than the previous phase. There are however other considerations that make this phase of relevant potential risk if actions are not coordinate in a global scheme aiming to solve all the problems that this phase sets.

The situation in Italy of temporary depositories of radioactive wastes has already been shown. On the contrary than in almost all European countries Italy has not a licensed centralized repository for low-medium activity wastes, not to speak of HLW. The localisation, on more than 25 places scattered all over the territory, of wastes stemming from medical activity and previous nuclear power activity as well as of spent fuel elements is from the radiological protection point of view far from being an optimised solution. Solidified high activity wastes in glass matrix, resulting from the Italian spent fuel elements reprocessed by BNFL that should be returned to our country, make the problem even worst.

The need for the establishment of a national repository for nuclear wastes, raised by technical-scientific institutions long time ago, has become in Italy a shared objective among all institutional bodies in 1997. In that year ENEL (at that time the owner of the four Italian commercial nuclear plants) application for decommissioning license of its plants with a SAFSTOR approach, deferring the dismantling within 50 years, was rejected by the Ministry of Industry, responsible of the authorization procedure, following similar comments and opinions expressed, in the foreseen licensing procedure by the Ministry of Health (prepared by its technical body ISS), APAT (at that time ANPA) and other administrations.

The Ministry of Industry published at the end of 1999 a document addressing “Strategic Directions for the management of the outcome of the nuclear commercial phase”. Three general objectives with relative time lines were defined. The first two regarded the conditioning of all radioactive wastes present in the national territory and the siting, construction and commissioning of the national repository. These objectives should have been reached within 10 years. The third

objective concerns the unrestricted release of the sites where the four nuclear power plants are localized. This last objective should be pursued through an accelerated dismantling (DECON) strategy within 20 years.

In the framework of the agreement Stato-Regioni concerning the definition of some initiatives to promote the safe management of radioactive wastes and to select a site for the national repository, an Expert Group composed by 7 members, designed by the Ministries of Industry, Environment and Health as well as by Piedmont, Venetia, Emily-Romagna and Tuscany Regions, prepared a report on "Conditions for a safe management of radioactive wastes".

Conclusions

Technical problems connected with the setting of clearance levels for all radionuclides of interest must be solved through a specific legislative document taking into account the debate that is developing at European Community and other International institutions and regulatory bodies.

The major point to be solved for the decommissioning activities in which Italy is deeply committed is the siting of a national repository for radioactive wastes that should be at the same time an ultimate repository for wastes of categories I and II and a temporary repository for spent fuel elements and wastes of category III. Having solved this problem, the repository must be built and commissioned approximately by 2010, to maintain the objective sets in the "Strategic Directions" document of the Ministry of Productive Activities (formerly Ministry of Industry) to have the unrestricted release of the sites where the four Italian nuclear power plants are located approximately by 2020. Also in Italy one main issue in all these problems is how to build a public consensus. As it is now done in all countries with democratic representative systems, such decision processes cannot be done without an involvement of stakeholders, starting from local communities.

There are not realistic and rational shortcuts to this procedure as already been seen in many countries and also in our own country. Italy has not yet a general legislation seeking stakeholders and more specifically public participation in the decision aiding process, then an administrative solution must be found. One possibility is to try to follow the recommendations of the Expert Group set up by the Conferenza Stato-Regioni. Probably this means that the time scale foreseen in the Decree of last December is unrealistic but not any more time must be wasted. In the meantime all the activities concerning the treatment and conditioning of radioactive wastes and dry storage of spent fuel must be considered as primary activities and carried out in a time as short as possible. It is a privilege and worthwhile here in Rome, at the end, to report the old logo of our Institute (Istituto Superiore di Sanità) that is also well adapted to the discussion: *Rerum Cognoscere Causa*s. It derives from Publius Vergilius Maro **Felix qui potuit rerum cognoscere causas.** Wise is the man who understood the reasons why things (facts) happen.

THE ITALIAN DECOMMISSIONING INDUSTRY

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Abstract

Italy's step out from nuclear activities in 1987 deeply affected an industry that, in the previous years, had managed to grow up in quality and technology levels to meet the nuclear standards. Only a few companies were able to partially retain their skills through activities abroad. The decommissioning program represents a new challenge for the Italian industry at large and will require a consistent effort to properly qualify the potential suppliers. On the other side, a program with such implications in terms of investments and so depending from social aspects cannot be effectively implemented without a significant involvement of the local industry. Essential conditions for the success are a reliable program, as well as a careful supply management scheme, which must facilitate aggregation of skills spread among different subjects.

"Human Resources: Maintaining a Nuclear Culture in Italy" Bruno Panella Politecnico di Torino, Giuseppe Forasassi, Università di Pisa, Inter-University Consortium for the Nuclear Technological Research (CIRTEN)

Abstract

After a brief history of the nuclear engineering education in Italy within the international and national nuclear energy scenario, the present situation, with reference to the Italian universities, is shown. In order to maintain a nuclear culture in Italy the solution, exploited with different peculiarities in each University, is to carry out high quality research activities in reciprocal collaboration (mostly within the CIRTEN inter university Consortium) as well as with the Industry and research Organisations and to collaborate actively in establishing a stable network and a synergy of teaching activities in Europe in the field of Nuclear Engineering Education. The aim is to maintain at a high level and as updated as possible the Italian educational offer in nuclear engineering and also to attract the best students for the enrolment.

SUMMARY OF PAPERS

SESSION 3:

DISPOSAL AND MATERIALS MANAGEMENT

THE SPECIFICITY OF DECOMMISSIONING WASTE FOR DISPOSAL AND FROM DIFFERENT FACILITIES

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Abstract

During the decommissioning of nuclear installations significant waste quantities arise, the bulk being material which qualifies for free release or exemption. Only minor quantities have to be submitted to regulatory control and have either to be disposed or can be released, recycled or reused under certain conditions defined by the regulatory body. Actually, it is almost impossible to derive at meaningful data for the expected waste quantities by a simple propagation of the experiences made in other installations. Rather, the quantities and categorisation are significantly installation specific and are determined by a variety of factors such as the plant construction and operation history, the thoroughness of facility characterisation in preparation for decommissioning, the timing of the decommissioning exercise, the kind and scope of the applied waste treatment and conditioning techniques, the possibility for recycling or reusing irradiated or contaminated materials as well as the applicable national legislation. Further international co-operation aiming at the development of waste estimation techniques is required. Moreover, a harmonisation of national legislation might help to compare waste arisings under the various decommissioning exercises.

DISPOSAL ROUTES AND INTERIM STORES FOR DECOMMISSIONING WASTES

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Introduction

Management and disposal of radioactive waste is a key element in the satisfactory completion of the decommissioning of nuclear facilities and is a major contributor to the overall costs. Reactor dismantling produces significant quantities of radioactive wastes, at both low and intermediate levels. The common policy across all countries is to dispose of such wastes in suitable near-surface or deep geological repositories, but these are not universally available.

The availability of waste disposal facilities is an obvious factor in considering when to start decommissioning a facility. If no disposal facility is available it may be judged appropriate to defer dismantling until a disposal route is established. Should dismantling proceed in absence of disposal facilities, then the resulting wastes would need to be placed in a temporary waste store, probably located on the reactor site.

This paper describes the management of radioactive waste resulting from decommissioning in France, Sweden and Spain and identifies waste types and quantities, disposal routes and interim stores, and waste management costs.

Conclusions

A great portion of the waste (LILW) produced during the decommissioning of nuclear facilities is similar to that produced during their operational lifetime. France, Sweden and Spain have repositories in operation which can accept this type of waste. The new challenge, characteristic of decommissioning specifically, is the large quantity of waste containing only small concentrations of radionuclides (very low level waste and free releasable materials). The French repository for VLLW started operation in 2003. In Sweden and Spain, existing repositories for LILW are planned to be extended in order to accommodate short lived decommissioning waste.

Waste quantities of the different types are very much affected by clearance levels and repository acceptance criteria. However, overall figures are quite similar, in the case of Sweden and Spain, taking into account the different size of the nuclear program, and are much greater in the case of France, due

to the fact that gas-cooled reactors produce significantly more radioactive waste than light water reactors.

Decommissioning generates also small quantities of ILLW, such as reactor internals and graphite waste that cannot be disposed at the existing LILW repositories. In the three countries, interim storage facilities are available or under planning for this type of waste, in order to proceed with decommissioning activities before a long-term solution is available.

Waste management costs are greatly affected by the size of the disposal facility, the type of waste, the processing, handling, and packaging required for the waste, and the cost items included in the total costs. Disposal costs for LILW and VLLW in France are smaller than in Sweden and Spain due to the much large size of their disposal facilities. Disposal costs for short-lived decommissioning waste in Sweden and Spain are fairly similar, but management costs associated to the long lived waste are quite different due to the different approach taken for cost estimation, i.e., total cost in Spain vs. marginal cost in Sweden.

CLEARANCE AND RELEASE FROM CONTROL - AN INTERNATIONAL PERSPECTIVE

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Introduction

This paper tries to give an overview of the clearance, or release from regulatory control, on an international scale, including some of those countries where clearance has become or is about to become vital for D&D. The emphasis lies on the impact of clearance, and in particular of differences between clearance levels of various countries, on D&D.

Relevance of clearance for D&D of nuclear installations

Clearance is an essential part of waste management (or more general, material management) in nuclear installations, and in particular during the decommissioning phase where waste streams continues to arise. Of course, the relevance of clearance in a particular country depends on a number of factors, like:

- availability of a final repository and its price: If such a repository is available and if the costs are acceptable, e.g. because it is of a near surface type, clearance is of less importance, while it may be of the utmost importance for countries where no repository is available and/or its costs are high e.g. because it is of a deep geological type;
- prevailing decommissioning strategy: If the most common decommissioning strategy will be safe enclosure after no or only partly dismantling, the material quantities arising from D&D will be comparatively small, so that clearance will have a low importance, while it will be of much higher importance for countries where direct dismantling (without enclosure periods) is most common;
- number of nuclear installations reaching decommissioning phase: In a country with only a small number of nuclear installations, clearance may be of low relevance because the overall quantity of waste material from D&D will be small and may even be managed by intermediate storage until a final repository will become available, while countries with a large number of nuclear installations under direct dismantling will inevitably need clearance options.

This small selection of reasons why clearance may be of varying importance for different countries may already suffice to illustrate why up to now clearance has been developed and implemented in quite different ways. If one thinks of additional reasons that may influence clearance, like politics, the public opinion, availability of funds etc., the situation becomes even more complex. It is, however safe to draw the conclusion that countries with a certain number of nuclear installations which have been or will soon be shut down or which are already in the decommissioning phase will need to implement provisions for clearance. This has indeed been the case with countries like the UK, Germany, the USA, Sweden, and a number of others.

The Way Forward – recommendations and suggestions for discussion

Conclusions which can be drawn from the paper are:

- It is not essential for clearance levels to be exactly equal between various countries. They may differ as long as the difference is not too large, e.g. the values fall into the same order of magnitude. This is the reason why for example Germany has no problems with clearance levels which differ from the EU recommendation RP 122 part I (this recommendation has been adopted in a number of EU countries (Sweden, Spain, Belgium).

- D&D projects should be aware of the destination of their material and the dose rate levels by which it will be monitored there or during its transport, e.g. at borders, in harbors etc. Appropriate dose rate monitors need to be installed at the exit gates of the D&D site monitoring all material leaving the premises.

- While there are no hard and essential reasons why clearance levels should be made equal worldwide (as long as they are harmonized to a sufficient degree), there is, of course, still the aspect of credibility and public opinion. Numerical differences in clearance levels between countries leave room for malevolent misinterpretation. Without looking to the reasons for those differences, anti-nuclear groups can try to present these differences as a lack of credibility and reliability of clearance. This has been tried with limited success in Germany when clearance was about to be implemented in the Radiation Protection Ordinance of 2001, and it has also been undertaken in the USA when differences emerged between clearance levels calculated in the earlier versions of the reports. In both countries the effort to bring clearance back in line again was considerable. Harmonization of clearance levels may therefore be desirable for the sake of public opinion.

In summary, worldwide harmonization of clearance levels need not be a top-priority goal. Some countries with extremely restrictive clearance levels might, however, take a look to their neighbours and switch over to the existing international recommendations. This would be a major step in the harmonization process. D&D projects will, however, continue to function also if the current situation will not change: It is more important for a certain country that clearance is possible at all than that the clearance levels are identical to those of the neighbouring countries. However, the worldwide public opinion should be carefully monitored to guarantee that clearance will still be viable in the future.

HOW RADIOACTIVE WASTE MANAGEMENT REGULATIONS RELATE TO THE AVAILABILITY AND COST OF RADIOACTIVE WASTE DISPOSAL - APPLICATION TO THE MANAGEMENT OF VERY LOW LEVEL RADIOACTIVE WASTE FROM DECOMMISSIONING

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Abstract

This paper intends to discuss synthetically what is thought to be the profound reason for the differences of national approaches in radioactive waste management regulations, in particular in the case of the management of very low level radioactive waste from decommissioning. These differences between national approaches may be an important element of questioning for the public.

While many reasons are often quoted to explain the differences in national regulations in that field, from philosophical, ethical and cultural differences, to different technology development levels, or even to different expected levels of safety for the public and the environment, this paper focuses on a cause that is thought to be far more important the actual national availability and cost of waste disposal.

The availability and cost of waste disposal is on the long term of course related to public acceptability and, more globally, on the ability of a particular society to achieve decisions in this kind of difficult issues; however, on a shorter term, which is the one in which decisions are being taken in industrial projects like the decommissioning of a single facility, the availability and cost of waste disposal may be considered as an externality, which constraints the project.

This parameter is discussed and evaluated and this paper shows, using a very preliminary study how economical reasoning will lead to very different solutions in waste management depending on the national situation.

SUMMARY OF PAPERS

SESSION 4:

TECHNIQUES

AN INTERNATIONAL OVERVIEW OF DATABASE ON R&D TECHNIQUES

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Abstract

At the early stage of decommissioning activities regarding relatively small nuclear facilities, various techniques for the decommissioning and dismantling (D&D) process had been developed to be applied to D&D projects in 1980s. It was then confirmed that the present techniques are available for decommissioning nuclear facilities by demonstrating successful completion of the projects. However, improvement of the present techniques is necessary for efficient adaptation to D&D process in cost efficient and safe manner when decommissioning commercial nuclear facilities with large scale and higher level contamination.

By the review of present status of D&D projects and decommissioning strategies, it was cleared that cost saving is one of important aspect in the D&D projects. From technical points of view in efficiency, techniques such as laser beam cutting, automated remote control of devices and computer simulation are expected to be useful tools for future use in cost saving process. In addition, techniques should be properly applied to D&D projects within wide range of areas such as dismantling and decontamination process, project planning, waste management, communication with regulatory body and public, safety evaluation and environmental impacts. To cope with overall D&D activities, it might be necessary to make continuous efforts to improve the techniques and construct database for evaluation from wide range of views of D&D projects.

R&D TECHNIQUES AND HOW TO CONTINUOUSLY IMPROVE THEM?

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Abstract

Although decommissioning of nuclear installations has been carried out successfully in different countries, and decommissioning is sometimes considered as a mature industrial activity, Research and Development can still improve the operations, and is also needed to keep the current know how. The research and development can bring reduction of costs, limitation of radioactive waste generation, and improve the safety and radioprotection aspects. When one consider that less than 100 facilities are currently in decommissioning for more than 800 reactors (power plants and research reactors, almost half and half) worldwide, the present used technology can be considered as the prehistory of D&D. The paper will focus on the needs for improvements and developments, on the attached constraints and restriction, and will then look at the potential ways to continue R&D and technology improvement.

How to continuously improve and who are the main actors?

It has first to be noted that R&D would probably not be done extensively by the industry, regarding the rather limited size of the market. Indeed, even if the market is in a growing trend, its spread in time (estimated to be more than 25 years) and the rather largely dispersed geographical location of the installations represent no incentive for the industry to make large investment in research and developments.

Moreover, in the absence of political or institutional will to keep the acquired know-how, there is a risk of loosing the current knowledge, leading to future potential errors in financial estimation of decommissioning costs, or in technical evaluation with inadequate use of equipment in controlled areas; this can also lead to increase the operator exposure due to bad estimate of the technique or operation, and another risk of producing more radioactive waste than currently feasible. With such an absence, the existing technologies would not be very much improved and it would then be difficult to take the decommissioning into account in designing the new generations of power plants and nuclear facilities. Furthermore, without a continuous up keeping of the knowledge and the know how, the regulatory bodies can also have problems in establishing rules or controlling their implementation. Thus, if it is not politically correct to mention that decommissioning is not yet a mature industrial activity (assuming also that there is a definition of mature industrial activity), it is quite obvious that a continuous effort of knowledge and know-how keeping and improvement has to be institutionalized; this should best be organized at international level to keep the competitive market open.

In this domain one can compare (at a lower scale) the decommissioning with the space quest: the industry is finally able to build the necessary parts and pieces of equipment, but the States and Governments have to finance the development of new technologies. This does not impede the

industrial competition if the development support is made at international level and if all the means are taken to disseminate the results of the R&D. For instance, R&D for the 4 th generation reactors is supported by States and international institutions. Thus supporting or financing R&D in any kind of operation or technology needed in the future can be regarded as normal or acceptable.

Finally, how to keep R&D ongoing and keep the know how available for future reactors and plants decommissioning? It is rather difficult to support it within industrial running projects where often private or strictly limited public funding is available. Moreover, industrial projects cannot be hampered by R&D which is often non foreseeable or request specific organization. Probably the best way should be:

- either to gather the small active groups in decommissioning R&D, under an official and supranational institution (like IAEA, OECD or other) with States subvention;
- or to continue the dismantling of research reactors and facilities, even in countries without the necessary funding, with some international funding, and take these opportunities to make R&D and demonstrate the use of developed technologies;
- or to support pilot or experimental projects as it was done in the U.S. (within the DOE clean up program) and in the E.C. (with the so-called pilot projects).

It is nevertheless important to detect and well determine the needs (market driven and not technology driven) for upgrading decommissioning technologies. There is also a need to industrialize the developments set up in these pilot or limited projects. There is surely a need for a link between the R&D (laboratories) and the application in large power plants and nuclear installations. The certification and validation of the techniques must also be prepared to allow the industry to integrate, with limited risk, the R&D output within actual large scale projects.

Conclusions

Regarding the rather recent development of the D&D technology and the large remaining market for D&D of nuclear installations, there is still a large field of open development for techniques and technologies for the dismantling of nuclear installations worldwide.

Although D&D of all kinds of nuclear installations have proven to be feasible, improvements are surely needed to reduce the costs and waste of D&D, therefore reducing the burden to the plant owners, and to improve the radioprotection of the operations. The same applies for the improvement of the overall operators safety during such operations.

There are different ways to go in this direction and the groups to gather the necessary experience and technological data are existing, but the will has to be present to go forward, in a competitive environment. It is difficult to believe that such improvements in the technologies and the approach of decommissioning can rely only on commercial and private initiatives. Therefore, organized international R&D should be promoted wherever it is possible, enhancing the forum of ideas and technology exchange.

TECHNIQUES THAT DID AND DID NOT WORK AND THE ROLE OF R&D IN SUCCESSFUL TECHNIQUE DEVELOPMENT"

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Introduction

Dismantling techniques

The complexity of components from nuclear installations subject to dismantling is enormous and so is the number of referring techniques. To choose the ideal technique and the corresponding strategy, complex boundary conditions have to be considered. The most important criteria are costs, the amount and kind of radioactivity (contamination, activation, isotopes, spatial distribution within the working piece…), aspects of radiation protection (segmentation, decontamination under ambient conditions/under water…) the kind of material to be treated (steel, concrete, graphite, compound materials…), geometries (thickness, structure…) and their spatial accessibility. Based on these criteria, decontamination or dismantling processes are selected. A selection of techniques is presented and new trends are pointed out.

Conclusions

The times for planning, procurement and test take averaged several months or even years and that's too long. This is not only due to work of regulators, independent technical inspectors and authorities. Their Focus is on the impact of dropping of load and component failure and how those can be recovered.

A shortening and thus a reduction of costs can be achieved by the following measures:

- Collection of all less important conditions and inventory data, such as on-site allowance, campaigns to record the actual status and adjustment of the plan data.
- Use of existing, well known technologies.
- Planning using 3D-Tools.
- Extensive mock-up tests are the key factor for successful development, implementation and operation of remote handling techniques.
- Early development and test of subsystems and tools.
- Elaboration of detailed dismantling plan parallel to system development.

- 3D-Simulation of the operational sequences, for example for the definition of the Kinematics of the handling equipment with regard to the local spatial conditions to enhance planning security and defining standards for the construction.
- Early recognizing of missing characteristics by test on mock-ups under operating conditions.
- Optimization and its consistent conversion for example adaptation and definition of the fundamental cutting parameters for upcoming segmentation tests, as demonstrated at the MZFR decommissioning using a plasma cutting system.
- Detailed segmentation with fixed dismantling sequences of the cutting tools and the auxiliary systems.
- Consideration of dismantling sequences for as large as possible segments or components with further external conditioning to save on-site operation time.
- Detail calculations, e.g. design of drive trains, for the optimized use of the material properties with the regard to the minimization of risks for early damages or failures during operation.
- Operation data recording system for optimization and error tracing.
- Careful analysis of the dismantling activities to be carried out, definition of system requirements and features to parametrize control and division concepts.
- Structuring, annotation and accompanying care of the software development with verification of the individual "software packages" (definition of features, characteristics, no black box).
- Call in external technical expertise to understand the entire system.

SUMMARY OF PAPERS SESSION 5:

MANAGEMENT OF TRANSITION AND CHANGE THROUGHOUT DECOMMISSIONING

EARLY PLANNING AND TRANSITION MANAGEMENT FROM OPERATION INTO DECOMMISSIONING - VISION OF FUTURE WORK IN THE AREA OF HUMAN AND ORGANISATIONAL FACTORS BASED ON EXPERIENCE"

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Jose Cabrera NPP, Spain

B. Gil
CSN, Spain

A. Lekberg
SKI, Sweden

B. Hansson
BKAB, Sweden

A. Frischknecht
HSK, Switzerland, (SEGHOF Chairman)

Pekka Pyy
NEA Secretariat

Abstract

Decommissioning commercial nuclear power plants with their employees and stakeholders leads to a range of safety management, socio-technical and societal challenges. These aspects need to be taken into account in order to assure smooth end-of –operation and decommissioning. The focus of this paper is especially in the planning and transition period into decommissioning. The areas found as critical as a conclusion of the workshop organised by Committee on Safety of Nuclear Installations (CSNI) in 1999 are used as the starting point of the evaluation. The topic is discussed based on experiences from mainly two countries with different cultural and regulatory frameworks: Spain and Sweden. The discussion is completed by information about the accomplishments of Special Expert Group on Human and Organisational Factors (SEGHOF) in the area. The area of treating human and organisational factors in planning and transition is broken down into five sub-areas. Each topic ends up with a view of the situation and visions for future, of which the most important are elaborated more in the concluding remarks.

Concluding remarks

Decommissioning commercial nuclear power plants leads to a broad range of safety management, socio-technical and societal challenges. Organisational aspects are fundamental to any successful decommissioning process. Organisations must provide support for the management of change and must assure that resource and competence needs are appropriately specified, that

uncertainty of personnel is minimised and staff morale is maintained. Furthermore, many new technical challenges must be met. The organisations too often have to address all these challenges with little guidance or experience, with reduced resources and surrounded by societal pressures.

During the planning and transition into decommissioning, an organisation needs to determine and implement a range of organisational processes: management of change, work planning & management, safety management, and allocation of the resources and staff to carry out the technical work. This all is necessary in order to identify key organisational functions and management skills that are critical during the transition and to sustaining organisational memory and obtaining and retaining staff competence during decommissioning.

Decommissioning is never purely technical project but it has to be planned and implement by staff with also human and organisational factors competence. Experience in decommissioning is still comparatively sparse, it is important to develop improved and well-defined means of sharing experience internationally. It is suggested that well focused workshops or technical meetings should be organised periodically between specialists of HOF, stakeholders and decommissioning executives in order to exchange good practices.

Sustaining safety culture and morale during the transition from operation into decommissioning is crucial in order to maintain adequate levels of safety performance. For that purpose, utilities need to have a structured and well-defined safety management & culture program. Any such program needs to include at least the following aspects: future plans, maintaining motivation and communication strategy. Maintaining and improving non-technical competencies at the top management level is very relevant when new organisational issues arise during this period.

Finally, due to the still limited experiences and the novelty and nature of human and organisational issues, it is strongly recommended a close cooperation between the utility and the regulatory body from the very beginning of the transition period. Open and frequent communication is needed.

PROVEN APPROACHES TO ORGANISE A LARGE DECOMMISSIONING PROJECT, INCLUDING THE MANAGEMENT OF LOCAL STAKEHOLDER INTERESTS

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Abstract

Spanish experience holds a relatively important position in the field of the decommissioning of nuclear and radioactive facilities. Decommissioning projects of uranium concentrate mill facilities are near completion; some old uranium mine sites have already been restored; several projects for the dismantling of various small research nuclear reactors and a few pilot plants are at various phases of the dismantling process, with some already completed. The most notable Spanish project in this field is undoubtedly the decommissioning of the Vandellós 1 nuclear power plant that is currently ready to enter a safe enclosure, or dormancy, period.

The management of radioactive wastes in Spain is undertaken by "Empresa Nacional de Residuos Radioactivos, S.A." (ENRESA), the Spanish national radioactive waste company, constituted in 1984. ENRESA operates as a management company, whose role is to develop radioactive waste management programmes in accordance with the policy and strategy approved by the Spanish Government. Its responsibilities include the decommissioning and dismantling of nuclear installations.

Decommissioning and dismantling nuclear installations is an increasingly important topic for governments, regulators, industries and civil society. There are many aspects that have to be carefully considered, planned and organised in many cases well in advance of when they really need to be implemented.

The goal of this paper is describe proven approaches relevant to organizing and managing large decommissioning projects, in particular in the case of Vandellos-1 NPPdecommissioning.

DECOMMISSIONING: GUIDING PRINCIPLES AND BEST PRACTICES FOR INVOLVING LOCAL STAKEHOLDERS

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Abstract

A wide range of nuclear facilities covering the entire nuclear fuel cycle have been constructed and operated for many years worldwide. For communities where the facilities are located, concerns about safety and environmental contamination are paramount. Working together with elected officials, local community leaders and the public at large during the earliest planning stages will help alleviate concerns about facility operation and ultimate disposition, and will result in better decisions about facility design, location, construction, operation and, ultimately, decommissioning. Such comprehensive community involvement has been the exception rather than the norm. Now that older facilities are being considered for decommissioning, efforts to involve local stakeholders and alleviate their concerns face major challenges. This is particularly true where some residual radioactive contamination will remain onsite and future use of the site may need to be restricted. Plans for stakeholder involvement at the decommissioning stage should be carefully designed and provide for honest, authentic and meaningful involvement of all stakeholders affected by decommissioning decisions. A set of principles and best practices is proposed to help guide the design and implementation of effective community involvement programs. The principles and best practices are drawn from the experiences of public involvement practitioners in a variety of environmental contamination applications.

Conclusions

Successful community involvement is the result of a carefully crafted set of coordinated activities conducted over the long term. Ideally, facility decommissioning is simply the end stage of the involvement process, or the beginning of a site stewardship process in those cases where decommissioning does not produce an uncontaminated site. In either case, decommissioning will not be a new, unexpected event, and stakeholders could be involved just as they have been over the life of the facility. In many cases, however, decommission will represent a new set of challenges for the community, and a stakeholder involvement program will have to be created from scratch. The guiding principles and best practices are intended to help designers and implementers of community involvement programs achieve effective community involvement regardless of where in the facility life cycle involvement is needed.

TRANSITION FROM A NUCLEAR TO AN INDUSTRIAL SITE MANAGING CHANGE IN THE RE-USE OF SITES

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Abstract

Examination of the role of nuclear decommissioning in the move towards sustainable development suggests that this potential for redevelopment should not be ignored. Sustainable development implies the need to combine economic development with conservation of natural resources such as land. Sustainable development also implies economic development with maintenance of social and community integrity. Both of these can be served by the sensitive redevelopment of sites to provide continuity of employment and new productive activity. Finally, experience to date with redevelopment both inside and outside the nuclear field suggests that successful engagement can be a key success factor in promoting outcomes which are both profitable for the operator and recognised as responsible and worthwhile by the wider community. Following a generic discussion on factors and issues inherent to the re-development of decommissioned sites, this paper expands on a significant UK example.

Conclusions

In the coming decades a large number of nuclear installations will reach the end of their useful lives and require decommissioning. Many of these installations will be decommissioned with the aim of replacing them by new installations that may serve the same purpose or another completely different purpose. By recognising and promoting the redevelopment potential of sites early in their life it is possible to enhance the prospects for worthwhile redevelopment offsetting the costs of decommissioning and ensuring that best use is made of the material and land resources associated with the sites.

SUMMARY OF PAPERS SESSION 6:

FUNDING AND COSTS

SECURING DECOMMISSIONING FUNDS. WHY ORGANIZATION MATTERS?

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Introduction

Securing decommissioning funds requires that the financial resources set aside for the purpose of decommissioning be managed prudently. Decommissioning of nuclear power plant is prescribed by National Atomic Laws or by other nuclear legislation. It is a mandatory operation. The operators of nuclear power plants set money aside for that purpose. This is known as "Decommissioning reserve fund". Decommissioning implies costs very distant in time. Thus, it is obvious, from an economic point of view, that the funds set aside should be managed. As decommissioning is mandatory, the funds accumulated should be secured. In others words, they should be available when needed.

Availability of funds is influenced by **endogenous** and **exogenous** factors. Endogenous factors are a matter of design of the reserve funds. They include the management of the funds, its monitoring & control... Availability of funds is influenced by these factors, depending on the rules to which the behaviour of the manager of the funds is subjected. In contrast, exogenous factors deal with the energy context. These factors are mainly the electricity sector organisation and/or the overall economic situation. They are decisive factors of the economic performance of the reserve fund for a given design. Therefore, **the requirement of availability of funds, when needed, is a matter of compatibility between the design of the decommissioning funds and the electricity contex**t. Put differently, reserve fund's design need to be consistent with the electricity context's features in respect of the availability of funds.

Current reserve funds were designed in a context of monopoly regime. In this context, availability of decommissioning funds was not questionable. At least, as far as the design of the reserve funds is concerned. This is because nuclear generator didn't confront any competition pressure. Electricity prices were set trough rate base mechanism, and all the business risks were borne by the customers. Because of electricity sector restructuring, businesses are no longer protected from market sanctions and stock market volatility.

The objective of this paper is to evaluate the compatibility of the design of reserve fund models with the liberalised electricity context. The paper first considers the design of reserve funds and concludes that there is no single design. Based on the variety of design, section two assess their respective compatibility with the new electricity context. It appears that the monitoring and control of the management of the funds are the main determinant of compatibility. The paper concludes that, as secure funding is a dimension of safe decommissioning, there is a necessity for an optimal design of decommissioning funds model. The paper also suggests that external management solution improve the credibility of decommissioning commitment.

Conclusion

This paper has completed two objectives. Firstly, it has highlighted the diversity of designs of the decommissioning reserve funds. We have seen that the reserve funds are organised differently, regarding the key features of their design, namely the collection of funds, the management of the funds collected, and the monitoring and control of that management. Secondly, and in respect of the objective to ensure the availability of the funds when needed, the paper has shown that current designs of decommissioning reserve funds are not equally compatible with the constraints of the electricity sector liberalisation. In fact, the new electricity context is characterised by electricity price volatility with, at some conditions, harmful effects on the financial viability of electric companies. The paper has shown that external fund designs offer a satisfactory compatibility with these constraints. This is because the design of external funds imposes clear limitations on the behaviour of the manager of the funds. Therefore, the paper suggests that in a context of liberalised electricity market, external funds model improves the credibility of the commitment to handle the financial burden of decommissioning.

WELL-FOUNDED COST ESTIMATION VALIDATED BY EXPERIENCE

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Abstract

Reliable cost estimating is one of the most important elements of decommissioning planning. Alternative technologies may be evaluated and compared based on their efficiency and effectiveness, and measured against a baseline cost as to the feasibility and benefits derived from the technology. When the plan is complete, those cost considerations ensure that it is economically sound and practical for funding.

Estimates of decommissioning costs have been performed and published by many organizations for many different applications. The results often vary because of differences in the work scope. Labor force cost, monetary considerations, oversight costs, the specific contaminated materials involved, the waste stream and peripheral costs associated with that type of waste, or applicable environmental compliance requirements. Many of these differences are unavoidable since a reasonable degree of reliability and accuracy can only be achieved by developing decommissioning cost estimates on a case-by-case site-specific basis.

This paper describes the estimating methodology and process applied to develop decommissioning cost estimates. A major effort has been made to standardize these methodologies, and to understand the assumptions and bases that drive the costs. However, estimates are only as accurate as the information available from which to derive the costs. This information includes the assumptions of scope of the work, labour cost inputs, inflationary effects, and financial analyses that project these costs to year of expenditure. Attempts at comparison of estimates for two facilities of similar design and size must clearly identify the assumptions used in developing the estimate, and comparison of actual costs versus estimated costs must reflect these same assumptions. For the nuclear industry to grow, decommissioning estimating tools must improve to keep pace with changing technology, regulations and stakeholder issues.

How Do We Improve It?

The decommissioning industry needs to build consistency into its cost estimates. A standardized list of decommissioning activities needs to be adopted internationally so estimates can be prepared on a consistent basis, and to facilitate tracking of actual costs against the estimate. The OECD/NEA Standardized List incorporates the consensus of international experts as to the elements of cost and activities that should be included in the estimate. A significant effort was made several years ago to promote universal adoption of this standard. Using the standardized list of activities as a template, a questionnaire was distributed to gather actual decommissioning costs (and other parameters) from international projects. The results of cost estimate contributions from many countries were analyzed

and evaluated as to reactor types, decommissioning strategies, cost drivers, and waste disposal quantities. The results were reported in the literature

A standardized list of activities will only be valuable if the underlying cost elements and methodology is clearly identified in the estimate. While no one would expect perfect correlation of every element of cost in a large project estimate versus actual cost comparison, the variants should be visible so the basis for the difference can be examined and evaluated.

What Needs to be Done Next?

For the nuclear power industry to grow to meet the increasing demand for electricity, the investors, regulators and the public must understand the total cost of the nuclear fuel cycle. The costs for decommissioning and the funding requirements to provide for safe closure and dismantling of these units are well recognized to represent a significant liability to the owner utilities and governmental agencies. Owners and government regulatory agencies need benchmarked decommissioning costs to test the validity of each proposed cost and funding request. The benchmarking process requires the oversight of decommissioning experts to evaluate contributed cost data in a meaningful manner.

An international organization such as the International Atomic Energy Agency (IAEA) or OECD/NEA, or both need to re-establish a committee to promote the standardization of cost estimation guidelines and methodology. The committee should seek adoption of cost estimating guidelines and methodology, and provide training as required for implementation of its use. Similarly, the committee should be directed to continue to accumulate actual decommissioning costs and convert them into a form that does not compromise proprietary information. From this data base, consensus can be achieved.

COST ESTIMATION TOOLS IN GERMANY AND THE UK. COMPARISON OF COST ESTIMATES AND ACTUAL COSTS

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Abstract

Accurate cost estimation for future decommissioning projects is a matter of considerable importance, especially for ensuring that sufficient funds will be available at the time of project implementation. This paper looks at the experience of cost estimation and real implementation outcomes from two countries, Germany and the UK, and draws lessons for the future.

In Germany, cost estimates for the decommissioning of power reactors are updated every two years. For this purpose, the STILLKO program of the NIS Company is used.

So far, Forschungszentrum Karlsruhe has successfully decommissioned two prototype reactor facilities. Recultivation of the premises has already been completed. At the moment, the activated components of the multi-purpose research reactor (MZFR), the first pressurized water reactor in Germany that was moderated and cooled with heavy water, and of the prototype fast breeder reactor (KNK) are being dismantled remotely. Consequently, vast experience exists in particular for the updating of total costs on the basis of actually incurred expenses. The further the dismantling work proceeds, the more reliable is the total cost estimate. Here, the development of the estimated MZFR decommissioning costs shall be presented and compared with the estimates obtained for a German reference PWR-type power reactor of 1200 MW.

In this way:

- common features of the prototype reactor and power reactor shall be emphasized,
- several parameters leading to an increase in the estimated costs shall be highlighted,
- cost risks shall be outlined with the remote dismantling of the reactor pressure vessel serving as an example,
- calculation parameters shall be presented, and
- recommendations shall be made for a consistent estimation of costs.

The United Kingdom Atomic Energy Authority (UKAEA) has a major programme for the environmental remediation of its former research and development sites at Dounreay, Windscale, Harwell and Winfrith together with the need to decommission the Joint European Torus (JET) fusion

facility at Culham when it has reached the end of its useful life. Total costs for this programme (including final disposal of arising wastes) are estimated at €14B, almost all of which will be funded by the UK taxpayer. UKAEA has developed a systematic approach to estimating the costs of individual projects (PRICE) which it has now been employed for estimates to a total value of €1.5B.

Costs from real projects are collected so that the system can be progressively improved by learning from real data. Benchmarking exercises with two other cost estimating systems have also been conducted.

Overall conclusions - Germany and UK

Both the German and UK experience show that:

1. Attention to considerable detail in the scope of a decommissioning task is required if a realistic cost estimate is to be produced.
2. Despite attention to such details, decommissioning projects regularly produce the unexpected. Recognition of such changes is essential in collecting data relevant to future cost estimates. Flexibility in project management arrangements is necessary to accommodate these unexpected changes.
3. Accurate cost estimation is still difficult to achieve. There is considerable scope for international collaboration in building up a database of real implementation costs and in applying cost estimation methodologies.

SUMMARY OF PAPERS

SESSION 7:

REGULATION AND SAFETY

INTERNATIONAL REGULATORY ISSUES & APPROACHES IN THE TRANSITION PHASE FROM OPERATION TO DECOMMISSIONING

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Abstract

The paper summarizes the work performed by an international group of senior nuclear safety regulators which was convened by the Committee on Nuclear Regulatory Activities (CNRA) of the OECD/Nuclear Energy Agency. The fundamental objective of this work was to identify the safety, environmental, organizational, human factors and public policy issues arising from decommissioning that will produce new challenges for the regulator. The study begins by recognizing that decommissioning is not simply an extension of operation and thus it is important for both the management of the facility and the regulator to understand the fundamental nature of the change taking place.

Major regulatory policy issues discussed during this study include assurance of adequate funds, waste storage and disposal sites, material release criteria and site release criteria. Some of the important regulatory challenges relate to organizational and human factors, to safety and security requirements and to waste disposal and license termination. The importance of regular communication with both the corporate and site management and with public is recognized in the study as one of the key factors.

Summary and Conclusions

When a nuclear facility ceases operation and enters into the decommissioning phase, both the operator and the regulator face a new set of challenges very different from those of an operating facility. The operator should have in place a strategic plan for decommissioning, prepared well in advance and reviewed by the regulatory body, to guide the facility managers and personnel through the changed circumstances. An essential part of the strategic plan should be the operator's plan for securing adequate funds to complete the decommissioning activities. In fact, the regulator should ensure that the operator sets aside funds, perhaps in a trust fund, while the facility is still operating and generating revenues.

Both the operator and the regulator should expect a heightened public interest and concern about decommissioning. It will be important for both the operator and the regulatory body to take the public concerns into account and to have regular occasions to explain the decommissioning plans, activities and the regulatory oversight to the public and local authorities. Such public discussions will greatly enhance the transparency of the decommissioning process.

The regulatory response to the challenges of decommissioning will involve frequent revisions of inspection programs and meetings with the licensee management. It is best to have the important public policy issues, such as material release criteria, site release criteria, and the availability of waste disposal or storage sites, settled well before decommissioning commences. In this regard, regulatory bodies should continue to share decommissioning information and experiences with their international colleagues.

Most of the decommissioning experience to date has come from research reactors, test facilities and relatively small commercial nuclear facilities. As experience is gained with decommissioning large commercial facilities like nuclear power plants and fuel cycle facilities, regulators and operators should collect the lessons learned and propose design guidelines for future nuclear facilities that will facilitate their decommissioning processes.

CASE STUDY FOR A FIT-TO-PURPOSE REGULATORY FRAMEWORK: THE HISTORY AND REASONS FOR THE EVOLUTION-IN THE FRENCH REGULATION REGARDING DECOMMISSIONING

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Abstract

This paper exposes the regulatory approach for the safety of decommissioning in France, from an historical perspective. The first regulatory framework concerning decommissioning was introduced in the end of the 1980's and considered decommissioning as successive important modifications of the facility, which lead to multiple successive licenses. The first feedback from actual decommissioning projects lead the nuclear safety authority to reconsider the regulatory approach of decommissioning. The new approach privileges an integrated approach to the decommissioning projects, with an initial decommissioning license authorizing the complete project, and puts more weight on the responsibility of the licensee, fostering the organization of internal safety commissions which are allowed to authorize minor operations that do not put into question the global facility safety demonstration. This new regulatory approach was implemented in 2003 and new corresponding licensing procedures are already under way.

Conclusions

It is thought that the new regulatory framework for decommissioning that has been introduced in 2003 will allow to regulate in a far more efficient way the decommissioning projects to come, while guarantying a high safety level, adapting the regulatory burden to the actual hazards, and allowing the licensee for the needed flexibility.

Taking advantage of this new framework, licensees have already filed many decommissioning license applications, and decommissioning project licensing is currently one of the main tasks of the nuclear safety authority in France. Many such licenses, for all types of nuclear facilities, will be granted in the next few years.

ISSUES, CHALLENGES, AND APPROACHES FOR RISK-INFORMED DECOMMISSIONING IN THE UNITED STATES

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Abstract

The U.S. Nuclear Regulatory Commission (USNRC) is the principal Federal regulatory authority in the United States responsible for ensuring public health and safety from the civilian use of radioactive material. USNRC staff has developed and implemented various risk-informed approaches for regulating and managing the remediation of contaminated sites. A risk-informed approach to regulating the decommissioning of nuclear facilities has been generally defined by the USNRC staff as an approach to decisionmaking that uses risk insights as well as traditional considerations to focus regulator and licensee attention on decommissioning activities commensurate with their importance to health and safety. Ensuring that decommissioning is carried out using a risk-informed approach should improve the focus on safety in decommissioning, improve the effectiveness, efficiency, and realism in regulatory decisions, and reduce unnecessary regulatory burden, and cost, on licensees. This paper summarizes the efforts by the USNRC to develop and implement risk-informed approaches to the remediation of nuclear facilities in the United States. It also discusses the issues and challenges encountered by the USNRC in attempting to implement a risk-informed approach to decommissioning.

Challenges

The USNRC has been incrementally implementing its existing risk-informed and performance-based approach as it has completed its decommissioning regulations, guidance and other tools over the past several years. The principal challenge for USNRC is implementing the existing risk-informed approach at specific sites in a manner that maintains safety, reduces costs, and enhances public understanding of the USNRC's approach. In addition, effectively communicating how the USNRC approaches are risk-informed and performance-based; ensuring that licensees understand, and take advantage of, the flexibility in meeting the decommissioning goals; ensuring that licensees and staff are aware of the "lessons learned" in implementing USNRC's risk-informed approach to decommissioning; and ensuring that the public understands that risk-informed does not mean that safety is reduced, are all challenges that the USNRC staff will need to address as they implement the USNRC risk-informed decommissioning program. Finally, a successful risk-informed decommissioning program requires that both the staff and licensees commit to constantly review their processes, approaches, and regulatory decisions to ensure that they remain risk-informed.

Conclusion

The USNRC has faced numerous challenges in the development of its decommissioning program, from the determination of the appropriate level of cleanup to ensuring that current activities do not adversely impact future decommissioning. However, the principal regulatory challenges associated with risk-informing a regulatory program for decommissioning is to maintain an acceptable level of safety while improving effectiveness, efficiency, and realism in agency decisions, practices, and processes, and reducing unnecessary regulatory burden on licensees.

GOVERNMENTS' ROLE IN DECOMMISSIONING NUCLEAR POWER FACILITIES

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Abstract

Many nuclear power plants will reach the end of their operating lives over the next 20 years; some may be life-extended, others may not. This development will precipitate enhanced industrial and regulatory activities in the area of decommissioning. We are also witnessing in many countries a significant shift in the role of government itself: new pressures on governments, such as enhanced attention on environmental impact/mitigation and strategies to implement market-oriented approaches in a variety of sectors, including the energy sector are driving the public policy agenda.

The paper will examine the range of policy issues, drawing from recent NEA studies on decommissioning policies and the recent NEA study on Government and Nuclear Energy and, strategies and costs, and other current trends and developments in the nuclear industry and in the nuclear policy fields. The paper will reflect on issues to be addressed during the conference and draw conclusions on the appropriate role of government in this area.

Conclusion

Decommissioning policy is very specific and focused: it is not a high level policy/political issue in most instances and rarely gets the same attention as the issue surrounding the future of nuclear energy itself and public concerns regarding safety, waste and economics. One reason why decommissioning does not get the same attention as for example disposal of spent nuclear fuel might be the fact that technology is available for decommissioning, while technology for disposal of spent nuclear fuel is under development.

High profile or not, it will remain an important issue for governments and industry alike particularly because of the cost and long lead times involved. In some instances, governments are the owners of the facilities to be decommissioned. In addition, decommissioning factors into issues surrounding the economics of nuclear energy and the sustainability of the nuclear option.

The International Seminar on Strategy Selection for the Decommissioning of Nuclear Facilities in Tarragona, Spain, September 2-4, 2003 provided an opportunity to exchange views and experiences on decommissioning strategies. There was general agreement that no size fits all and the different countries take different approaches based on a variety of domestic factors. It also provided an opportunity to focus on key issues such as availability of funding.

Based on results of the Tarragona Seminar and the Rome Workshop, we conclude that, with respect to power production facilities, government policy should aim at securing funding, whatever system is practically chosen, so that the actual beneficiary from the power generated - and not the future taxpayer -pays for all the production costs, including future decommissioning.

There are very good ethical reasons behind a system which ensures that the generations that consume this electricity do not leave such an economic burden to their grandchildren. This is also one of the principles that are expressed in the 1999 Joint Convention (on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management).

The most practical way to ensure that such economic burdens do not crop up at a later stage is probably to create some sort of funding mechanism. Such funding can be organised in different ways according to different conditions in different countries.

Generally speaking, to ensure an effective funding mechanism, there has to be national legislation on *how* such a mechanism should be constructed. Different systems with governmental institutions more or less involved are possible. But *any* funding system, aiming at providing economic resources for decommissioning in a foreseeable future should meet the following requirements.

- Stable legal framework: the legislation regarding funding should have high profile among legislators to ensure that political pressures do not lead to decisions to change the legislation in order to allow assets to be used for other urgent purposes. Legal rules must ensure that funds collected for this purpose cannot disappear as a consequence of bankruptcy of an owner of a nuclear facility that needs to be decommissioned.
- Calculations of future costs have to meet high accuracy standards. This means that appropriate discount factors will have to be applied to ensure that the timeframes when costs will be incurred will be factored into the costing formulae. One possible way to achieve high accuracy is to require regular and frequent reviews of all calculations.
- It is essential that mechanisms are in place to ensure that the real value of assets in the fund guard against periods of high inflation.
- Last but not least, competent administration of the funding system is of paramount importance.

To conclude, the cost of decommissioning is an important criterion in deregulated markets where competition calls for a lowering of costs of producing electricity. In this regard, the NEA Study on the Role of Government concluded that one duty of government is to ensure that funds will be available to carry out decommissioning for facilities that may not close for a century or more. This

may require fairly sophisticated financial management of billion dollar sums of money and ongoing attention of national governments. Enhanced dialogue at the international level will be particularly beneficial to governments, regulatory bodies and industry.